Risk Sharing in Supply Chains of Business Groups: Evidence from Trade Credit *

Jinzhao Du[†] Ronald W. Masulis [‡] Peter K. Pham[§] Jenny Jihyun Tak[¶]

March 17, 2025

Abstract

This paper examines customer-supplier relationships and competing views on trade financing motivations within business groups. We find group firms actively trade among themselves and use trade financing to help affiliates mitigate operational risks. Compared to standalone peers, group firms with same-group suppliers receive more trade credit, particularly when financially constrained. Trade financing substitutes for direct investment by group affiliates, although most capital-dependent affiliates benefit from both forms of investment. Our results suggest that extending trade credit does not hurt group suppliers' minority shareholders. An identification strategy based on major natural disasters strengthens the causal interpretation of our main results.

Keywords: Business groups, supply chain, trade credit, liquidity, natural disasters, tunneling

*We thank DuckKi Cho (discussant), Joseph Fan, Hyemin Kim (discussant), Taehyun Kim (discussant), David Reeb, Yupana Wiwattanakantang, Jing Xu, Deniz Yavuz, and other conference participants at Australasian Finance & Banking Conference 2023, Sydney Banking and Financial Stability Conference 2023, 18th Annual Conference on Asia-Pacific Financial Markets, FMA Asia Korea-America Finance Association 2024, 20th Annual Conference of the Asia-Pacific Association of Derivatives and Nankai University for their helpful comments. All errors are our own.

[†]School of Banking and Finance, University of New South Wales. Email: jinzhao.du@unsw.edu.au

[‡]School of Banking and Finance, University of New South Wales. Email: ron.masulis@unsw.edu.au

[§]Discipline of Finance, University of Sydney. Email: peter.pham@sydney.edu.au

[¶]School of Banking and Finance, University of New South Wales. Email: j.tak@unsw.edu.au

1 Introduction

Business groups, characterized by more than two listed companies that share the same controlling shareholder, are a ubiquitous structure in many countries, where they are found to have important implications for economic and institutional development (e.g. Morck et al., 2005; Khanna and Yafeh, 2007; Hamdani et al., 2020; Dau et al., 2021). It is well established in the literature that business groups gain economic advantages by having access to an internal capital market.[1] Beyond ownership ties, many business groups are also structured around supply chains, where trade credit, one of the most widely used forms of corporate financing, helps to manage demand risk between customers and suppliers (Petersen and Rajan, 1997; Yang and Birge, 2018).[2]

However, the economic implications of trade credit within business groups remain controversial. On the one hand, trade credit is often seen as a risk-sharing mechanism, allowing affiliated firms to buffer liquidity constraints and stabilize operations. This perspective aligns with the broader evidence that business groups play a crucial role in financial and operational coordination of its affiliates (Khanna and Palepu, 1999). On the other hand, trade credit can serve as a vehicle for expropriation, enabling controlling shareholders to divert resources through related-party transactions, such as extending excessive credit at favored interest rates to affiliates at the expense of the suppliers' minority shareholders (Johnson et al., 2000; Bertrand et al., 2002; Im and Kim, 2024).

[1]Business groups can leverage their group structure to finance cash poor affiliates through internal capital market mechanisms such as intra-group loans, intra-group dividend payments, cross-firm equity investments, initial public offerings of group firms, etc. (e.g. Gopalan et al., 2007, 2014; Buchuk et al., 2014; Almeida et al., 2011, 2015; Masulis et al., 2020).

[2]Trade credit plays a major role in corporate balance sheets. For example, Emery (1984) finds that accounts receivable made up 26.5% of total assets for manufacturing firms in 1981, while Murfin and Njoroge (2015) highlights that trade payables were the second largest liability of US nonfinancial businesses as of 2009. Internationally, Levine et al. (2018) shows that trade credit accounts for 24% of debt financing among listed firms across 34 countries.

Despite the important role trade credit plays, our understanding of how business groups allocate supplier financing within their networks remains limited. While recent research has examined groups' internal capital markets, the role of trade financing in resource reallocation is relatively unexplored. This is surprising given the economic power of business groups and the prevalence of trade credit in corporate financing. For instance, studies of Belgian firms show that 23% of accounts receivable originate from affiliated firms, with trade credit representing approximately 80% of these receivables (Deloof, 1995; Deloof and Jegers, 1996).

Our study helps fill this gap by examining the dynamics of intra-group trade credit in a cross-country setting. Specifically, we investigate whether business groups primarily use trade credit as a liquidity buffer, facilitating financial stability, or as a mechanism for tunneling, facilitating wealth transfers among affiliated firms. To test these competing views, we analyze trade credit adjustments in response to financial distress, such as declining sales, cash shortages, or disruptions caused by natural disasters. Our findings support the risk-sharing hypothesis, indicating that trade credit within business groups primarily functions as a liquidity buffer, rather than a means of expropriation.

To empirically examine these questions, we assemble a dataset combining supplier-customer linkage data from the Factset Revere Supply Chain database with data on business group affiliation for 45 countries from Masulis and Mobbs (2011); Masulis et al. (2020, 2023). We then classify firms into four categories based on their group affiliation and supplier relationships. Subsequently, we merged this dataset with financial and accounting information from the Thomson Reuters Worldscope database. Following Levine et al. (2018); Li et al. (2021), we focus on manufacturing firms (SIC code 2000 - 3999), resulting in a final sample comprising 9,254 unique manufacturing firms in 45 economies covering the period 2013-2021.

As a starting point, we document the extent to which business group firms form their supply chains with other group affiliates. We find that suppliers and customers within the same group

constitute a substantial portion of a group's supplier network and its customer base. Among group firms that disclosed their customers and suppliers, 36.8% (36.4%) of group firms have at least one same-group customer (supplier), and these proportions are higher for family business groups. Comparing actual business groups to "pseudo" group firms with similar characteristics, but no controlling shareholder, we confirm that controlling ownership increases the likelihood of intra-group supply chains.

After documenting the prevalence of same-group supplier-customer relationships, we next examine how these relationships influence the trade credit that firms receive. Following Petersen and Rajan (1997); Levine et al. (2018); Li et al. (2021); Gofman and Wu (2022); Ersahin et al. (2024), we measure trade credit using accounts payable scaled by cost of goods sold. Our baseline results show that group firms with same-group suppliers receive 30% more trade credit compared to standalone firms. These findings remain robust when we expand our sample to include all industries, excluding financial and service sectors, or when trade credit is alternatively measured by scaling accounts payable by sales.

We then investigate strategic use of trade financing within business groups, focusing on circumstances under which group firms receive more trade credit from same-group suppliers. If trade credit facilitates group-wide risk-sharing, we would expect firms with greater liquidity needs to receive more trade credit from their affiliated suppliers. In contrast, if trade credit primarily serves as a tunneling mechanism for controlling shareholders, the effect should persist regardless of customer liquidity needs. To distinguish between these explanations, we examine whether the impact of same-group suppliers on trade credit is more pronounced when customers experience cash shortages or financial constraints. Our results indicate that group firms with higher liquidity needs receive more trade credit from same-group suppliers, supporting the risk-sharing hypothesis.

We further analyze the strategic use of trade credit alongside of other internal capital mecha-

nisms within business groups to understand how funds are reallocated among affiliated firms. To do this, we construct a measure of investments received by the group firm from other affiliated firms within the same group as a proxy to gauge the extent of intragroup capital reallocation to the same affiliate. This allows us to investigate how trade credit differs from other previously documented internal capital channels, such as intra-group loans and equity investments. Our findings indicate that, except for financially weaker affiliates, trade credit can substitute for other forms of internal capital in pyramidal group firms. Focal firms with same-group suppliers receive more trade credit, but this is reduced when alternative group affiliate capital is provided. There is also a complementary relationship between trade credit and internal capital transfers for firms at the bottom of the pyramid, indicating varying alternative internal capital market support mechanisms operate across different group affiliates.These new findings contribute to our understanding of how business groups utilize various internal financing strategies to optimize resource allocation across their affiliated firms.

To further distinguish the risk-sharing hypothesis from tunneling, we perform two additional tests and find evidence inconsistent with tunneling. First, the positive impact of having same-group suppliers on trade credit in family pyramidal firms is more pronounced among firms in countries with strong minority shareholder protections, where the costs of expropriation are relatively high, redusing default incentives. Second, we find no evidence that internal suppliers extend trade credit in an excessive way that benefit customer firms at the expense of suppliers' minority shareholders. Instead, trade credit is positively associated with the long-term value of both the same-group supplier and customer, supporting the risk-sharing hypothesis and its role in enhancing group welfare.

As an identification strategy, we rely on major natural disasters as an exogenous shock to supply chain operations to assess the costs and benefits of having same-group supply chain relationships and using trade financing to provide internal capital. Natural disasters serve as a

informative shock for two reasons. First, trade credit plays a pivotal role in hedging the volatility in operations and sharing risk along the supply chain, which is consistent with prior studies that use natural disasters as disruptions to supply chain continuity (e.g. Barrot and Sauvagnat, 2016). Second, business groups are known for their resilience during economic downturns and other negative shocks (e.g. Masulis et al., 2023; Faccio and O'Brien, 2021). For instance, during the global financial crisis, group affiliation became particularly valuable when credit was scarce (Masulis et al., 2023). If business groups strategically utilize trade financing from their internal supply chains, then we expect to observe that group firms with same-group suppliers receive more trade credit after experiencing negative operating shocks. To test this hypothesis, we use the EM-DAT international natural disaster database[3] and employ a difference-in-differences (DiD) framework to compare trade credit responses between group and standalone firms. Our results confirm that group firms with same-group suppliers receive more trade credit after natural disasters, and these findings remain robust when using a stacked-cohort DiD approach,

Overall, our analysis finds that groups strategically employ trade credit from their internal supply chains. Group suppliers generally extend more trade credit when the same-group customers are in greater need of capital. Our study's main contributions are threefold. First, we provide empirical evidence on a new channel (trade financing) through which groups can financially support their affiliates. Second, we show that this channel can be a substitute for other previously documented internal capital reallocation mechanisms involving financially stronger firms and to be a complement for financially weaker firms. Third, this study utilizes major natural disasters as exogenous shocks to supply chain continuity, which allows for sharper inferences about the magnitude of the effect.

This study adds to the prior literature by highlighting the financial advantages that business

[3]EM-DAT is a global database that records at the country level both the human and economic losses associated with major natural disasters. EM-DAT, CRED / UCLouvain, Brussels, Belgium – www.emdat.be

groups can realize through intra-group loans, intra-group dividend payments, cross-firm equity investments, starting up firms de novo or acquiring new group firms, and initial public offerings of group firms (Chang and Hong, 2000; Gopalan et al., 2007, 2014; Buchuk et al., 2014; Almeida et al., 2011, 2015; Masulis et al., 2020). While these studies highlight many of the group's financial advantages in supporting affiliates through internal capital markets, the operation relationships and the role of within-group supply chain networks are not well documented due to a lack of data. Our study expands the existing body of literature by using a comprehensive dataset of customer-supplier relationships.

Trade financing differs in two key aspects from other channels of business group internal capital transfers, such as intra-group loans and dividend payments. Firstly, trade financing offers greater flexibility, enabling quick or delayed cash payments in response to changing needs and business circumstances among group affiliates. In contrast, the transfer process through intra-group loans, dividends, and cross-equity investments may not address certain short-term financing needs promptly as it takes time to sign contracts and agreements. Secondly, trade financing is characterized by higher opacity since the supply contract and trade credit terms and conditions are subject to fewer disclosure requirements and are not extensively regulated by governments. This inherent opacity allows additional flexibility to a group's financial operations. Given the limited availability of inter-company transaction data, we examine accounts payable as a proxy for trade financing among group firms.

Using a cross-country setting, this study is the first to show a broad picture of the supply chain relationships that exist within business groups. This contributes to our understanding of the inner workings of business group firm's operations. There is very little evidence on the roles of affiliated firms within supply chains of business groups. We present the frequencies of group affiliated firms with different roles based on their position within the group's internal supply chain. We also discuss some firm attributes related to these roles as key suppliers and

customers involved in trade credit.

Our discussion is related more broadly to the trade credit literature. Prior literature suggests that negative economic shock can propagate through a supply chain Barrot and Sauvagnat (2016); Ersahin et al. (2024); Agca et al. (2022), we show that given such shocks, business groups provide advantages that can alleviate the impact of such shocks by providing support through trade financing. Our findings also provide additional evidence that business group members are more resilient during these shocks. This complements the literature on business groups that shows how transfers of internal funds create value during economic shocks and crises (Almeida et al., 2015; Gopalan et al., 2007; Santioni et al., 2020; Buchuk et al., 2020).

2 Hypotheses Development

In many economies, business groups are known for having great economic power (Morck et al., 2005; Almeida and Wolfenzon, 2006a).[4] Transactions between affiliated firms within these groups can improve the competitiveness of both suppliers and customers, acting as an alternative to external markets when such markets lack efficiency. At the same time, such transactions may involve implicit loans and wealth transfers from minority shareholders to controlling shareholders (OECD, 2020; Fan et al., 2016).

2.1 Risk-sharing view

Researchers on the bright sides of business groups argue that the prevalence of business groups in many emerging economies is a response to institutional underdevelopment, such as developing capital markets and institutions and weaker legal systems (Khanna and Yafeh, 2007;

[4]For example, Boutin et al. (2013); Masulis et al. (2023) show that group's internal capital markets enhance group firm's competitive strength in the product market.

Morck, 2010).[5]

Business groups have incentives to maximize the joint utility of their affiliated firms by reallocating resources and sharing risks (Khanna and Yafeh, 2005). A key advantage of internal capital markets is their ability to help business groups share risks among member firms by reallocating internal funds and stabilizing income flows across affiliates (Khanna and Yafeh, 2005). For example, group affiliates may provide coinsurance to one another by bailing out financially distressed subsidiaries in the event of bankruptcy (Lewellen, 1971; Khanna and Yafeh, 2005; Riyanto and Toolsema, 2008; Beaver et al., 2023).

Trade credit in group-affiliated firms serves as a crucial short-term funding source within internal capital markets.[6] More importantly, it also plays a pivotal role in enhancing supply chain efficiency by facilitating risk-sharing between customers and suppliers. Specifically, trade credit enables customers to partially shift demand risk to suppliers, improving inventory financing and operational coordination, while stabilizing supply chain relationships and enabling more flexible cash flow management (Yang and Birge, 2018). This risk-sharing role is reinforced by reduced information asymmetry and stronger control, which lower the default risk for business group suppliers when extending trade credit to affiliated customers.

Within a business group, there is a higher level of information sharing among affiliated companies. Based on the supplier's financial advantage theory of trade credit (Petersen and Rajan, 1997), the suppliers have a comparative advantage over banks and other creditors in

[5] Chang and Hong (2000) show that group firms benefit from sharing intangible and financial resources with other affiliated firms. (Almeida and Wolfenzon, 2006a) model that business groups can better support new firms' funding requirements in underdeveloped external capital markets. This echoes Hoshi et al. (1991)'s financing advantage explanation of the pyramidal structure of many business groups. Subsequent empirical research also documents evidence of internal transfers of group funds across affiliated firms consistent with internal financing motives for business group formation (Belenzon and Berkovitz, 2010; Fisman and Wang, 2010; Gopalan et al., 2007; Almeida et al., 2011, 2015; Buchuk et al., 2014; Masulis et al., 2011, 2020, 2023).

[6] Fan et al. (2016) discuss the change in trade credit in business groups which can influence intra-group cash flows through normal transactions or implicit intra-group loans.

terms of creditworthiness investigations and their influence over their customers.[7] When the supplier and customer are affiliated with the same business group, the group supplier can have access to detailed information about the financial health, creditworthiness, and performance of the same-group customers. This enhanced information allows the supplier to make more informed decisions when extending trade credit, reducing the risk of default.

Business group suppliers may have tighter control and monitoring mechanisms in place compared to transactions with unrelated parties. The supplier can exercise greater control over the affiliated customers' operations, product development, and payment practices. Suppliers frequently play an active role in their customers' new product development processes and offer solutions to their technical challenges Ring and van de Ven (1992); Mahmood et al. (2011). This is particularly true in cases where there is a business group affiliation between the customer and supplier.[8] These closely linked business models enable suppliers to monitor affiliated customers more closely, reducing default risk by identifying and addressing issues early, especially through trade credit.

With the lower default risk, we hypothesize that group suppliers are willing to extend more trade credit to same-group customers, compared to unaffiliated customers. If the trade credit plays a risk-sharing role as an optimal response to maximize group interest, the trade credit should be extended more when the customer firms that have same-group suppliers face liquidity such as cash shortages, financial constraints, and operational disruption caused by exogenous reasons such as natural disasters.

[7] Petersen and Rajan (1997); Cuñat (2007) show that suppliers have comparative advantages over banks as lenders due to suppliers' ability to threaten to immediately stop supplying goods to ensure debt repayment. Jain (2001)'s model attributes the existence of trade credit to the benefits of reduced monitoring costs due to a supplier's informational advantages. Other theoretical discussions on a supplier's superior information advantage over financial institutions include Smith (1987); Brennan et al. (1988); Biais and Gollier (1997).

[8] For example, Helper and Sako (1995); Colpan et al. (2010) document how Japanese *keiretsu* suppliers assist their affiliated customers in product development. Another example is found in the context of Korean *chaebol* such as LG Group who sought for diversification due to difficulties in finding qualified suppliers as discussed in Kim (2010).

H1. To share risk among affiliates, group firms with same-group suppliers receive more trade credit than standalone firms.

2.2 Tunnelling view

On the dark side of business groups, a substantial portion of the earlier literature on family business groups finds that controlling families often expropriate minority shareholders through resource tunneling activities (Johnson et al., 2000; Bertrand et al., 2002), especially in Korean chaebol context (Bae et al., 2002; Baek et al., 2004, 2006).[9]

As an important short-term financing source, trade credit offers a unique advantage because of its less transparency and flexibility, compared with other internal capital transfer mechanisms such as intra-group loans and direct equity investments. As a result, business groups may use internal supply chains and trade financing to tunnel away group resources (profit) from minority shareholders.

If the trade credit is a tunneling tool for the controlling shareholders, then the trade credit extension should be higher when the costs of expropriation on minority shareholders are low (protection is weaker). The tunnelling hypothesis also predicts that extending trade credit benefits the receiver of the internal capital (customers) while hurting the interest of minority shareholders of the supplier's value.

H2. Group firms with same-group suppliers receive more trade credit, a form of tunneling that harms minority shareholders.

[9]Other empirical work testing tunneling and expropriation hypothesis in business group literature includes Fisman and Wang (2010); Claessens et al. (2000); Lemmon and Lins (2003); La Porta et al. (1999, 2002); Siegel and Choudhury (2012).

3 Data and Sample

In this section, we discuss the construction of our sample for analysis and our data sources. Our empirical analysis relies on identifying (i) firm-level supply chains and (ii) business group affiliation information. We obtain the supplier-customer linkage data from the FactSet Revere Supply Chain database. We then combine the FactSet Revere data set with data on business group affiliation for countries where this affiliation data is available. The sample of listed firms used in our analysis is created by merging the above supplier-customer linkage dataset with the Thomson Reuters Worldscope database. The final sample comprises 9,254 unique firms in 45 economies from 2013 to 2021.

The literature in trade credit mainly focuses on manufacturing firms, because trade credit mainly exists between suppliers and customers in a supply chain and is of little relevance in non-manufacturing industries (Levine et al., 2018; Li et al., 2021; Bougheas et al., 2009; Ersahin et al., 2024).[10]

3.1 Supply chain data

FactSet Revere Supply Chain Relationships data provides a detailed classification of global companies' business relationships and interconnectedness. This data is obtained from reliable primary sources and encompasses both disclosed and undisclosed relationships, resulting in a comprehensive and consistent network of relationships over time. The primary information sources for the firm's relationship data drawn from the Factset Revere datasets include annual

[10]For robustness, we also test on a sample of firms in all industries excluding financial (SIC 6000-6999) and service (SIC 7000-8999) firms in their sample. In addition to excluding financial industries (Gofman and Wu, 2022), we follow Petersen and Rajan (1997) to also exclude service industries for two reasons. First, service firms typically have relatively small book values of assets, which may affect the comparability of their financial characteristics with firms in other industries. Second, service firms tend to have lower levels of credit purchases, as their business nature often involves infrequent purchases and is not primarily focused on the supply of physical goods.

and quarterly reports, SEC filings, conference call transcripts, investor presentations, company websites, and press releases. Several recent studies (e.g. Agca et al., 2022; Dai et al., 2023; Ersahin et al., 2024; Gofman and Wu, 2022) have utilized this dataset to examine the correlation between supplier-customer relationships and various factors, including credit shocks, corporate social responsibility, trade credit, and profitability. Studies such as Gofman and Wu (2022) exploit the newly available data to test theoretical explanations for the existence of trade credit, while Agca et al. (2022) and Ersahin et al. (2024) explore the propaganda of credit shocks along supply chain through trade credit. Our study explores how internal supply chain relationships within business groups can benefit these business groups.

In the dataset, the relationships are categorized into four main types (customer, supplier, partner, competitor) and further subdivided into 13 sub-types, enabling precise categorization from the company's perspective. In our analysis, we specifically focus on customer and supplier relationships. For non-US firms, the FactSet Revere data provides extensive coverage starting in 2013, forming the foundation of our sample period spanning the period 2013-2021.[11]

3.2 Business group identification

Our identification of business group firms and family business group firms relies on the business group dataset first assembled by Masulis et al. (2011) and then extended as of 2007

[11]Nonetheless, the data may not fully capture all the global supply-chain relationships as we can only observe relationships that are either voluntary or mandated disclosures by customers and suppliers. As such, the starting and ending date of the relationship may not be accurately disclosed. (See the discussion of the time inconsistency issue associated with this data in e.g. Culot et al., 2023) To address concerns about the potential incompleteness in the supply chain relationships data outside of the US and across time, we adjust the supplier-customer linkage data by assuming the relationship continues to exist as long as the focal firm and its supplier/customer firm exist. In other words, the supplier-customer linkage can only be "switched on" and not "switched off". We make this "switch-on only" adjustment in our main analysis. We employ robustness checks to ensure that our findings are not influenced by data gaps or incomplete information as explained below. We use unadjusted as well as "constant" supplier-customer relationships as robustness checks and we find that the results are similar. The "constant" supplier-customer relationship adjustment involves holding the relationship between a supplier and a customer constant over our sample period.

by Masulis et al. (2020). This comprehensive ownership dataset covers business group firms in 45 countries and is drawn from standard ownership databases such as Bureau van Dijk Orbis, Worldscope, Thomson Reuters Global Ownership, and Lionshares databases combined with hand-collected data from media reports (LexisNexis, Factiva, Bloomberg, Dun and Bradstreet's Who Owns Whom, stock exchanges, and securities regulators). Following Masulis et al. (2011), a business group is defined as a collection of two or more listed firms controlled by the same ultimate controlling shareholder. The ultimate controlling shareholder of a firm is the largest shareholder with at least 20 percent of the voting rights, or at least a 10 percent holding if the shareholder also has other forms of control through positions such as CEO, chairman of the board, or as a founder. When the ultimate controlling shareholder is a family or an individual, the business group is defined as a family-controlled business group. The controlling family can be a biologically linked family or a known alliance of families. The remaining business groups can be state owned, publicly owned or non-profit owned.

We merge FactSet Revere Supply chain data with the Business Group Data from 2013 to 2021 and identify group-affiliated listed firms. For private firms reported in the FactSet database, we identify them as group-affiliated if their listed parent belongs to a business group.

3.3 Main variable construction

To answer the question about whether groups realize added advantages from having supply chain relationships, we examine the relationship between the focal firm and its supplier(s). We propose two measures to capture the relationship. The first measure is based on indicator variables for the following four categories: Initially, a focal firm is categorized as either a BG-affiliated or a standalone firm according to our BG database. Subsequently, based on the composition of its suppliers, the firm is further classified into one of the four main vari-

ables. If a focal BG-affiliated firm has any (zero) same BG-affiliated suppliers, then $I.BG\text{-}BG$ ($I.BG\text{-}NBG$) is equal to one, and zero otherwise. Similarly, if a focal firm is a standalone firm that has any (zero) BG-affiliated suppliers, $I.SA\text{-}BG$ ($I.SA\text{-}SA$) is equal to one and zero otherwise. Figure 1 shows a diagram that illustrates the formation of the four main indicator variables corresponding to each focal firm in our sample.

The alternative measure we propose to capture the relationship between the focal firm and its supplier(s) is *BG Importance*. To capture the relative importance of the same-group-affiliated suppliers to the focal firm, this measure calculates the total sales of its same-group supplier(s) as a proportion of the total sales of all of its suppliers.

3.4 Natural disaster data

We rely on the EM-DAT database[12] collected by the Centre for Research on the Epidemiology of Disasters (CRED) to identify major disasters. This comprehensive database is global in scope and includes data on natural disasters from 1900 to the present. The information in the EM-DAT database is sourced from a variety of reliable channels, including United Nations agencies, national governments, non-governmental organizations, insurance companies, research institutions, and press agencies. For an event to be recorded in the database, it must meet at least one of the following criteria: result in more than 10 deaths, affect/injure/homeless 100 or more people, or be declared as a state of emergency by the country with an appeal for international assistance. EM-DAT is a commonly-used international database for natural disasters. Some development economics and macroeconomics literature using this database include Botzen et al. (2019); Noy (2009); Felbermayr and Gröschl (2014); Ballesteros et al. (2017).

We consider natural disasters causing significant economic damage. We identify major nat-

[12]EM-DAT, CRED / UCLouvain, Brussels, Belgium – www.emdat.be

ural disasters as those associated with total monetary damage or a total number of people affected that fall within the top decile of the EM-DAT sample. One limitation of this international disaster dataset is that the EM-DAT disaster intensity measures (total estimated damages in USD, and total number of affected people) are likely to be correlated with the size of the economy because losses are generally higher and better recorded in developed countries (Botzen et al., 2019; Felbermayr and Gröschl, 2014). To address this data limitation and standardize the disaster intensity measures across different countries, we follow Botzen et al. (2019); Noy (2009) to scale the total estimated damages in a country by last year's GDP and scale the total number of affected people by last year's population. We identify 74 major natural disaster events which are shown in Table A.6.

After we identify the major disasters, we collect geographical coordinates of the affected areas and locations of these disasters reported in EM-DAT by using Google Maps Geocoding API. We then identify disaster-affected firms in our sample as those whose headquarters is located within 50 (100) kilometers of the affected areas. Factset provides the headquarters address locations for companies with supply chain relationships.

4 Within-Group Supply Chain Network Analysis

4.1 Same-group suppliers and customers of group firms

Table 1 presents the distribution and descriptive statistics of business groups in 45 countries in our sample. Following Masulis et al. (2023), we use the MSCI index classification system to classify our sample countries into developed and emerging markets.[13] Panel A reports the

[13]Developed capital markets are the 23 countries that MSCI includes in the MSCI World Index. Emerging capital markets refer to the 22 countries that MSCI designates as "Emerging Markets" and "Frontier Markets" as of 2007.

emerging capital markets and Panel B reports the developed markets.

No. of Groups is the total number of business groups in the sample for each country and *Avg Group Size* is the average number of firms in a business group. From Table 1, Japan, the United States, South Korea, and India show the largest number of business groups in the sample. On average, a business group consists of 4 group firms, while for the countries with the largest groups, there are on average 8 firms in a business group.

% *Int. Supp.* (% *Int. Cust.*) reports the average proportion of internal or same-group suppliers (customers) for each business group firm. These percentages are calculated by dividing the number of same-group suppliers (customers) by the total number of suppliers (customers) of the group firm in a given year. On average, 7% of the suppliers and 8% of the customers of a group firm are also members of the same business group. These country-average proportions are at least 60% higher in emerging markets compared to developed markets.

4.2 Supply-chain roles within a business group

Next, we show the supply-chain roles of firms within the business groups in the sample. For each firm in a business group, we define their role as *Supplier*, *Customer*, or *Neither*. The *Supplier* category is the group affiliated firms with same-group customers in a given year. They supply the rest of the group with their production, so we label their role within the group as an "internal supplier". Similarly, *Customer* is defined as the group-affiliated firms with same-group suppliers. They purchase from other firms in the same group, so we label their role within the group as an "internal customer". Note that a firm can be both *Supplier* and *Customer* when they supply to same-group firms and at the same time purchase from same-group firms, so the two categories are not mutually exclusive. The third category, *Neither*, contains group-affiliated firms without same-group customers or same-group suppliers. In other

words, these are the group firms whose trading partners are all standalone firms or firms from other business groups.

In Table 2, Panel A reports the group-level statistics of the average proportions of firms in each role for groups. We separate the business groups based on whether they are family business groups and whether they are in a pyramidal structure. In our sample, 70% of the groups are ultimately controlled by families or individuals, and most of the family-controlled groups have a pyramidal structure. From Panel A, we see that pyramidal groups have a higher proportion of internal suppliers and customers than the horizontal groups. Moreover, family pyramidal groups have the lowest proportion of firms without internal partners, which suggests that more firms in family pyramidal groups have internal trading partners, that are part of a supply chain.

We present the firm-level statistics in Panel B of Table 2. It shows that, within a group, 49% (100%-51.4%) of group firms have either internal customers or internal suppliers. 36.8% (36.4%) of group firms are labeled as internal suppliers (customers). Moreover, the proportion of family group firms having internal trading partners is higher than in non-family groups.

We take a closer look at the pyramidal groups in Panel C. Following Masulis et al. (2011), we distinguish firms in different layers of the pyramidal chain. *Apex* firms are firms at the top, and *Middle* and *Bottom* firms are those in the middle and at the very bottom of the pyramidal ownership chain. Statistics in Panel C show that *Middle* firms are more likely to have same-group suppliers and customers, while *Apex* firms are more likely to just trade with external firms.

4.3 Critical supplier and customer within a group

In the previous section, we show the proportion of internal suppliers and internal customers within business groups. To gain a deeper understanding of the internal supply chain dynamics within groups, we create critical supplier and customer scores. These scores serve to measure the relative importance of group firms within their business groups as internal suppliers and customers. The critical supplier score is calculated by dividing the number of same-group firms directly and indirectly supplied by the focal firm by the total number of potential same-group customer firms (i.e., the total number of firms in the group excluding the focal firm). Similarly, the critical customer score is constructed by dividing the number of group firms that purchase from the focal firm by the total number of remaining firms in the group, thus providing a scaled measure of the focal firm's importance as a customer within the group.

To comprehensively capture the number of affiliated firms directly and indirectly supplied by the focal firm, we construct the multi-tier supply chain for each group, using the term as in Mena et al. (2013). Each multi-tier supply chain within a group includes the focal group firm, its same-group customer, the customer's customer, the customer's customer's customer, and so on. These paths of multi-tier supply chains form a cascading supply chain relationship network within a group. We term the immediate (direct) supplier-customer relationship as the first-tier supplier/customer, while the subsequent (indirect) supplier-customer relationships are termed the second-tier, third-tier, and so forth. To avoid duplication, we retain only the shortest path of the multi-tier supply chain between any two firms in the same group. For example, if firm i is both directly and indirectly purchasing from firm j, firm i is considered the first-tier customer of firm j. In our sample, the longest multi-tier supply chain path within a group spans seven tiers.

After constructing the multi-tier supply chain relationship network within each business

group, we then calculate the critical supplier and customer scores using the aforementioned methods. Table A.1 presents the summary statistics of these scores of different types of group firms. From the table, pyramidal group firms (both family and non-family) have higher critical supplier and customer scores than horizontal group firms. Within a pyramidal group, apex, middle and bottom firms have similar critical scores.

4.4 Summary statistics of main variables

Table 3 presents summary statistics of our main variables for the four categories of focal firms based on their relationships with their suppliers. All continuous variables are winsorized at the 1% and 99% levels. The detailed description of variables is reported in Appendix A.1. As can be seen from the table, the unconditional mean of the trade credit measure $^{AP}/_{COGS}$ in our sample is 0.293, which suggests that accounts payable constitute 29% (16%) of the cost of goods sold for the average (median) firm in the sample. This ratio highlights the importance of trade credit that a firm receives in operation and production activities (Li et al., 2021).

4.5 Actual and "pseudo" group firms

From previous statistics, we show the business groups typically have same-group customers and suppliers and the proportion of these trading partners is non-trivial. In this section, we aim to provide more direct evidence of the importance of group affiliation in forming customer-supplier relationships. We examine the probability of group firms having same-group customer-supplier relationships, by comparing the group firms to matched standalone firms. To control for the selection effects of business group structure Almeida and Wolfenzon (2006b); Almeida et al. (2015); Buchuk et al. (2020), we compare a group to matched standalone firms following Masulis et al. (2023)'s matching procedure.

Firstly, we create a "pseudo group" for each (actual) business group in the sample. The "pseudo group" consists of standalone firms that are matched to each affiliated firm in an actual group. For each group firm, the matched standalone firm is found in the same country and 2-digit SIC industry based on nearest neighbour matching of covariates including size, age, sales growth, leverage, cash and short-term investments, and tangibility. This procedure ensures the "pseudo group" has a portfolio of standalone firms that mimic the actual group composition. The underlying assumption is that the "pseudo" groups form the same organizational structure as the actual groups, and the difference between the actual groups and (counterfactual) "pseudo" groups is the presence of an ultimate controlling shareholder. By doing so, we aim to examine the effects of group affiliation in forming same-group customer-supplier relationships. We allow the composite of standalone firms forming a "pseudo group" to be varied year by year. Otherwise, this would limit the sample size of matches as it is difficult to find matched standalone firms with similar firm-level characteristics that hold across the entire sample period.

After we assemble the "pseudo" groups, we construct the $I.BG\text{-}BG$ measures for standalone firms in these "pseudo" groups, assuming that they are a single business group. Similar to our previous construction of the customer-supplier relationship classification variable, $I.BG\text{-}BG$ indicates the group (or pseudo group) firm having same-group suppliers/customers. We then compare the $I.BG\text{-}BG$ for the group firms to their matched "pseudo" group firms.

Table 4 reports the likelihood of a focal firm having same-group suppliers in Panel A and that of having same-group customers in Panel B. The main variable of interest is *Actual Group*, which is an indicator variable for actual business groups, compared to "pseudo" groups in the sample. We examine the likelihood of having same-group suppliers and customers in the manufacturing firm sample and show robustness in appendix Table A.2. The results suggest that business group affiliation has strong positive effects on having same-group trading partners.

In addition to the likelihood of forming same-group trading relationships, we also investigate

the relative importance of these same-group trading partners (suppliers or customers). *BG_Splr* estimates the relative importance of the business group supplier(s) to the focal firm. For a focal firm as a customer, this measure is calculated as the proportion of the total sales measured in USD of its same-group supplier(s) to the total sales in USD of all of its suppliers. Similarly, *BG_Cust* measures the relative importance of the business group customer(s) to the focal firm. For a focal firm as a supplier, this measure is calculated as the proportion of the total cost of goods sold in USD of its same-group customer(s) to the total COGS in USD of all its customers. The intuition behind the measures is that the transaction amount is associated with sales of suppliers and purchases (hence reflected in the cost of goods sold in financial statements) of customers. By scaling the group sales or cost of goods sold by the focal firm's total figure, we can capture the relative importance of group suppliers or customers to the focal firm.

We show that not only is the likelihood of forming same-group customer-supplier relationships higher for actual business group firms, but the same-group suppliers/customers are also important trading partners. In Columns (3) to (4) of Panel A and B in Table 4, the dependent variable is *BG_Splr* and *BG_Cust*. These coefficients suggest that the same-group suppliers/customers account for proportionally more of their entire supplier/customer base when the focal firm belongs to an actual business group, instead of a "pseudo" group. This implies that business group affiliation is positively associated with the relative importance of same-group trading partners.

5 Empirical Methodology

We begin our empirical analysis by adopting the perspective of the customer firm. From this perspective, the focal firm's accounts payable are considered to be loans from its supplier(s), so the focal firms serve as borrowers and their suppliers act as lenders (Petersen and Rajan,

1997). Therefore, from the customer's standpoint, we estimate the following equation in our baseline model.

$$TradeCredit_{i,t} = \beta_0 + \beta_1 C\text{-}S\ Classification_{i,t} + \beta_2 X_{i,t-1} + \lambda_{ind,ctry,t} + \epsilon_{i,t} \quad (1)$$

where i and t index firm and year respectively and X denotes a set of control variables. We define our main dependent variable $TradeCredit$ as a firm's accounts payable divided by the cost of goods sold, following the extant literature (e.g. Li et al., 2021; Billett et al., 2021; Gofman and Wu, 2022; Levine et al., 2018; Ersahin et al., 2024). This variable captures the amount of trade credit provided by a firm's suppliers. We also provide robustness results using an alternative $TradeCredit$ measure, accounts payables scaled by the firm's sales over the year (Petersen and Rajan, 1997; Bougheas et al., 2009; Li et al., 2021). The main explanatory variable $C\text{-}S\ Classification$ is the customer-supplier relationship classification, which captures the business group affiliation and the relationship of the focal firm to its supplier(s). We propose two measures to capture this relationship. We define four categories based on the focal firm's group affiliation status and the group affiliation of its supplier. The first measure is an indicator variable for each of the four categories. Specifically, the first category $I.BG\text{-}BG$ takes a value of one for business group affiliated firms when any of its suppliers is affiliated with the same group, and the second category $I.BG\text{-}NBG$ takes the value of one when the focal group firm does not have any same-group supplier. In other words, all of the suppliers for $I.BG\text{-}NBG$ firms are standalone firms or affiliated with different business groups than the focal firm's group. For standalone firms, $I.SA\text{-}BG$ equals one if the firm has at least one supplier who is affiliated with a business group. $I.SA\text{-}SA$ captures the remaining category that the standalone firms where all the suppliers are also standalone firms.

The second measure we use to capture the $C\text{-}S\ Classification$ is $BG\ Importance$. It

measures the relative importance of the business group supplier(s) to the focal firm. For each focal firm, this measure is calculated as the proportion of the total sales in USD of its within-same-group supplier(s) to the total sales in USD of all of its suppliers. By definition, the measure is only positive when $I.BG\text{-}BG$ takes a value of one. The transaction amounts between the focal firm and its suppliers are recorded as sales in the financial statements of the supplier firm. Thus, our crude measure $BG\ Importance$, based on the proportion of same-group sales, captures the importance of same-group suppliers relative to all suppliers of the focal firm (in terms of sales).

$X_{i,t-1}$ indicates the firm-level control variables for the focal firms in our sample. We control for firm characteristics including firm size, firm age, tangible assets, leverage, cash holdings, and sales growth. We follow Petersen and Rajan (1997) in defining $Sales\ Growth_{Pos}$ and $Sales\ Growth_{Neg}$. We also include country-industry-year fixed effects or country-year and industry-year fixed effects to control for time-invariant unobservable country-year-industry characteristics. We cluster the standard errors at the firm level.

6 Trade Credit and Same-group Suppliers

In the previous analysis, we investigate the role of group firms in the within-group supply chain and compare it across different types of groups. Next, we explore the question of whether the groups support their affiliates through trade financing within the production network of its business group. We show that business groups with same-group suppliers receive higher trade credit and importantly that the effects are higher when the focal firm is short of cash holdings or experiences financial difficulties.

6.1 Focal Firms as Customers: Who Receives More Trade Credit?

In this section, we show the effects of having same-group supplier(s) on the trade credit a focal firm receives. We estimate the regression as specified in equation (1) and present the results for our baseline analysis in Table 5. The first four columns report the regression results for firms in manufacturing industries only, and the next four columns report results for the sample of firms in all industries excluding financial and services industries.

In Columns (1), and (2), we regress the firm's trade credit on the four main indicator variables capturing the business group affiliation of focal firms and their suppliers. The coefficients on the $I.BG\text{-}BG$ indicators are significantly positive across multiple specifications, suggesting that group-affiliated firms with same-group suppliers tend to obtain higher levels of trade credit. For example, the coefficient of $I.BG\text{-}BG$ in Column (1) indicates that compared with standalone firms who only purchase from standalone suppliers, business group firms with same-group suppliers tend to have 0.095 higher levels of trade credit. This value represents approximately 30% of the sample mean of the ratio of accounts payable to the cost of goods sold.

In the manufacturing sample, the focal firm receives greater trade credit when it is a group-affiliated firm, compared with a typical manufacturing transaction by standalone firms without group suppliers. This can be seen from the significant positive coefficient on both $I.BG\text{-}BG$ and $I.BG\text{-}NBG$. This could reflect the fact that business groups have better credit quality because of their lower likelihood of default. Notably, the coefficient of $I.BG\text{-}BG$ nearly doubles that of $I.BG\text{-}NBG$, which highlights the important role of having same-group suppliers for a focal group firm's trade credit.

Columns (3), and (4) use the $BG\ Importance$ measure instead of the four indicator variables to capture the relationship between focal firms and their suppliers. Consistent with the indicator

variables, the results for the *BG Importance* are also significant and positive. From Column (3), we see that a one standard deviation (0.161) change in same-group suppliers' importance measure leads to 0.018 (0.114×0.161) increase in $^{AP}/_{COGS}$, which represents 10.8% of the median (or 6.3% of the sample mean) of $^{AP}/_{COGS}$.

We also examine whether these results are robust to alternative definitions of trade credit. We show the regression results of using accounts payable scaled by sales ($^{AP}/_{Sales}$) to estimate trade credit in Table A.5. The results are consistent with the previous finding that group firms with same-group suppliers receive a higher level of trade credit.

Overall, the baseline results of same-group supplier and trade credit consistently indicate that groups have advantages in trade financing. This is especially the case when they have internal suppliers, where they receive a higher level of trade credit. Although the accounts payable collectively represent the total accounts payable to all suppliers, having internal suppliers significantly increases the accounts payable of the focal group firms, which implies that their same-group suppliers are extending more trade credit to the focal group firm.

6.2 When Focal Firms Have Liquidity Needs

Having established that group firms with same-group suppliers have greater trade credit, we conduct cross-sectional heterogeneity tests to show which group firms receive more trade credit. In this section, we investigate the question of whether business groups strategically extend trade credit to affiliates when they are particularly in need. We discuss three circumstances when firms have high liquidity needs with respect to their sales conditions, cash holdings, and financial constraints.

First, we consider the cash holdings of focal firms. Firms that face cash shortages typically have higher liquidity needs. In these firms, the demand for trade credit financing from their

suppliers is predicted to be higher. At the same time, the relative default risk associated with group firms is higher than standalone firms not experiencing cash shortages. If the business groups strategically support the group affiliates in need of trade credit, then we expect the group firms with less cash to receive more trade credit if they have same-group suppliers. We classify firms with lower cash holdings ($LessCash$) as those whose cash and short-term investments scaled by total assets, $Cash$, are below the median for the corresponding country, industry, and year. We test the level of $^{AP}/_{COGS}$ on the interaction of $LessCash$ and $I.BG\text{-}BG$. Table 6 shows the results. The interaction term is positive and significant, which suggests that when the focal firm has below-median cash holdings and short-term investments, they are more likely to receive greater trade credit when they have same-group suppliers.

Moreover, we examine whether financially constrained firms receive more trade credit when they have same-group suppliers. From a risk-sharing perspective, the internal supplier may prioritize the group's overall interests by supporting the financially constrained firm by extending them new trade credit. This helps prevent internal supply chain disruptions and protects the group's reputation and financial health. By keeping the liquidity-constrained firm operational, the risk is shared across the group, minimizing potential negative impacts on any single member. The risk-sharing channel can be reinforced by reduced information asymmetry where a trusted relationship within the group reduces the perceived risk of default, facilitating trade credit extensions. Better information sharing within the group also allows for more accurate risk assessment.

Table 7 reports the results. The dependent variable is the level of trade credit received by the focal firm. We identify financially constrained firms ($Finl.Const.$) as having a value in the top tercile of the Hadlock-Pierce (size-age) financial constraints indices (Hadlock and Pierce, 2010). The results are consistent with the risk-sharing hypothesis suggesting that financially constrained firms receive more trade credit when they are group firms with same-group suppliers

($I.BG\text{-}BG$).

7 Identification Strategy

7.1 Effects on disaster-affected firms

In previous sections, we show that the groups share the liquidity and operational risk of affiliates through trade financing. In this section, we investigate how the trade credit received by downstream affiliated firms varies with its needs by utilizing natural disasters as exogenous shocks raising its financing needs.

Previous literature shows that operating shocks caused by natural disasters are transmitted along the supply chain network (e.g. Agca et al., 2022; Barrot and Sauvagnat, 2016; Carvalho et al., 2021; Pankratz and Schiller, 2021; Ersahin et al., 2024). Ersahin et al. (2024) argue that disaster affected firms receive more trade credit because their upstream suppliers extend more trade credit to maintain the supplier-customer relationship to ensure continuing product demand and transactions in the future. Business groups are known to have greater economic power in many countries (Morck et al., 2005). If the business group strategically supports their affiliated firms through trade financing while sharing much of the operating risks of their affiliated customers, but not of its standalone trading partners, then we expect group firms with same-group suppliers to receive more trade credit when they are adversely affected by major natural disasters.

We identify major natural disasters as those associated with total monetary damages or a total number of people affected that is in the top decile of the EM-DAT sample. Our disaster impact measures are adjusted for country size: total estimated damages are scaled by the prior year's GDP, and the number of people adversely affected is scaled by the previous

year's population. To focus on disasters with immediate supply chain disruptions, we exclude highly damaging but slow-onset events such as droughts, which have more gradual impacts. In addition, to avoid potential confounding effects from the widespread economic and supply chain disruptions caused by COVID-19, which could mask or exaggerate the impact of natural disasters, we restrict the sample to pre-COVID years. The country and yearly distribution of the major natural disaster events are reported in Table A.6. Table A.7 lists the major natural disasters included in the study. The results remain consistent even without these restrictions.

After identifying the major disasters, we collect geographical coordinates of the affected areas and locations of these disasters reported in EM-DAT. We rely on FactSet data for firm headquarters address locations. Firms whose headquarters are located within 50 (100) kilometers of the affected areas are identified as natural disaster affected in our sample.

We first investigate the impact of natural disasters on the sales growth of firms whose headquarters are located in the affected areas. We regress the sales growth of firms in our sample. Table A.8 presents the results. Columns (1) and (2) show the coefficients of the variable $I.Disaster50$ are both negative and statistically significant. This implies that when a major natural disaster hits a firm, its sales growth experiences a decline of 2.1 to 2.6 percentage points. When we expand the definition of affected firms to those whose headquarters are located within 100 kilometers of the natural disaster, the drop in a firm's sales growth remains negative and significant. The effect of a drop in sales growth is not only statistically significant but is also economically significant, given that the mean sales growth is 9.2 percentage points. Overall, the results suggest that a firm's sales growth drops significantly when the firm is located near an area affected by a natural disaster.

To examine whether the group firms react differently in terms of their trade financing when

they are adversely affected by natural disasters, we estimate the following equation.

$$\begin{aligned} TradeCredit_{i,t} = \beta_0 + \beta_1 DisasterAffected + \beta_2 C\text{-}S\ Classification_{i,t} \\ +\beta_3 DisasterAffected \times C\text{-}S\ Classification_{i,t} + \beta_4 SupplierDisasterAffected \\ +\beta_5 X_{i,t-1} + \lambda_{ind,ctry,t} + \epsilon_{i,t} \end{aligned} \tag{2}$$

where $DisasterAffected$ indicates the firm is located in the affected area of a major disaster. We use two alternative indicators to measure whether a firm is $DisasterAffected$: $I.Disaster50$ represents any firm located within 50 kilometers of the affected disaster area, and $I.Disaster100$ extends the firm's distance to the affected disaster area to 100 kilometers.[14] $SupplierDisasterAffected$ is the indicator of at least one of the suppliers of the firm is hit by a major natural disaster.[15]

Following Masulis et al. (2023), the "treatment" in our analysis is whether a firm is affiliated with a business group. This is purely based on observational data as there is no experiment that can randomly sorts firms into either affiliated or standalone firms. Our variable of interest is thus the interaction term of $C\text{-}S\ Classification$ and $DisasterAffected$ as we are only interested in the difference in the crisis-induced effects for observed same-group firms and for standalone firms, not for all firms in the population. Throughout the disaster analysis, we focus on the sample of manufacturing firms because the trade credit is mainly relevant to manufacturing industries (Levine et al., 2018; Bougheas et al., 2009; Li et al., 2021).

Table 8 reports the regression results of equation 2. The coefficients on the $I.BG\text{-}BG$ and $I.BG\text{-}NBG$ remains significantly positive, which supports our baseline results that the group firms receive more trade credit and they receive more trade credit when at least one of their

[14] In robustness tests, we also use 500 kilometers as the cutoff point to identify affected firms.

[15] Based on the geographical coordinates, the mean value of the disaster-affected area is around 420k square kilometers. Note that this is just a crude calculation as the geographical coordinates we identify are just one point (combination of longitude and latitude) of the affected cities/provinces recorded in the database.

suppliers is in the same business group.

Our variable of interest is the interaction between $C\text{-}S\ Classification$ and $Disaster Affected$. The positive and significant coefficients of the interaction of $I.BG\text{-}BG$ and $I.Disaster50$ indicate that the group firms with same-group suppliers receive more trade credit when they are hit by major natural disasters, compared with the standalone firms without same-group suppliers. The effects are robust when we expand the definition of affected areas to identify disaster-hit firms in Columns (3) and (4). Thus, a group firm hit by a natural disaster receives more trade credit if they have same-group suppliers. At the same time, these firms can be experiencing rising default risk.[16]

7.2 Stacked Difference-in-Differences

To mitigate potential issues associated with a staggered Difference-in-Differences (DiD) approach (Gormley and Matsa, 2011, 2016), we employ a stacked-cohort DiD methodology for more robust testing. Previous studies such as Ersahin et al. (2024); Barrot and Sauvagnat (2016) have indicated that the impact of a disaster on a firm generally persists for approximately one year. Therefore, we adopt a three-year time frame centered around the event year for each cohort in our analysis. We employ country-year cohort, industry-year cohort, and country-industry-year-cohort fixed effects in our specifications. Additionally, to further validate our findings, we conduct a separate stacked-DiD analysis using a five-year window for robustness, and the results remain both qualitatively and quantitatively consistent with our three-year window results.

Next, we run the stacked-cohort DiD regressions on the time dynamics of the effect of

[16]Using Capital IQ capital structure data, we also examine the changes in percentage leverage funded by bank loans in firms impacted by disasters. Our results in Table A.9 show that when the area nearby where a firm's headquarters is located is hit by a major disaster, the firm also experiences a loss in bank loans as a percentage of their total debt, as suggested by the negative significant coefficient on *Bank Share*.

the major natural disaster events on trade credit from 2013-2019 in the manufacturing firms sample. First, we construct a stacked-matched event sample. To ensure that natural disasters have a homogeneous impact on firms located in affected areas, we focus on major events that result in substantial economic damage. The major natural disasters in our sample are those associated with the top 10th percentile of scaled total monetary damages or scaled number of people adversely affected. For each natural disaster year (event) in a country, treated firms that are hit by (located nearby) natural disasters are paired with a group of control firms that are never hit by natural disasters (i.e., never-treated firms) one year prior to and one year after the event year. After forming all the cohorts for treated firms, we stack the cohorts of treated and control firms together to finalize the stacked cohort DiD sample. We then examine whether the group firms having same-group suppliers receive more trade credit when they are hit by natural disasters. We compare the changes in trade credit between disaster-affected and control firms one year before and after the natural disaster. Columns (5) to (8) in Table 8 show that the results are consistent with our prior Diff-in-Diff analysis.

Overall, the disaster analysis implies that business groups support the affiliates by extending more trade credit when an affiliated firm is hit by operating shocks.[17] This result is consistent with Masulis et al. (2023) that family business groups utilize their greater economic power and cash pool in the internal capital markets to acquire more market share after the economic crisis. It provides additional evidence on channels through which the business groups support member firms.

[17]For suppliers hit by major natural disasters, their customers could be pressured to pre-pay for goods or pay back trade credits early, leading to a reduced level of accounts receivable for the suppliers. From the supplier's perspective, empirical studies typically use accounts receivable scaled by firm sales to measure trade credit extended by the suppliers (e.g. Petersen and Rajan, 1997; Li et al., 2021; Gofman and Wu, 2022). In contrast, the results in Table A.10 imply that customers of disaster-hit firms repay more slowly. If at least one of the customers is also affected by the natural disaster (negatively significant $I.DisasterHitCust$ dummies), then the suppliers receive the overall payment quicker.

8 Risk-Sharing vs. Tunneling Views

Thus far, our results suggest that group firms actively utilize trade financing to support affiliates, particularly when they face financial constraints. It is conceivable that both the risk-sharing and tunneling hypotheses can help explain the observed increase in trade credit provided by internal suppliers to the focal firm. For instance, trade credit terms may not be set at arm's length for group-affiliated firms, where suppliers may need to bear the cost of delayed payments or bad debts if these firms fail to repay on time. However, the implications of these two hypotheses diverge when this shift in profits to other group firms comes at the expense of minority shareholders' investments. To identify the channel through which group-affiliated firms have their trade credits extended by same-group suppliers, we conduct the following two tests.

First, we examine whether the effect of having same-group suppliers varies across different levels of expropriation faced by group firms. If our baseline results are predominantly driven by the tunneling hypothesis, we would expect family groups to leverage their pyramidal structures to exploit minority shareholders, especially in countries with poor minority shareholder protection where the costs of tunneling activities are relatively low.

To test this, we now restrict our sample to group firms, which results in a significant reduction in the number of observations. We then split the sample based on the median level of the Minority Shareholder Protection (MSP) index from Guillén and Capron (2016), which captures the strength of legal protection of the rights and interests of minority shareholders.[18]

Table 10 presents the results. The coefficient on $I.BG\text{-}BG$ suggests that the positive effects of having same-group suppliers on firm trade credit are mainly concentrated in countries with

[18]The advantage of this index is that it covers a broad set of (ten) provisions that legal scholars consider important for shareholder protection. It is also updated to 2011, whereas other early cross-country governance indicators tend to rely on data from the early 1990s. Given that the MSP index tends to be static over our sample period, we use the average value of the index for each country.

strong minority shareholder protection, which is inconsistent with the tunneling hypothesis.

Second, we conduct an analysis at the customer-supplier level to provide more direct evidence of risk-sharing motives instead of tunneling. We explore the effect of the heterogeneous long-term value of the focal firm on that of the same-group supplier firm. Specifically, we estimate the following equation by restricting our sample to manufacturing firms.

$$\begin{aligned} Tobin's\ Q_{i,t} =& \beta_0 + \beta_1 \times Tobin's\ Q_{j,t} + \beta_2 \times Tobin's\ Q_{j,t} \times I.BG\text{-}BG \\ &+ X_i + \lambda_{i,j} + \lambda_{ctry,ind,t} + \epsilon_{i,j,t}, \end{aligned} \tag{3}$$

where i represents customer firm and j represents supplier firm. We separate the sample based on whether the customer-supplier pair is characterized by excessive trade credit, where both the supplier j has above-median accounts receivable scaled by sales and the customer i has above-median accounts payable scaled by the cost of goods sold.[19]

The tunneling hypothesis predicts that, within a business group, suppliers extend more trade credit in a way that may undermine the supplier firm's minority shareholders while benefiting the customer firm receiving the credit. Consequently, if the tunneling hypothesis holds, the customer's Tobin's Q (which reflects long-term value) will be negatively correlated with the supplier's Tobin's Q when the internal supplier extends excessive trade credit to the customer. However, if the optimal view is that the group uses trade credit to share risk and enhance overall group welfare, a positive relationship between the customer's and supplier's Tobin's Q should be observed.

The test results in Table 11 show a positive significant relationship in the interaction term $Tobin's\ Q_{j,t} \times I.BG\text{-}BG$ when the supplier extends excessive trade credit to the customer. This finding suggests that, compared to firms without same-group suppliers, a group's firm's

[19]Due to the absence of bilateral transaction data for each relationship, this approach is likely to capture instances where the supplier extends excessive credit to the customer.

Tobin's Q increases when its supplier, within the same group, provides excessive trade credit. Therefore, we did not find evidence consistent with the tunneling hypothesis, which posits that providing (excessive) trade credit benefits the customer while harming the supplier.

Overall, our results from both firm-level and customer-supplier firm pair-level analyses find evidence inconsistent with the tunneling hypothesis.

9 Internal Capital Allocation, Trade Credit, and Crowding-Out Effects of Business Groups

9.1 Trade Credit and Other ICM Mechanisms

Our previous analysis shows that trade credit is one of the important internal capital mechanisms through which business groups reallocate internal funding to affiliates in need. However, it remains unclear to what extent the impacts of extending trade credit differ from those of other previously documented internal capital market (ICM) channels supporting financially weak firms. These channels include intra-group loans, intra-group dividend payments, and cross-firm equity investments, among others (e.g. Gopalan et al., 2007, 2014; Buchuk et al., 2014; Almeida et al., 2011, 2015). To further investigate this question, we rely on the measure of $GroupIAF$ used by Masulis et al. (2023) as a proxy for the extent to which the focal group firm may receive debt or equity investments by all the other firms collectively in the business group.

This measure relies on the disclosure of the fair value of group firms' investment holdings (both equity and debt) in their affiliated firms (IAF) where they are deemed to have a significant influence, as per International Accounting Standard 28 (IAS 28). $GroupIAF$ calculates the asset-weighted average of the adjusted IAF changes of the other affiliates in the same group for

each firm.[20][21] $I.GroupIAF$ indicates a group firm has a positive $GroupIAF$, suggesting that the group firm receives internal capital from other affiliated firms within the same group.

Table 9 reports the results of having same-group supplier(s) and receiving intra-group internal capital on a group firm's trade credit for the sample of business group firms in manufacturing industries. We split the sample into pyramidal group firms (Columns (1) and (2)) and horizontal group firms (Columns (3) and (4)). Our variable of interest is the interaction of $I.GroupIAF$ and $I.BG\text{-}BG$. In pyramidal group firms, we observe a substitution effect between internal capital reallocation received from other channels, represented by $I.GroupIAF$, and trade credit. While pyramidal group firms with same-group suppliers tend to receive more trade credit, this decreases when other forms of internal capital are provided. This substitution effect is not observed in horizontal business groups, which is consistent with prior literature suggesting that internal capital reallocation can offer financing advantages for pyramidal firms.

Furthermore, we distinguish between the firm's position in the controlling pyramidal chain. In Columns (5) and (6), we find that when the group is at the very bottom of the pyramid, as indicated by the $Bottom$ indicator, there exists a complementary relationship between trade credit and other forms of ICM mechanisms. This suggests that for financially weaker affiliates(i.e. bottom firms), pyramidal groups provide support through various internal capital channels, while apex and middle firms that are not at the bottom of the organizational structure, receive either extended trade credit or alternative capital investments from the group. This is consistent with the literature that the bottom firms are typically younger, riskier, and

[20]The Investments in Associates and Joint Ventures data are from Worldscope. We adjust the estimated impairment charge as the data only reflects the book value, which can vary due to accounting revaluations. To estimate the yearly change in IAF, the book value of IAF changes is calculated and the estimated impairment charge is added back. We assume they occur at the same rate as impairment charges on the firm's investment assets when specific impairment charges for IAF are unavailable.

[21]The limitation of the IAF measure is its outbound nature, as it indicates the provision of finance by the reported firm. By constructing the $GroupIAF$ measure, we argue that the capital reported and provided by all other affiliated firms within the same group has directly or indirectly reached the focal group firms.

more opaque (Masulis et al., 2011) and also consistent with our hypothesis that business groups have incentives to maximize overall group welfare through supporting weaker affiliates.

9.2 When the Group Firm and the Standalone Firm Share Suppliers

So far, our analysis has focused on group firms with same-group suppliers and their trade credit dynamics compared to standalone firms. However, we have yet to consider a scenario where both group firms and standalone firms share suppliers. In such cases, if the shared suppliers of business group firms extend more trade credit to their same-group customers, it could put the other standalone customers at a disadvantage and expose them to some degree of operational risks associated with the group supplier.

To test this hypothesis, we compare group firms with same-group suppliers ($I.BG$-BG) with standalone firms with group suppliers whose customers include same-group firms ($I.SA$-BG and the group supplier in this context has the same-group customer(s)). In other words, we examine the customers of group suppliers that include some, but not all same-group customers. A graphical illustration of this comparison is in Figure 2.

For each business group firm in a given year, we find the matched standalone firms in the same country, 2-digit SIC industry with the closest firm characteristics as in Equation 1.[22] We then run OLS regressions of the following equation.

$$TradeCredit_{i,t} = \beta_0 + \beta_1 I.BG_{i,t} + \beta_2 X_{i,t-1} + \lambda_{ind,ctry,t} + \epsilon_{i,t} \tag{4}$$

where i and t index firm and year respectively and X denotes a set of control variables. Our variable of interest is $I.BG$, which indicates whether the focal firm is affiliated with a business group.

[22]For robustness, we also show in Table 12 Panel B that the matching covariates only include firm size.

Consider a situation where group suppliers have both same-group and standalone customers. If group suppliers have incentives to favor their same-group customers, then for the same level of customer operating risk, they are likely to extend more trade credit to their same-group customers than to their standalone customers. In Table 12, we compare the group and standalone customers of group-affiliated suppliers having same-group customers, and we find that same-group customers receive significantly more trade credit than their standalone customers do.

We further distinguish between family group firms and non-family group firms. The variable $I.FamBG$ ($I.NonfamBG$) takes the value of one when the firm is affiliated with a family (non-family) business group and is zero otherwise. To maintain close linkage of the affiliated firms and family control over the group, the family group suppliers may have stronger incentives than non-family groups to let outside customers bear some of their operating risks and instead offer greater support to same-group customers. In Table 12, we find that family group firms do receive more trade credit. This suggests that with stronger control over group member firms, family business groups may better facilitate trade financing along the internal supply chain.

Overall, the analysis focuses on the customers of group-affiliated suppliers having same-group customers. It shows that same-group customers receive more trade credit than standalone customers. It implies that these standalone firms may be disadvantaged because the suppliers can favor their same-group customers by extending more trade credit. This is especially true for standalone firms trading with family business group suppliers.

10 Conclusion

Using a comprehensive dataset of customer-supplier relationships of business group firms and standalone firms globally, we analyze the role of internal supply chains within business

groups. Our study provides insights into supplier-customer relationships within business groups and their significance relative to the group's overall supplier networks and customer base. We find that a substantial proportion of suppliers and customers of group firms are members of the same business group. The average proportions of same-group suppliers and customers are higher in emerging markets compared to developed markets, suggesting the importance of mitigating market frictions and institutional constraints through business group formation in much greater in developing economies.

Moreover, we observe that a significant percentage of group firms have at least one same-group customer or supplier, with higher proportions found among family business group firms. Our study provides valuable insights into the trade credit dynamics within business groups and their implications for firm financing. We find that supplier-customer relationships within business groups constitute a significant proportion relative to the group's overall supplier networks and customer base. The proportions of same-group suppliers and customers are higher in emerging markets compared to developed markets, indicating the importance of mitigating market friction through business group affiliation in these markets. This is the first study to provide a comprehensive overview of the internal workings of supply chains inside business groups and across different countries by examining the frequencies of affiliated firms with different roles based on their positions within the internal supply chain. Additionally, we discuss the importance of firm attributes, such as critical (major) suppliers and critical (major) customers, in shaping the dynamics of these supply chain relationships. Overall, our findings shed new light on the operations of business group firms and enhance our understanding of their supply chain networks and the financial stability of business groups.

Throughout our empirical analysis, we show that business groups strategically use trade financing along the supply chain when their affiliated downstream firms are in need of trade credit. Group firms, particularly those with same-group suppliers, are associated with higher

trade credit compared to standalone firms. This can be attributed to their lower default risk and better information flow within same-group customer-supplier relationships. Family business group firms, which exhibit centralized control, receive more trade credit and demonstrate the beneficial effects of same-group relationships to a greater extent compared to non-family business group firms. We also provide evidence of higher trade credit for group firms with same-group suppliers when these customers have a higher demand for trade credit (negative sales growth, less cash, and affected by natural disasters), which presumably implies greater credit or default risk. Since trade credit terms are typically the same for all the firm's customers, this implies greater financing subsidies to affiliated customers in financial need. Our study provides novel empirical evidence on a new channel (trade financing) through which business groups support their member firms. This adds to the prior literature which highlights several other financial advantages of business groups, by broadening the scope of mechanisms business groups have at their disposal to support their member firms.

References

Agca, Senay, Volodymyr Babich, John R. Birge, and Jing Wu, 2022, Credit Shock Propagation Along Supply Chains: Evidence from the CDS Market, *Management Science* 68, 6506–6538.

Almeida, Heitor, Chang-Soo Kim, and Hwanki Brian Kim, 2015, Internal Capital Markets in Business Groups: Evidence from the Asian Financial Crisis, *The Journal of Finance* 70, 2539–2586.

Almeida, Heitor, Sang Yong Park, Marti G. Subrahmanyam, and Daniel Wolfenzon, 2011, The structure and formation of business groups: Evidence from Korean chaebols, *Journal of Financial Economics* 99, 447–475.

Almeida, Heitor, and Daniel Wolfenzon, 2006a, Should business groups be dismantled? The equilibrium costs of efficient internal capital markets, *Journal of Financial Economics* 7, 99–144.

Almeida, Heitor, and Daniel Wolfenzon, 2006b, A Theory of Pyramidal Ownership and Family Business Groups, *The Journal of Finance* 61, 2637–2680.

Bae, Kee-Hong, Jun-Koo Kang, and Jin-Mo Kim, 2002, Tunneling or Value Added? Evidence from Mergers by Korean Business Groups, *The Journal of Finance* 57, 2695–2740.

Baek, Jae-Seung, Jun-Koo Kang, and Inmoo Lee, 2006, Business Groups and Tunneling: Evidence from Private Securities Offerings by Korean Chaebols, *The Journal of Finance* 61, 2415–2449.

Baek, Jae-Seung, Jun-Koo Kang, and Kyung Suh Park, 2004, Corporate governance and firm value: Evidence from the Korean financial crisis, *Journal of Financial Economics* 71, 265–313.

Ballesteros, Luis, Michael Useem, and Tyler Wry, 2017, Masters of Disasters? An Empirical Analysis of How Societies Benefit from Corporate Disaster Aid, *Academy of Management Journal* 60, 1682–1708.

Barrot, Jean-Noël, and Julien Sauvagnat, 2016, Input Specificity and the Propagation of Idiosyncratic Shocks in Production Networks, *The Quarterly Journal of Economics* 131, 1543–1592.

Beaver, William H., Stefano Cascino, Maria Correia, and Maureen F. McNichols, 2023, Bankruptcy in groups, *Review of Accounting Studies* .

Belenzon, Sharon, and Tomer Berkovitz, 2010, Innovation in Business Groups, *Management Science* 56, 519–535.

Bertrand, Marianne, Paras Mehta, and Sendhil Mullainathan, 2002, Ferreting Out Tunneling: An Application to Indian Business Groups, *The Quarterly Journal of Economics* 117, 121–148.

Biais, Bruno, and Christian Gollier, 1997, Trade Credit and Credit Rationing, *The Review of Financial Studies* 10, 903–937.

Billett, Matthew T., Kayla Freeman, and Janet Gao, 2021, Access to Debt and the Provision of Trade Credit, *SSRN Electronic Journal* .

Botzen, W. J. Wouter, Olivier Deschenes, and Mark Sanders, 2019, The Economic Impacts of Natural Disasters: A Review of Models and Empirical Studies, *Review of Environmental Economics and Policy* 13, 167–188.

Bougheas, Spiros, Simona Mateut, and Paul Mizen, 2009, Corporate trade credit and inventories: New evidence of a trade-off from accounts payable and receivable, *Journal of Banking & Finance* 33, 300–307.

Boutin, Xavier, Giacinta Cestone, Chiara Fumagalli, Giovanni Pica, and Nicolas Serrano-Velarde, 2013, The deep-pocket effect of internal capital markets, *Journal of Financial Economics* 109, 122–145.

Brennan, Michael J., Vojislav Maksimovic, and Josef Zechner, 1988, Vendor Financing, *The Journal of Finance* 43, 1127–1141.

Buchuk, David, Borja Larrain, Francisco Muñoz, and Francisco Urzúa I., 2014, The internal capital markets of business groups: Evidence from intra-group loans, *Journal of Financial Economics* 112, 190–212.

Buchuk, David, Borja Larrain, Mounu Prem, and Francisco Urzúa Infante, 2020, How Do Internal Capital Markets Work? Evidence from the Great Recession, *Review of Finance* 24, 847–889.

Carvalho, Vasco M, Makoto Nirei, Yukiko U Saito, and Alireza Tahbaz-Salehi, 2021, Supply Chain Disruptions: Evidence from the Great East Japan Earthquake, *The Quarterly Journal of Economics* 136, 1255–1321.

Chang, Sea Jin, and Jaebum Hong, 2000, Economic Performance of Group-Affiliated Companies in Korea: Intragroup Resource Sharing and Internal Business Transactions, *The Academy of Management Journal* 43, 429–448.

Claessens, Stijn, Simeon Djankov, and Larry H. P Lang, 2000, The separation of ownership and control in East Asian Corporations, *Journal of Financial Economics* 58, 81–112.

Colpan, Asli M., Takashi Hikino, and James R. Lincoln, 2010, *The Oxford Handbook of Business Groups* (Oxford University Press).

Culot, Giovanna, Matteo Podrecca, Guido Nassimbeni, Guido Orzes, and Marco Sartor, 2023, Using supply chain databases in academic research: A methodological critique, *Journal of Supply Chain Management* 59, 3–25.

Cuñat, Vicente, 2007, Trade Credit: Suppliers as Debt Collectors and Insurance Providers, *The Review of Financial Studies* 20, 491–527.

Dai, Lili, Rui Dai, Lilian Ng, and Zihang Ryan Peng, 2023, Global Supply Chains and Voluntary Disclosure, SSRN Working Paper 3674690.

Dau, Luis Alfonso, Randall Morck, and Bernard Yin Yeung, 2021, Business groups and the study of international business: A Coasean synthesis and extension, *Journal of International Business Studies* 52, 161–211.

Deloof, M., 1995, Liquiditeit, financieringsbeperkingen en investeringen van grote Belgische ondernemingen, *Brussels Economic Review* 145, 55–92.

Deloof, Marc, and Marc Jegers, 1996, Trade Credit, Product Quality, and Intragroup Trade: Some European Evidence, *Financial Management* 25, 33.

Emery, Gary W., 1984, A Pure Financial Explanation for Trade Credit, *Journal of Financial and Quantitative Analysis* 19, 271–285.

Ersahin, Nuri, Mariassunta Giannetti, and Ruidi Huang, 2024, Trade credit and the stability of supply chains, *Journal of Financial Economics* 155, 103830.

Faccio, Mara, and William J. O'Brien, 2021, Business Groups and Employment, *Management Science* 67, 3468–3491.

Fan, Joseph P. H., Li Jin, and Guojian Zheng, 2016, Revisiting the Bright and Dark Sides of Capital Flows in Business Groups, *Journal of Business Ethics* 134, 509–528.

Felbermayr, Gabriel, and Jasmin Gröschl, 2014, Naturally negative: The growth effects of natural disasters, *Journal of Development Economics* 111, 92–106.

Fisman, Raymond, and Yongxiang Wang, 2010, Trading Favors within Chinese Business Groups, *American Economic Review* 100, 429–433.

Gofman, Michael, and Youchang Wu, 2022, Trade Credit and Profitability in Production Networks, *Journal of Financial Economics* 143, 593–618.

Gopalan, Radhakrishnan, Vikram Nanda, and Amit Seru, 2007, Affiliated Firms and Financial Support: Evidence from Indian Business Groups, *Journal of Financial Economics* 86, 759–795.

Gopalan, Radhakrishnan, Vikram Nanda, and Amit Seru, 2014, Internal Capital Market and Dividend Policies: Evidence From Business Groups, *The Review of Financial Studies* 27, 1102–1142.

Gormley, Todd A., and David A. Matsa, 2011, Growing Out of Trouble? Corporate Responses to Liability Risk, *The Review of Financial Studies* 24, 2781–2821.

Gormley, Todd A., and David A. Matsa, 2016, Playing it safe? Managerial preferences, risk, and agency conflicts, *Journal of Financial Economics* 122, 431–455.

Guillén, Mauro F., and Laurence Capron, 2016, State Capacity, Minority Shareholder Protections, and Stock Market Development, *Administrative Science Quarterly* 61, 125–160.

Hadlock, Charles J., and Joshua R. Pierce, 2010, New Evidence on Measuring Financial Constraints: Moving Beyond the KZ Index, *The Review of Financial Studies* 23, 1909–1940.

Hamdani, Assaf, Konstantin Kosenko, and Yishay Yafeh, 2020, Regulatory Measures to Dismantle Pyramidal Business Groups: Evidence from the United States, Japan, Korea and Israel, ECGI Law Working Paper No. 542/2020, European Corporate Governance Institute.

Helper, Susan R., and Mari Sako, 1995, Supplier Relations in Japan and the United States: Are They Converging?, *MIT Sloan Management Review* .

Hoshi, Takeo, Anil Kashyap, and David Scharfstein, 1991, Corporate Structure, Liquidity, and Investment: Evidence from Japanese Industrial Groups, *The Quarterly Journal of Economics* 106, 33–60.

Im, Jieun, and Woojin Kim, 2024, Supply Chain within Business Groups: Do Families Prefer Upstream or Downstream Firms?, Working Paper No. 963/2024.

Jain, Neelam, 2001, Monitoring costs and trade credit, *The Quarterly Review of Economics and Finance* 41, 89–110.

Johnson, Simon, Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Shleifer, 2000, Tunneling, *The American Economic Review* 90, 22–27.

Khanna, Tarun, and Krishna Palepu, 1999, Policy Shocks, Market Intermediaries, and Corporate Strategy: The Evolution of Business Groups in Chile and India, *Journal of Economics & Management Strategy* 8, 271–310.

Khanna, Tarun, and Yishay Yafeh, 2005, Business Groups and Risk Sharing around the World, *The Journal of Business* 78, 301–340.

Khanna, Tarun, and Yishay Yafeh, 2007, Business Groups in Emerging Markets: Paragons or Parasites?, *Journal of Economic Literature* 45, 331–372.

Kim, Hicheon, 2010, Business Groups in South Korea, in Asli M. Colpan, Takashi Hikino, and James R. Lincoln, eds., *The Oxford Handbook of Business Groups*, 0 (Oxford University Press).

La Porta, Rafael, Florencio Lopez-De-Silanes, and Andrei Shleifer, 1999, Corporate Ownership Around the World, *The Journal of Finance* 54, 471–517.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert Vishny, 2002, Investor Protection and Corporate Valuation, *The Journal of Finance* 57, 1147–1170.

Lemmon, Michael L., and Karl V. Lins, 2003, Ownership Structure, Corporate Governance, and Firm Value: Evidence from the East Asian Financial Crisis, *The Journal of Finance* 58, 1445–1468.

Levine, Ross, Chen Lin, and Wensi Xie, 2018, Corporate Resilience to Banking Crises: The Roles of Trust and Trade Credit, *Journal of Financial and Quantitative Analysis* 53, 1441–1477.

Lewellen, Wilbur G., 1971, A Pure Financial Rationale for the Conglomerate Merger, *The Journal of Finance* 26, 521–537.

Li, Xiao, Jeffrey Ng, and Walid Saffar, 2021, Financial Reporting and Trade Credit: Evidence from Mandatory IFRS Adoption, *Contemporary Accounting Research* 38, 96–128.

Mahmood, Ishtiaq P., Hongjin Zhu, and Edward J. Zajac, 2011, Where can capabilities come from? network ties and capability acquisition in business groups, *Strategic Management Journal* 32, 820–848.

Masulis, Ronald W., and Shawn Mobbs, 2011, Are All Inside Directors the Same? Evidence from the External Directorship Market, *The Journal of Finance* 66, 823–872.

Masulis, Ronald W., Peter K. Pham, and Jason Zein, 2011, Family Business Groups around the World: Financing Advantages, Control Motivations, and Organizational Choices, *The Review of Financial Studies* 24, 3556–3600.

Masulis, Ronald W., Peter K. Pham, and Jason Zein, 2020, Family Business Group Expansion Through IPOs: The Role of Internal Capital Markets in Financing Growth While Preserving Control, *Management Science* 66, 5191–5215.

Masulis, Ronald W., Peter K. Pham, Jason Zein, and Alvin E. S. Ang, 2023, Crises as Opportunities for Growth: The Strategic Value of Business Group Affiliation, *Journal of Financial and Quantitative Analysis* 58, 1508–1546.

Mena, Carlos, Andrew Humphries, and Thomas Y. Choi, 2013, Toward a Theory of Multi-Tier Supply Chain Management, *Journal of Supply Chain Management* 49, 58–77.

Morck, Randall, 2010, The Riddle of the Great Pyramids, in Asli M. Colpan, Takashi Hikino, and James R. Lincoln, eds., *The Oxford Handbook of Business Groups*, 602–628 (Oxford University Press).

Morck, Randall, Daniel Wolfenzon, and Bernard Yeung, 2005, Corporate Governance, Economic Entrenchment, and Growth, *Journal of Economic Literature* 43, 655–720.

Murfin, Justin, and Ken Njoroge, 2015, The Implicit Costs of Trade Credit Borrowing by Large Firms, *The Review of Financial Studies* 28, 112–145.

Noy, Ilan, 2009, The Macroeconomic Consequences of Disasters, *Journal of Development Economics* 88, 221–231.

OECD, 2020, *Duties and Responsibilities of Boards in Company Groups*, Corporate Governance (OECD Publishing, Paris).

Pankratz, Nora M. C., and Christoph Schiller, 2021, Climate Change and Adaptation in Global Supply-Chain Networks, SSRN Scholarly Paper 3475416, Social Science Research Network, Rochester, NY.

Petersen, Mitchell A., and Raghuram G. Rajan, 1997, Trade Credit: Theories and Evidence, *The Review of Financial Studies* 10, 661–691.

Ring, Peter Smith, and Andrew H. van de Ven, 1992, Structuring Cooperative Relationships between Organizations, *Strategic Management Journal* 13, 483–498.

Riyanto, Yohanes E., and Linda A. Toolsema, 2008, Tunneling and propping: A justification for pyramidal ownership, *Journal of Banking & Finance* 32, 2178–2187.

Santioni, Raffaele, Fabio Schiantarelli, and Philip E. Strahan, 2020, Internal Capital Markets in Times of Crisis: The Benefit of Group Affiliation, *Review of Finance* 24, 773–811.

Siegel, Jordan, and Prithwiraj Choudhury, 2012, A Reexamination of Tunneling and Business Groups: New Data and New Methods, *Review of Financial Studies* 25, 1763–1798.

Smith, Janet Kiholm, 1987, Trade Credit and Informational Asymmetry, *The Journal of Finance* 42, 863–872.

Yang, S. Alex, and John R. Birge, 2018, Trade Credit, Risk Sharing, and Inventory Financing Portfolios, *Management Science* 64, 3667–3689.

Table 1: Internal Trading Partners of Business Groups

This table reports business group statistics for each of the 45 economies. *No. of Groups* is the total number of business groups in the sample for each country. *Avg Group Size* is the average number of firms in a business group. % *Int. Supp.* and % *Int. Cust.* report the average proportion of internal suppliers (customers) for each group firm. These percentages are calculated by dividing the number of internal suppliers (customers) by the total number of suppliers (customers) in a given year.

	No. of	Avg	Business Groups		Family Groups		Non-family Groups	
Markets	Groups	Group Size	% Int. Splr.	% Int. Cust.	% Int. Splr.	% Int. Cust.	% Int. Splr.	% Int. Cust.
Panel A: Emerging Capital Markets								
Argentina	11	4.31	13.13	5.51	17.56	7.63	6.63	2.41
Brazil	29	3.38	4.06	7.46	2.55	8.19	5.77	6.65
Chile	25	4.23	9.86	6.61	10.84	7.21	5.37	3.88
Colombia	4	4.25	12.10	3.59	12.10	3.59		
Czech Republic	2	6.00	0.00	2.19			0.00	2.19
Hungary	2	3.27	22.59	22.12			22.59	22.12
India	95	4.78	8.24	9.91	6.73	8.58	15.86	16.65
Indonesia	47	5.46	16.53	18.01	14.97	17.36	27.14	22.42
Israel	29	3.01	2.31	4.57	2.08	4.83	6.32	0.00
Malaysia	52	3.57	12.72	13.90	14.23	16.44	9.78	8.94
Mexico	13	3.87	3.88	14.07	4.04	14.61	0.00	0.00
Pakistan	17	3.61	10.67	18.64	17.08	26.19	4.66	11.57
Peru	13	4.11	8.66	4.08	11.34	2.31	5.92	5.88
Philippines	27	4.16	7.46	6.11	6.56	6.10	13.90	6.18
Poland	17	2.68	13.85	14.57	4.88	5.64	28.95	29.61
South Africa	20	3.78	1.56	1.46	0.55	2.91	2.36	0.29
South Korea	109	5.34	12.01	12.84	12.62	13.41	4.56	5.82
Sri Lanka	12	2.23	4.70	5.90	3.13	4.93	7.44	7.59
Taiwan (China)	60	5.14	9.27	11.16	9.41	11.02	8.16	12.23
Thailand	56	4.08	15.47	16.90	14.97	15.79	16.70	19.65
Turkey	29	4.89	24.55	28.08	23.80	25.30	27.88	40.28
Venezuela	1	1.00	0.00	0.00	0.00	0.00		
Average	30	3.96	9.71	10.35	9.47	10.10	11.00	11.22
Panel B: Developed Capital Markets								
Australia	27	4.16	0.24	5.74	0.00	6.25	0.36	5.47
Austria	7	2.63	0.57	2.71	0.00	0.00	0.74	3.58
Belgium	18	3.46	0.67	3.30	0.06	2.03	1.72	5.46
Canada	27	2.61	3.36	4.45	3.79	4.31	1.28	5.16
Denmark	7	1.89	1.15	0.87	0.00	0.00	3.38	2.55
Finland	6	2.32	0.65	0.06	0.00	0.13	1.20	0.00
France	44	4.13	1.34	1.82	1.59	2.92	1.05	0.52
Germany	37	5.66	5.72	6.83	5.10	4.63	6.28	8.78
Greece	10	2.07	26.60	16.86	30.74	18.69	1.16	5.65
Hong Kong (China)	54	3.82	15.49	28.62	16.15	29.78	4.77	9.72
Ireland	1	3.00	0.00	0.00			0.00	0.00
Italy	30	3.14	10.42	11.52	14.32	10.24	3.42	13.80
Japan	160	7.63	8.54	10.66	4.30	6.23	9.05	11.20
Netherlands	9	6.73	4.28	4.48	14.28	15.44	0.29	0.11
New Zealand	1	2.00	0.00	3.66	0.00	3.66		
Norway	17	2.90	7.77	8.69	10.63	10.77	0.17	3.14
Portugal	7	2.54	2.78	4.37	0.00	5.95	3.92	3.72
Singapore	27	2.85	5.43	5.53	8.19	8.85	1.43	0.75
Spain	17	5.40	2.92	5.30	0.58	3.79	4.45	6.29
Sweden	19	4.42	4.41	2.91	2.04	0.26	20.44	20.86
Switzerland	22	4.75	3.82	5.14	5.62	5.08	1.55	5.21
United Kingdom	36	5.37	2.68	6.50	4.78	3.57	0.71	9.25
United States	148	4.23	2.33	3.25	1.70	3.21	2.87	3.28
Average	32	3.81	4.83	6.23	5.63	6.63	3.19	5.66
Average	31	3.89	7.22	8.24	7.46	8.28	6.91	8.31

Table 2: Frequency of the suppliers and customers within business groups

This table reports the role of group-affiliated firms in the sample. *Supplier* is defined as the group affiliated firms with same-group customers in a given year. *Customer* is defined as the group-affiliated firms with same-group suppliers. *Neither* is the group affiliated firms without same-group customers nor same-group suppliers. Panel A reports the number of groups and the average proportion of group firms as *Supplier*, *Customer*, and *Neither* for each group in the sample for four categories of business groups. Panel B separately reports the number of observations and proportions of each category for family groups and non-family groups. Panel C separately presents the number of observations and proportions of suppliers and customers at different levels of control pyramids for group firms in the pyramidal structure.

Panel A: Group Level Statistics

		Proportion of Group Firms (Mean)		
Group Type	No.of Groups	Supplier %	Customer %	Neither %
Family Groups	756	37.40	37.67	49.90
Nonfamily Keiretsu Groups	196	39.57	36.74	50.56
Other Nonfamily Groups	138	27.03	28.96	60.89

Panel B: Frequency of suppliers and customers in family vs non-family groups

	Group Type							
	Family Groups		Nonfamily Keiretsu Groups		Other Nonfamily Groups		Total	
	No.	Percent.	No.	Percent.	No.	Percent.	No.	Percent.
Supplier	4,503	37.4%	2,185	39.6%	618	27.0%	7,306	36.8%
Customer	4,536	37.7%	2,029	36.7%	662	29.0%	7,227	36.4%
Neither	6,009	49.9%	2,792	50.6%	1,392	60.9%	10,193	51.4%

Panel C: Frequency of suppliers and customers within pyramidal groups

	Pyramidal Group Firms							
	Apex Firms		Middle Firms		Bottom Firms		Total	
	No.	Percent.	No.	Percent.	No.	Percent.	No.	Percent.
Supplier	2,073	39.1%	1,064	49.4%	2,158	45.6%	5,295	43.5%
Customer	2,064	38.9%	1,103	51.2%	2,023	42.8%	5,190	42.6%
Neither	2,513	47.4%	799	37.1%	2,031	42.9%	5,343	43.8%

Table 3: Summary Statistics

This table reports summary statistics of the main variables. *BG With Internal Supplier* is the category where the focal firm is a business group-affiliated firm (BG firm) and has group-affiliated supplier(s) within the same business group. *BG Without Internal Supplier* is the category where the focal firm is a BG firm and does not have any supplier within the same business group (i.e., all of its suppliers are standalone firms or affiliated with other business groups). *SA With BG Supplier* is the category where the focal firm is a standalone firm and has group-affiliated supplier(s). *SA Without BG Supplier* is the category where the focal firm is a standalone firm and does not have any group-affiliated supplier. $BG\ Importance_{supplier}$ measures the relative importance of the business group supplier(s) to the focal firm. For a focal firm as a customer, this measure is calculated as the proportion of the total sales in USD of its within-same-group supplier(s) to the total sales in USD of all of its suppliers. By definition, the measure is only positive when the firm belongs to *BG With Internal Supplier* category. Detailed description of other variables are listed in A.1.

	count	mean	p25	p50	p75	sd
BG With Internal Supplier						
AP/COGS	3,830	0.205	0.108	0.160	0.238	0.295
AP/Sales	3,830	0.135	0.075	0.112	0.162	0.168
Size	3,830	21.426	19.842	21.191	22.940	2.022
Age	3,829	3.268	3.045	3.332	3.526	0.470
Sales Growth	3,830	0.065	-0.043	0.037	0.128	0.269
Leverage	3,829	0.226	0.075	0.213	0.341	0.174
Cash	3,830	0.145	0.060	0.114	0.201	0.120
Tangibility	3,830	0.324	0.195	0.305	0.435	0.173
BG Importance	3,365	0.578	0.390	0.645	0.821	0.256
BG Without Internal Supplier						
AP/COGS	6,110	0.221	0.107	0.166	0.237	0.427
AP/Sales	6,110	0.139	0.073	0.113	0.165	0.178
Size	6,110	20.556	19.396	20.463	21.769	1.767
Age	6,082	3.188	2.944	3.296	3.466	0.501
Sales Growth	6,110	0.051	-0.054	0.031	0.119	0.285
Leverage	6,099	0.238	0.084	0.220	0.354	0.188
Cash	6,110	0.153	0.054	0.115	0.210	0.141
Tangibility	6,107	0.310	0.170	0.293	0.432	0.179
BG Importance	6,110	0.000	0.000	0.000	0.000	0.000
SA With BG Supplier						
AP/COGS	21,377	0.286	0.109	0.166	0.246	0.722
AP/Sales	21,366	0.149	0.063	0.101	0.153	0.324
Size	21,376	20.358	19.054	20.295	21.627	1.920
Age	21,234	2.928	2.565	3.091	3.434	0.747
Sales Growth	21,377	0.088	-0.046	0.041	0.143	0.378
Leverage	21,346	0.231	0.071	0.210	0.341	0.192
Cash	21,373	0.189	0.064	0.137	0.256	0.172
Tangibility	21,368	0.264	0.119	0.232	0.378	0.179
BG Importance	21,377	0.000	0.000	0.000	0.000	0.000
SA Without BG Supplier						
AP/COGS	18,148	0.344	0.106	0.167	0.265	0.878
AP/Sales	18,136	0.193	0.063	0.105	0.168	0.464
Size	18,147	19.007	17.955	19.073	20.094	1.601
Age	17,734	2.714	2.303	2.890	3.296	0.808
Sales Growth	18,148	0.121	-0.055	0.044	0.167	0.489
Leverage	18,092	0.222	0.045	0.182	0.333	0.211
Cash	18,146	0.200	0.060	0.147	0.279	0.186
Tangibility	18,133	0.271	0.124	0.243	0.385	0.187
BG Importance	18,148	0.000	0.000	0.000	0.000	0.000
Total						
AP/COGS	49,465	0.293	0.108	0.166	0.250	0.734
AP/Sales	49,442	0.163	0.065	0.105	0.161	0.362
Size	49,463	19.969	18.673	19.871	21.209	1.961
Age	48,879	2.909	2.565	3.091	3.401	0.750
Sales Growth	49,465	0.094	-0.050	0.040	0.146	0.407
Leverage	49,366	0.228	0.062	0.201	0.341	0.197
Cash	49,459	0.185	0.061	0.135	0.253	0.172
Tangibility	49,438	0.277	0.131	0.250	0.393	0.183
BG Importance	49,000	0.040	0.000	0.000	0.000	0.161

Table 4: Comparison between Actual vs "Pseudo" Group Firms Forming Same-group Supply Chain Relationships

The table reports the probability of a group firm to form a same-group customer-supplier relationship. The sample is composed of actual group firms and "pseudo group" firms. We create a "pseudo" group for each corresponding group by forming a group of standalone firms that are in the same country and 2-digit SIC industry, and share otherwise similar firm-level observables (size, age, sales growth, leverage, cash, and tangibility) as each of the group firms. *Actual Group* is an indicator variable that equals one for actual group firms, and zero otherwise. The dependent variables are *I.BG-BG*, which indicates group firms with same-group supplier/customer, and BG_Splr (BG_Cust), which measures the relative importance of the group supplier(s)/customer(s) to the focal firm. Detailed variable descriptions are in appendix A.1. Panel A (B) presents the probability of actual and matched "pseudo" group firms having suppliers (customers) from the same group and the corresponding importance measure attached to these same-group suppliers (customers). Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Same-group Suppliers

Dep. Var. =	I.BG-BG		BG_Splr	
	(1)	(2)	(3)	(4)
Actual Group	0.301***	0.303***	0.179***	0.181***
	(24.42)	(24.57)	(23.47)	(23.96)
Country-Industry-Year FE	✓		✓	
Country-Year FE		✓		✓
Industry-Year FE		✓		✓
Obs.	16,733	16,838	16,289	16,408

Panel B: Same-group Customers

Dep. Var. =	I.BG-BG		BG_Cust	
	(1)	(2)	(3)	(4)
Actual Group	0.340***	0.337***	0.226***	0.225***
	(24.39)	(24.71)	(22.78)	(23.47)
Country-Industry-Year FE	✓		✓	
Country-Year FE		✓		✓
Industry-Year FE		✓		✓
Obs.	13,927	14,199	13,348	13,634

Table 5: Same-group Supplier and Trade Credit (AP/COGS)

This table presents results on the effect of having a BG supplier on a firm's trade credit from 2013–2021. The dependent variable, trade credit, is measured by accounts payable divided by the cost of goods sold. *I.BG-BG*, *I.BG-NBG*, and *I.SA-BG* are dummy variables that represent group firms with internal supplier(s), without internal supplier(s), and standalone firms with group supplier(s), respectively. *BG Importance* measures the relative importance of the business group supplier(s) to the focal firm. Detailed variable descriptions are in Appendix A.1. Columns (1) to (4) present baseline results for firms in manufacturing industries only (SIC 2000-3999) . Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Trade Credit = AP/COGS	Manufacturing			
	(1)	(2)	(3)	(4)
I.BG-BG	0.095***	0.092***		
	(5.66)	(5.82)		
I.BG-NBG	0.017	0.021		
	(1.07)	(1.43)		
I.SA-BG	0.026*	0.021		
	(1.73)	(1.49)		
BG Importance			0.114***	0.119***
			(6.51)	(6.90)
Size	-0.038***	-0.037***	-0.036***	-0.035***
	(-7.61)	(-7.89)	(-7.66)	(-8.00)
$Sales\ Growth_{Pos}$	0.318***	0.332***	0.316***	0.330***
	(10.95)	(11.80)	(10.87)	(11.75)
$Sales\ Growth_{Neg}$	-1.421***	-1.432***	-1.424***	-1.435***
	(-15.77)	(-16.52)	(-15.71)	(-16.45)
Tangibility	-0.015	-0.016	-0.023	-0.023
	(-0.34)	(-0.40)	(-0.52)	(-0.59)
Leverage	0.415***	0.438***	0.418***	0.441***
	(7.80)	(8.58)	(7.80)	(8.60)
Cash	0.675***	0.726***	0.683***	0.733***
	(8.48)	(9.17)	(8.51)	(9.21)
Country-Industry-Year FE	✓		✓	
Country-Year FE		✓		✓
Industry-Year FE		✓		✓
Obs.	48,011	49,509	47,536	49,039

Table 6: Less Cash BG Firms and Same-group Supplier

This table presents results on the effect of having a BG supplier on a firm's trade credit from. The dependent variable, trade credit, is measured by accounts payable divided by the cost of goods sold. *I.BG-BG*, *I.BG-NBG*, and *I.SA-BG* are dummy variables that represent group firms with internal supplier(s), without internal supplier(s), and standalone firms with group supplier(s), respectively. *BG Importance* measures the relative importance of the business group supplier(s) to the focal firm. Detailed variable descriptions are in appendix A.1. The sample consists of business group firms in the manufacturing industries (SIC 2000-3999) from 2013 to 2021. Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Dep. Var. = Trade Credit	Manufacturing			
	(1)	(2)	(3)	(4)
LessCash × *I.BG-BG*	0.093***	0.081***		
	(3.94)	(3.70)		
LessCash × *I.BG-NBG*	0.041	0.038		
	(1.52)	(1.57)		
LessCash × *I.SA-BG*	-0.006	-0.003		
	(-0.25)	(-0.11)		
BG Importance			0.060***	0.077***
			(2.86)	(3.73)
LessCash × *BG Importance*			0.113***	0.099***
			(4.34)	(3.95)
I.BG-BG	0.051**	0.057***		
	(2.57)	(3.07)		
I.BG-NBG	-0.002	0.005		
	(-0.10)	(0.23)		
I.SA-BG	0.034	0.027		
	(1.53)	(1.29)		
LessCash	-0.084***	-0.071***	-0.079***	-0.066***
	(-4.33)	(-3.96)	(-6.84)	(-5.97)
Firm Controls	✓	✓	✓	✓
Country-Industry-Year FE	✓		✓	
Country-Year FE		✓		✓
Industry-Year FE		✓		✓
Obs.	47,400	48,878	46,929	48,414

Table 7: Financially Constrained BG Firms and Same-group Supplier

This table presents results on the effect of having a BG supplier on a firm's trade credit. The dependent variable, trade credit, is measured by accounts payable divided by the cost of goods sold. *I.BG-BG*, *I.BG-NBG*, and *I.SA-BG* are dummy variables that represent group firms with internal supplier(s), without internal supplier(s), and standalone firms with group supplier(s), respectively. *Finl.Const.* is an indicator equal to 1 if the focal firm has a value in the top tercile of the Hadlock-Pierce (size-age) financial constraints indices. Detailed variable descriptions are in appendix A.1. The sample consists of business group firms in the manufacturing industries (SIC 2000-3999) from 2013 to 2021. Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Dep. Var. = Trade Credit	Manufacturing			
	(1)	(2)	(3)	(4)
Finl.Const. × *I.BG-BG*	0.070**	0.060**		
	(2.51)	(2.29)		
Finl.Const. × *I.BG-NBG*	0.039	0.033		
	(1.33)	(1.22)		
Finl.Const. × *I.SA-BG*	0.004	0.006		
	(0.16)	(0.24)		
BG Importance			0.071***	0.077***
			(3.13)	(3.31)
Finl. Const. × *BG Importance*			0.059**	0.057**
			(2.12)	(2.08)
I.BG-BG	0.055***	0.057***		
	(3.04)	(3.32)		
I.BG-NBG	0.001	0.007		
	(0.04)	(0.40)		
I.SA-BG	0.023	0.017		
	(1.35)	(1.07)		
Finl. Const.	0.050**	0.052**	0.062***	0.063***
	(2.01)	(2.43)	(3.54)	(4.82)
Firm Controls	✓	✓	✓	✓
Country-Industry-Year FE	✓		✓	
Country-Year FE		✓		✓
Industry-Year FE		✓		✓
Obs.	47,424	48,925	46,951	48,456

Table 8: Group Firms and the Impact of Major Natural Disasters

This table presents results on the effect of having a BG supplier on a firm's trade credit when the focal firm gets hit by natural disasters. The dependent variable, trade credit, is measured by accounts payable divided by the cost of goods sold. $I.Disaster50$ ($I.Disaster100$) is a dummy indicates that the firm is located within 50(100)km of the disaster-affected area. $I.BG\text{-}BG$, $I.BG\text{-}NBG$, and $I.SA\text{-}BG$ are dummy variables represent group firms with internal supplier(s), without internal supplier(s), and standalone firms with group supplier(s), respectively. *BG Importance* measures the relative importance of the business group supplier(s) to the focal firm. Detailed variable descriptions are in appendix A.1. The sample includes firms in manufacturing industries (SIC 2000-3999) in the pre-covid period (2013–2019). Columns (1) to (4) present results from Diff-In-Diff regressions, and Columns (5) to (8) present results from stacked Diff-In-Diff regressions with a three-year window ($[t-1,\ t+1]$). Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Dep. Var. = Trade Credit	DID				Stacked DID			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$I.Disaster50 \times I.BG\text{-}BG$	0.064	0.071*			0.071	0.078*		
	(1.52)	(1.79)			(1.56)	(1.80)		
$I.Disaster50 \times I.BG\text{-}NBG$	0.033	0.030			0.039	0.041		
	(0.89)	(0.90)			(0.98)	(1.14)		
$I.Disaster50 \times I.SA\text{-}BG$	0.042	0.037			0.040	0.037		
	(1.15)	(1.03)			(1.06)	(1.01)		
$I.Disaster100 \times I.BG\text{-}BG$			0.061	0.066*			0.073*	0.078**
			(1.61)	(1.85)			(1.77)	(1.99)
$I.Disaster100 \times I.BG\text{-}NBG$			0.039	0.033			0.046	0.043
			(1.15)	(1.04)			(1.25)	(1.29)
$I.Disaster100 \times I.SA\text{-}BG$			0.055	0.049			0.057	0.053
			(1.52)	(1.37)			(1.55)	(1.48)
$I.Disaster50$	-0.033	-0.032			-0.024	-0.026		
	(-0.94)	(-0.94)			(-0.66)	(-0.74)		
$I.DisasterHitSupp50$	0.029*	0.030**			0.027*	0.030**		
	(1.92)	(2.24)			(1.73)	(2.04)		
$I.Disaster100$			-0.044	-0.041			-0.040	-0.040
			(-1.36)	(-1.31)			(-1.21)	(-1.26)
$I.DisasterHitSupp100$			0.028*	0.030**			0.026*	0.028*
			(1.92)	(2.19)			(1.70)	(1.96)
$I.BG\text{-}BG$	0.086***	0.080***	0.086***	0.080***	0.077***	0.070***	0.077***	0.070***
	(4.46)	(4.47)	(4.44)	(4.46)	(3.97)	(3.92)	(3.91)	(3.84)
$I.BG\text{-}NBG$	0.018	0.018	0.018	0.017	0.019	0.018	0.021	0.021
	(1.03)	(1.06)	(0.99)	(1.03)	(0.93)	(0.97)	(1.01)	(1.13)
$I.SA\text{-}BG$	0.022	0.015	0.020	0.014	0.023	0.016	0.023	0.016
	(1.22)	(0.91)	(1.16)	(0.85)	(1.31)	(1.01)	(1.27)	(0.96)
Country-Industry-Year FE	✓		✓					
Country-Year FE		✓		✓				
Industry-Year FE		✓		✓				
Country-Year-Cohort FE						✓		✓
Country-Industry-Year-Cohort FE					✓		✓	
Industry-Year-Cohort FE						✓		✓
Obs.	33,777	34,936	33,777	34,936	93,391	96,764	92,678	96,051

Table 9: Trade Credit and Other Internal Capital

This table reports the effect of having same-group supplier(s) and receiving intragroup internal capital on a group firm's trade credit. The dependent variable, trade credit, is measured by accounts payable divided by the cost of goods sold. *I.BG-BG* represents group firms with same-group suppliers. The omitted dummy variable is *I.BG-NBG*, which represents group firms without same-group suppliers. *I.GroupIAF* indicates the group firm receiving positive capital from other affiliates within the same group. *Bottom* indicates the firm is located in the lowest level in a pyramidal group. Detailed variable descriptions are in Appendix A.1. The sample consists of business group firms in the manufacturing industries (SIC 2000-3999) from 2013 to 2021. Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Dep. Var. = Trade Credit	Pyramidal		Horizontal		Pyramidal	
	(1)	(2)	(3)	(4)	(5)	(6)
I.BG-BG × *I.GroupIAF*	-0.026*	-0.028*	0.015	0.012	-0.050**	-0.057***
	(-1.68)	(-1.77)	(0.50)	(0.53)	(-2.55)	(-2.77)
I.BG-BG	0.026	0.029*	-0.023	-0.024	0.045**	0.050**
	(1.64)	(1.84)	(-1.17)	(-1.41)	(2.21)	(2.34)
I.GroupIAF	0.021*	0.022**	-0.006	-0.004	0.016	0.022**
	(1.69)	(2.17)	(-0.14)	(-0.17)	(1.14)	(1.97)
I.BG-BG × *I.GroupIAF* × *Bottom*					0.076**	0.090**
					(1.99)	(2.51)
I.BG-BG × *Bottom*					-0.059*	-0.063**
					(-1.87)	(-2.05)
I.GroupIAF × *Bottom*					0.010	-0.008
					(0.37)	(-0.35)
Bottom					-0.024	-0.022
					(-1.14)	(-1.13)
Firm Controls	✓	✓	✓	✓	✓	✓
Country-Industry-Year FE	✓		✓		✓	
Country-Year FE		✓		✓		✓
Industry-Year FE		✓		✓		✓
Obs.	8,664	9,350	4,002	4,482	8,664	9,350

Table 10: Minority Shareholder Protection and Trade Credit in Group Firms

This table reports the effect of having same-group supplier(s) and receiving intragroup internal capital on a group firm's trade credit. The sample consists of group firms in manufacturing industries (SIC 2000-3999) from 2013–2021. Columns (1) to (2) represent subsamples from countries with high minority shareholder protection, while Columns (3) and (4) represent subsamples from countries with low minority shareholder protection. The dependent variable, trade credit, is measured by accounts payable divided by the cost of goods sold. *I.BG-BG* represents group firms with same-group suppliers. The omitted dummy variable is *I.BG-NBG*, which represents group firms without same-group suppliers. Detailed variable descriptions are in Appendix A.1. Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Good Minority Protection		Poor Minority Protection	
	(1)	(2)	(3)	(4)
I.BG-BG	0.037**	0.035**	0.001	0.003
	(2.18)	(2.00)	(0.04)	(0.15)
Country-Industry-Year FE	✓		✓	
Country-Year FE		✓		✓
Industry-Year FE		✓		✓
Obs.	4,558	4,800	3,099	3,762

Table 11: Customer-Supplier Pair Analysis

This table reports the regression estimation for the equation below for a sample of firm pairs consisting of customers i and suppliers j in manufacturing industries.

$$Tobin's\ Q_{i,t} = \beta_0 + \beta_1 \times Tobin's\ Q_{j,t} + \beta_2 \times Tobin's\ Q_{j,t} \times I.BG\text{-}BG + X_i + \lambda_{i,j} + \lambda_{ctry,ind,t} + \epsilon_{i,j,t},$$

where i represents customer firm and j represents supplier firm. Columns (1) and (2) include a subsample of firm pairs characterized by excessive trade credit, where both the supplier j has above-median accounts receivable scaled by sales and the customer i has above-median accounts payable scaled by the cost of goods sold. Columns (3) and (4) report a subsample of customer-supplier firm pairs not characterized by excessive trade credit. The sample consists of group firms in manufacturing industries (SIC 2000-3999) from 2013–2021. Detailed variable descriptions are in Appendix A.1. Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Dep. Var. $= Q_{i,t}$	Excessive TC		NonExcessive TC	
	(1)	(2)	(3)	(4)
$Q_j \times I.BG\text{-}BG$	0.350***	0.298***	0.010	0.030
	(3.15)	(2.72)	(0.64)	(1.42)
Q_j	0.009**	0.010**	0.012***	0.015***
	(2.21)	(2.49)	(5.76)	(6.22)
Pair FE	✓	✓	✓	✓
Country-Industry-Year FE	✓		✓	
Industry-Year FE		✓		✓
Country-Year FE		✓		✓
Obs.	76,876	77,339	451,442	451,921

Table 12: Group and Matched Standalone Customer Firms of Group Suppliers

This table presents the results of the matched sample consisting of business group firms with same-group suppliers, and standalone firms with business group suppliers whose customers include same-group firms. $I.BG$ takes the value of one when it is a BG firm with same-group supplier, and takes the value of zero when it is a standalone firm with group-affiliated suppliers who have same-group customers. The matched control firms are drawn from all these standalone firms in the same country and 2-digit SIC industry in the same year, and are the nearest neighbor match based on firm characteristics. Matching covariates for Panel A include: $Size$, $SalesGrowth$, Age, $Tangibility$, $Leverage$, and $Cash$. Panel B sample is matched based on $Size$ only. Figure 2 illustrates our empirical setting under this analysis. The dependent variable, trade credit, is measured by accounts payable divided by the cost of goods sold. $I.FamBG$, and $I.NonfamBG$ are dummy variables represent family and non-family group firms with internal suppliers. Detailed variable description are in appendix A.1. The sample consists of business group firms in the manufacturing industries (SIC 2000-3999) from 2013 to 2021. Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Matched on Multiple Covariates

Dep. Var. = Trade Credit	Manufacturing			
	(1)	(2)	(3)	(4)
$I.BG$	0.018**	0.018**		
	(2.11)	(1.99)		
$I.FamBG\text{-}BG$			0.031***	0.026**
			(2.78)	(2.28)
$I.NonfamBG\text{-}BG$			0.001	0.007
			(0.13)	(0.67)
Country-Industry-Year FE	✓		✓	
Country-Year FE		✓		✓
Industry-Year FE		✓		✓
Obs.	6,346	6,346	6,346	6,346

Panel B: Matched on Size

Dep. Var. = Trade Credit	Manufacturing			
	(1)	(2)	(3)	(4)
$I.BG$	0.022**	0.022**		
	(2.39)	(2.29)		
$I.FamBG\text{-}BG$			0.031**	0.028**
			(2.48)	(2.20)
$I.NonfamBG\text{-}BG$			0.011	0.015
			(1.04)	(1.38)
Country-Industry-Year FE	✓		✓	
Country-Year FE		✓		✓
Industry-Year FE		✓		✓
Obs.	6,357	6,362	6,357	6,362

Figure 1: Construction of Customer-Supplier Relationship Classification Variables

The diagram illustrates the formation of the main four variables corresponding to each focal firm in our sample. Initially, a focal firm is categorized as either a BG-affiliated or a standalone firm. Subsequently, based on the composition of its suppliers, the firm is further classified into one of the four main variables. If a focal BG-affiliated firm has any (zero) same BG-affiliated supplier, then $I.BG - BG$ ($I.BG - NBG$) is equal to one, and zero otherwise. Similarly, if a focal firm is a stand-alone firm that has any (zero) BG-affiliated supplier, $I.SA - BG$ ($I.SA - SA$) is equal to one and zero otherwise.

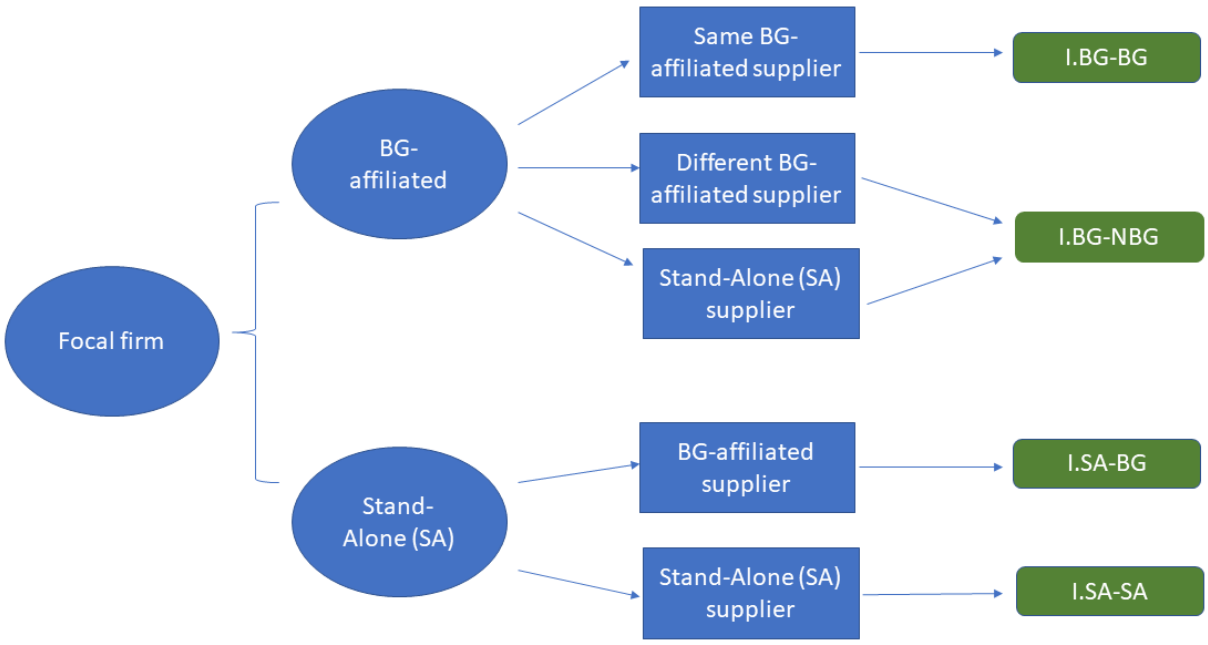
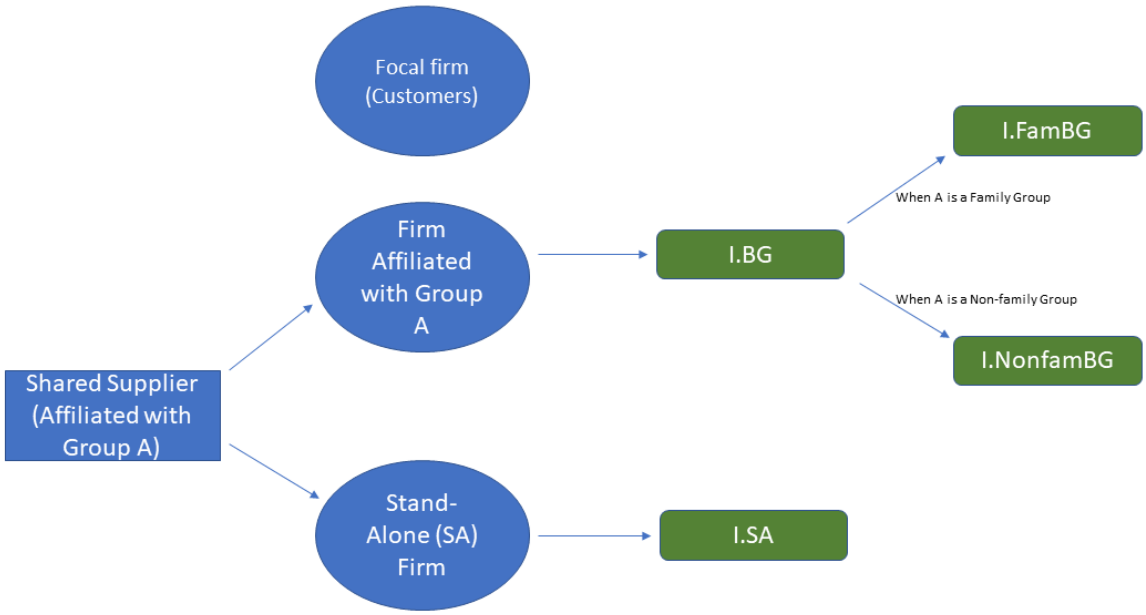


Figure 2: Construction of Overlapping Supplier Analysis

The diagram illustrates the sample of for the analysis on firms with overlapping suppliers. The sample consists of business group firms with same-group suppliers, and standalone firms with business group suppliers whose customers include same-group firms. In this sample, a focal firm is categorized as either a BG-affiliated or a stand-alone firm. $I.BG$ takes the value of one when it is a BG firm with same-group supplier and takes the value of zero when it is a standalone firm with group-affiliated suppliers who have same-group customers.



A Appendix

A.1 Variable Definitions

Supply Chain Relationship Information

Focal Firms as Customers

I.BG-BG: A dummy variable takes one when the focal firm is a business group-affiliated firm (BG firm) and has group-affiliated supplier(s) within the same business group. See Figure 1 for a graphic illustration.

I.BG-NBG: A dummy variable takes one when the focal firm is a BG firm and does not have any supplier within the same business group (i.e., all of its suppliers are standalone firms or affiliated with other business groups). See Figure 1 for a graphic illustration.

I.SA-BG: A dummy variable takes one when the focal firm is a standalone firm and has group-affiliated supplier(s). See Figure 1 for a graphic illustration.

I.SA-SA: A dummy variable takes one when the focal firm is a standalone firm and does not have any group-affiliated supplier. See Figure 1 for a graphic illustration.

BG Importance It measures the relative importance of the business group supplier(s) to the focal firm. For a focal firm as a customer, this measure is calculated as the proportion of the total sales in USD of its within-same-group supplier(s) to the total sales in USD of all of its suppliers. By definition, the measure is only positive when $I.BG - Internal_{supplier}$ takes one.

Trade Credit Measures

AP/COGS: Accounts payable (Worldscope ITEM3040) divided by the cost of goods sold (Worldscope ITEM1051).

AP/Sales: Accounts payable divided by the net sales or revenues (Worldscope ITEM1001).

Firm Characteristics

Size: Natural logarithm of the book value of total assets.

Age: Natural logarithm of the number of years since listing.

Cash: Cash and short-term investments (Worldscope ITEM2001) divided by total assets.

Leverage: Total debt (Worldscope ITEM3255) divided by total assets.

Capex: Capital expenditure (Worldscope ITEM4601) divided by total assets.

Sales Growth: Sales at the end of year t minus sales at the beginning of year t, divided by sales at the beginning of year t.

Sales Growth_Pos: Percentage sales growth if positive, 0 otherwise.

Sales Growth_Neg: Percentage sales growth if negative, 0 otherwise.

Tangibility: Total property, plant, and equipment (Worldscope ITEM2501) divided by total assets.

Tobin's Q: Natural logarithm of the market value of total assets/book value of total assets, where the market value of total assets equals the market value of equity plus book value of assets minus book value of equity, and market value of equity equals the stock price at the end of period t multiplied by the total number outstanding shares.

A.2 Additional Tables

Table A.1: Critical Supplier and Critical Customer Scores Within Group

This table reports the statistics of the critical supplier score and the critical customer score of group affiliated firms in the sample. *Supp.* represents the critical supplier score of the focal firm relative to the group. It is calculated by the number of affiliated firms directly and indirectly supplied by the focal firm, scaled by the total number of potential internal customer firms (the total number of firms of the group - 1). *Cust.* represents the critical customer score of the focal firm relative to the group. It is calculated by the number of affiliated firms directly and indirectly supply to the focal firm, scaled by the total number of potential internal supplier firms (the total number of firms of the group - 1).

	Mean		Median		Sd	
	Supp.	Cust.	Supp.	Cust.	Supp.	Cust.
Business Group Firms						
Family Pyramid Group Firms	0.16	0.16	0.00	0.00	0.30	0.30
Family Horizontal Group Firms	0.09	0.09	0.00	0.00	0.27	0.26
Non-family Pyramid Group Firms	0.16	0.15	0.00	0.00	0.28	0.29
Non-family Horizontal Group Firms	0.11	0.12	0.00	0.00	0.25	0.27
Total	0.14	0.14	0.00	0.00	0.28	0.28
Pyramidal Group Firms						
Apex Firms	0.16	0.15	0.00	0.00	0.30	0.29
Middle Firms	0.16	0.16	0.00	0.00	0.27	0.27
Bottom Firms	0.16	0.16	0.00	0.00	0.30	0.30
Total	0.16	0.16	0.00	0.00	0.29	0.29

Table A.2: Comparison between Actual vs "Pseudo" Group Firms Forming Same-group Supply Chain Relationships (All Industries)

The table reports the probability of a group firm to form a same-group customer-supplier relationship. The sample is composed of actual group firms and "pseudo group" firms. We create a "pseudo" group for each corresponding group by forming a group of standalone firms that are in the same country and 2-digit SIC industry, and share otherwise similar firm-level observables (size, age, sales growth, leverage, cash, and tangibility) as each of the group firms. *Actual Group* is an indicator variable that equals one for actual group firms, and zero otherwise. The dependent variables are *I.BG-BG*, which indicates group firms with same-group supplier/customer, and BG_Splr (BG_Cust), which measures the relative importance of the group supplier(s)/customer(s) to the focal firm. Detailed variable descriptions are in appendix A.1. Panel A (B) presents the probability of actual and matched "pseudo" group firms having suppliers (customers) from the same group and the corresponding importance measure attached to these same-group suppliers (customers). Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Same-group Suppliers

	I.BG-BG		BG_Splr	
	(1)	(2)	(3)	(4)
Actual Group	0.281***	0.283***	0.163***	0.165***
	(28.70)	(29.07)	(27.52)	(28.28)
Country-Industry-Year FE	✓		✓	
Country-Year FE		✓		✓
Industry-Year FE		✓		✓
Obs.	25,725	26,019	25,078	25,416

Panel B: Same-group Customers

	I.BG-BG		BG_Cust	
	(1)	(2)	(3)	(4)
Actual Group	0.325***	0.322***	0.219***	0.216***
	(27.65)	(28.38)	(26.30)	(27.48)
Country-Industry-Year FE	✓		✓	
Country-Year FE		✓		✓
Industry-Year FE		✓		✓
Obs.	20,203	20,965	19,296	20,105

Table A.3: Comparison between Actual vs "Pseudo" Group Firms Forming Same-group Supply Chain Relationships (Matched on Size)

The table reports the probability of a group firm forming a same-group customer-supplier relationship. The sample is composed of actual group firms and "pseudo group" firms. We create a "pseudo" group for each corresponding group by forming a group of standalone firms that are in the same country and 2-digit SIC industry, and share otherwise similar firm-level observables (size, age, sales growth, leverage, cash, and tangibility) as each of the group firms. *Actual Group* is an indicator variable that equals one for actual group firms, and zero otherwise. The dependent variables are *I.BG-BG*, which indicates group firms with same-group supplier/customer, and BG_Splr (BG_Cust), which measures the relative importance of the group supplier(s)/customer(s) to the focal firm. Detailed variable descriptions are in appendix A.1. Panel A (B) presents the probability of actual and matched "pseudo" group firms having suppliers (customers) from the same group and the corresponding importance measure attached to these same-group suppliers (customers). Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Same-group Suppliers

Dep. Var. =	All Industries				Manufacturing			
	I.BG-BG		BG_Splr		I.BG-BG		BG_Splr	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Actual Group	0.234***	0.227***	0.134***	0.129***	0.240***	0.242***	0.149***	0.150***
	(17.13)	(17.46)	(18.43)	(19.81)	(11.96)	(12.06)	(14.31)	(15.49)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year FE	✓		✓		✓		✓	
Country-Year FE		✓		✓		✓		✓
Industry-Year FE		✓		✓		✓		✓
Obs.	26,584	27,349	24,979	25,791	15,466	15,790	14,404	14,740

Panel B: Same-group Customers

Dep. Var. =	All Industries				Manufacturing			
	I.BG-BG		BG_Cust		I.BG-BG		BG_Cust	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Actual Group	0.297***	0.279***	0.217***	0.201***	0.326***	0.316***	0.232***	0.220***
	(16.38)	(17.80)	(18.77)	(21.36)	(14.47)	(16.24)	(15.41)	(16.92)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Country-Industry-Year FE	✓		✓		✓		✓	
Country-Year FE		✓		✓		✓		✓
Industry-Year FE		✓		✓		✓		✓
Obs.	16,222	17,328	15,290	16,444	10,247	10,698	9,677	10,138

Table A.4: Same-group Supplier and Trade Credit (All Industries)

This table presents results on the effect of having a BG supplier on a firm's trade credit from 2013–2021. The dependent variable, trade credit, is measured by accounts payable divided by the cost of goods sold. *I.BG-BG*, *I.BG-NBG*, and *I.SA-BG* are dummy variables that represent group firms with internal supplier(s), without internal supplier(s), and standalone firms with group supplier(s), respectively. *BG Importance* measures the relative importance of the business group supplier(s) to the focal firm. Detailed variable descriptions are in Appendix A.1. Columns (1) to (4) present baseline results for firms in all industries excluding finance (SIC 6000-6999) and service (SIC 7000-8999). Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	All Industries			
	(1)	(2)	(3)	(4)
I.BG-BG	0.059***	0.058***		
	(3.15)	(3.07)		
I.BG-NBG	-0.002	0.004		
	(-0.11)	(0.25)		
I.SA-BG	-0.002	-0.007		
	(-0.14)	(-0.57)		
BG Importance			0.099***	0.102***
			(3.89)	(3.72)
Size	-0.038***	-0.036***	-0.038***	-0.036***
	(-8.61)	(-9.04)	(-9.23)	(-9.82)
$Sales\ Growth_{Pos}$	0.292***	0.296***	0.291***	0.296***
	(13.78)	(14.57)	(13.72)	(14.54)
$Sales\ Growth_{Neg}$	-1.362***	-1.373***	-1.362***	-1.374***
	(-20.01)	(-21.48)	(-19.94)	(-21.39)
Tangibility	0.014	-0.022	0.011	-0.023
	(0.32)	(-0.56)	(0.26)	(-0.57)
Leverage	0.332***	0.334***	0.334***	0.336***
	(7.85)	(8.12)	(7.84)	(8.13)
Cash	0.456***	0.488***	0.459***	0.490***
	(7.02)	(7.04)	(7.01)	(7.04)
Country-Industry-Year FE	✓		✓	
Country-Year FE		✓		✓
Industry-Year FE		✓		✓
Obs.	77,531	81,069	76,852	80,405

Table A.5: Same-group Supplier and Trade Credit (AP/Sales)

This table presents results on the effect of having a BG supplier on a firm's trade credit from 2013–2021. The dependent variable, trade credit, is measured by accounts payable divided by sales. *I.BG-BG*, *I.BG-NBG*, and *I.SA-BG* are dummy variables that represent group firms with internal suppliers, without internal suppliers, and standalone firms with group suppliers, respectively. *BG Importance* measures the relative importance of the business group supplier(s) to the focal firm. Detailed variable descriptions are in appendix A.1. Columns (1) to (4) present baseline results for firms in manufacturing industries only (SIC 2000-3999) and Columns (5) to (8) present baseline results for firms in industries excluding finance (SIC 6000-6999) and service (SIC 7000-8999). Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Manufacturing				All Industries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I.BG-BG	0.057***	0.050***			0.073***	0.070***		
	(5.64)	(5.37)			(6.78)	(7.16)		
I.BG-NBG	0.009	0.009			0.014	0.019**		
	(0.94)	(1.05)			(1.42)	(2.05)		
I.SA-BG	0.006	0.004			0.008	0.005		
	(0.70)	(0.47)			(1.00)	(0.70)		
BG Importance			0.076***	0.070***			0.103***	0.097***
			(6.80)	(6.63)			(7.06)	(7.19)
Size	-0.028***	-0.026***	-0.027***	-0.026***	-0.040***	-0.040***	-0.038***	-0.039***
	(-9.51)	(-9.70)	(-9.82)	(-10.00)	(-14.55)	(-15.67)	(-14.97)	(-16.17)
Sales Growth$_{Pos}$	0.120***	0.132***	0.118***	0.130***	0.130***	0.149***	0.129***	0.148***
	(8.26)	(9.45)	(8.19)	(9.38)	(11.38)	(13.82)	(11.29)	(13.74)
Sales Growth$_{Neg}$	-1.135***	-1.148***	-1.136***	-1.148***	-1.238***	-1.278***	-1.241***	-1.280***
	(-19.82)	(-20.82)	(-19.75)	(-20.72)	(-27.77)	(-30.74)	(-27.73)	(-30.66)
Tangibility	0.036	0.028	0.031	0.024	0.027	0.020	0.024	0.018
	(1.26)	(1.07)	(1.09)	(0.89)	(1.03)	(0.83)	(0.93)	(0.74)
Leverage	0.150***	0.160***	0.151***	0.162***	0.135***	0.115***	0.135***	0.115***
	(5.49)	(6.40)	(5.50)	(6.43)	(5.64)	(5.18)	(5.62)	(5.17)
Cash	0.221***	0.261***	0.223***	0.263***	0.152***	0.205***	0.153***	0.206***
	(5.43)	(6.36)	(5.42)	(6.36)	(4.28)	(5.93)	(4.27)	(5.93)
Country-Industry-Year FE	✓		✓		✓		✓	
Country-Year FE		✓		✓		✓		✓
Industry-Year FE		✓		✓		✓		✓
Obs.	48,792	50,294	48,317	49,824	78,769	82,314	78,088	81,648

Table A.6: Distribution of Major Natural Disaster Events

This table reports the distribution of the number of major natural disaster events identified from EM-DAT.

Country	Year							
	2013	2014	2015	2016	2017	2018	2019	Total
	No.	No.	No.	No.	No.	No.	No.	No.
Argentina	1	0	0	1	0	1	0	3
Australia	1	0	0	0	1	0	0	2
Austria	1	0	0	0	0	0	0	1
Brazil	0	1	0	0	0	0	0	1
Canada	1	0	0	1	0	0	0	2
Chile	1	0	3	0	1	0	0	5
Colombia	0	0	0	0	0	0	0	0
Czech Republic	1	0	0	0	0	0	0	1
France	0	0	0	0	0	0	0	0
Germany	2	0	0	0	0	0	0	2
Greece	0	1	0	0	0	0	0	1
Hong Kong (China)	0	0	0	0	1	0	0	1
Hungary	0	0	0	0	0	0	0	0
India	0	2	1	0	0	0	1	4
Indonesia	1	0	0	0	0	1	0	2
Ireland	0	0	0	0	0	0	0	0
Israel	0	0	0	1	0	0	0	1
Italy	0	0	0	1	0	0	0	1
Japan	0	0	0	2	0	2	2	6
Malaysia	0	0	0	0	0	0	0	0
Mexico	1	1	0	0	2	0	0	4
Netherlands	0	0	0	0	0	0	0	0
New Zealand	1	0	0	1	0	0	0	2
Norway	0	0	0	0	0	0	0	0
Pakistan	1	1	0	0	0	0	0	2
Peru	0	0	0	0	1	0	0	1
Philippines	2	1	1	0	0	0	0	4
Poland	0	0	0	0	0	0	0	0
Portugal	0	0	0	0	1	0	0	1
Singapore	0	0	0	0	0	0	0	0
South Africa	0	0	0	0	2	0	0	2
South Korea	0	0	0	0	0	0	0	0
Spain	0	0	0	0	0	0	1	1
Sri Lanka	0	0	0	1	2	0	0	3
Sweden	0	0	0	0	0	0	0	0
Switzerland	0	0	0	0	0	0	0	0
Taiwan (China)	0	0	0	0	0	0	0	0
Thailand	0	0	1	0	1	0	0	2
Turkey	0	0	0	0	0	0	0	0
United Kingdom	0	0	0	0	0	0	0	0
United States	0	0	0	0	2	0	0	2
Venezuela	0	0	0	0	0	0	0	0
Total	14	7	6	8	14	4	4	57

Table A.7: Distribution of Major Natural Disaster Events by Disaster Type

This table reports the distribution of the number of major natural disaster events identified from EM-DAT.

Disaster Type	Sum No.
Earthquake	9
Extreme temperature	1
Flood	19
Storm	16
Volcanic activity	1
Wildfire	5
Total	51

Table A.8: The Impact of Natural Disasters on a Firm's Sales Growth

This table presents results on the effect of major natural disasters on a firm's sales growth. $I.Disaster50$ ($I.Disaster100$) is a dummy that indicates that the firm is located within 50(100)km of the disaster-affected area. $I.DisasterSupp50$ ($I.DisasterSupp100$) is a dummy that indicates that the firm has supplier(s) who is located within 50(100)km of the disaster-affected area. Detailed variable descriptions are in appendix A.1. The Table presents results for firms in manufacturing industries only (SIC 2000-3999). Country-Industry-Year and Firm fixed effects are included in Columns (1) and (2), and Industry-Year, Country-Year, and firm fixed effects are included in Columns (3) and (4). Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Manufacturing			
	(1)	(2)	(3)	(4)
$I.Disaster50$	-0.029**	-0.032***		
	(-2.21)	(-2.66)		
Size	-0.132***	-0.128***	-0.132***	-0.128***
	(-9.28)	(-9.50)	(-9.28)	(-9.50)
Age	-0.105***	-0.103***	-0.104***	-0.103***
	(-4.64)	(-4.94)	(-4.63)	(-4.94)
Tangibility	-0.102	-0.116	-0.102	-0.116
	(-1.37)	(-1.63)	(-1.37)	(-1.63)
Leverage	0.017	0.010	0.017	0.010
	(0.40)	(0.24)	(0.40)	(0.24)
Cash	0.189***	0.190***	0.189***	0.190***
	(3.20)	(3.39)	(3.20)	(3.39)
$I.Disaster100$			-0.018	-0.021*
			(-1.43)	(-1.81)
Firm FE	✓	✓	✓	✓
Country-Industry-Year FE	✓		✓	
Industry-Year FE		✓		✓
Country-Year FE		✓		✓
Obs.	47,681	49,216	47,681	49,216

Table A.9: The Impact of Natural Disasters on a Firm's Bank Loan

This table presents results on the effect of major natural disasters on a firm's bank loan. $I.Disaster50$ ($I.Disaster100$) is a dummy that indicates that the firm is located within 50(100)km of the disaster-affected area. The dependent variable is the firm's bank loan as a share of its total debt. Detailed variable descriptions are in appendix A.1. The Table presents results for firms in manufacturing industries only (SIC 2000-3999). Country-industry-year and firm fixed effects are included in Columns (1) and (2), and industry, country, and year fixed effects are included in Columns (3) and (4). Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Dep. Var. = Bank share	Manufacturing			
	(1)	(2)	(3)	(4)
*I.Disaster*50	-0.111*	-0.089*		
	(-1.86)	(-1.77)		
Size	-0.054***	-0.059***	-0.054***	-0.059***
	(-10.28)	(-14.17)	(-10.24)	(-14.14)
Age	-0.068***	-0.064***	-0.068***	-0.064***
	(-6.15)	(-7.59)	(-6.14)	(-7.60)
Tangibility	0.100	0.080	0.103	0.081
	(1.35)	(1.42)	(1.38)	(1.43)
Leverage	-0.076	-0.074*	-0.075	-0.074*
	(-1.45)	(-1.73)	(-1.43)	(-1.73)
Cash	-0.169**	-0.217***	-0.168**	-0.217***
	(-2.21)	(-3.45)	(-2.20)	(-3.45)
Sales Growth	0.004	0.006	0.004	0.007
	(0.24)	(0.48)	(0.28)	(0.51)
*I.Disaster*100			-0.039	-0.046
			(-0.85)	(-1.15)
Country-Industry-Year FE	✓		✓	
Country FE		✓		✓
Year FE		✓		✓
Industry FE		✓		✓
Obs.	2,803	3,235	2,803	3,235

Table A.10: The Impact of Natural Disasters on a Supplier Firm's Receivables ($^{AR}/_{Sales}$)

This table presents results on the effect of major natural disasters on a firm's account receivables. $I.Disaster50$ ($I.Disaster100$) is a dummy that indicates that the firm is located within 50(100)km of the disaster-affected area. $I.DisasterCust50$ ($I.DisasterCust100$) is a dummy that indicates that the firm has customer(s) who is located within 50(100)km of the disaster-affected area. The dependent variable is the firm's accounts receivable as a proportion of its sales. Detailed variable descriptions are in appendix A.1. The Table presents results for firms in manufacturing industries only (SIC 2000-3999). Country-industry-year and firm fixed effects are included in Columns (1) and (2), and industry, country, and year fixed effects are included in Columns (3) and (4). Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Manufacturing			
	(1)	(2)	(3)	(4)
$I.Disaster50$	0.008	0.011		
	(1.01)	(1.43)		
$I.DisasterHitCust50$	-0.010***	-0.011***		
	(-2.61)	(-2.95)		
$I.Disaster100$			0.013*	0.014*
			(1.69)	(1.90)
$I.DisasterHitCust100$			-0.010***	-0.011***
			(-2.89)	(-3.12)
Size	-0.014***	-0.015***	-0.014***	-0.015***
	(-10.53)	(-11.60)	(-10.52)	(-11.60)
Age	-0.008***	-0.007**	-0.008***	-0.007**
	(-2.58)	(-2.42)	(-2.58)	(-2.42)
Tangibility	-0.186***	-0.194***	-0.186***	-0.194***
	(-8.39)	(-9.30)	(-8.38)	(-9.29)
Leverage	0.068***	0.069***	0.068***	0.069***
	(4.83)	(5.14)	(4.83)	(5.14)
Cash	0.068***	0.068***	0.068***	0.068***
	(2.69)	(2.80)	(2.70)	(2.80)
Sales Growth	-0.035***	-0.033***	-0.035***	-0.033***
	(-4.62)	(-4.20)	(-4.62)	(-4.20)
Country-Industry-Year FE	✓		✓	
Country-Year FE		✓		✓
Industry-Year FE		✓		✓
Obs.	64,416	65,646	64,416	65,646

Table A.11: Customer-Supplier Pair Analysis in Pyramidal Groups

This table reports the regression estimation for the equation below for a sample of firm pairs consisting of customers i and suppliers j in manufacturing industries.

$$TradeCredit_{i,j,t} = \beta_0 + \beta_1 \times LowerSplr._{i,j,t} + X_i + \lambda_{i,j} + \lambda_{ctry,ind,t} + \epsilon_{i,j,t},$$

where i represents customer firm and j represents supplier firm. The sample consists of pyramidal group firms in manufacturing industries (SIC 2000-3999) from 2013–2021. Detailed variable descriptions are in Appendix A.1. Standard errors are corrected for clustering of observations at the firm level, and associated t-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Dep. Var. =	Excss TC		Cust. AP/COGS		Splr. AR/Sales	
	(1)	(2)	(3)	(4)	(5)	(6)
LowerSplr.	-0.011	-0.024	0.001	0.001	0.001	0.004
	(-0.20)	(-0.45)	(0.21)	(0.30)	(0.19)	(0.45)
Cust FE	✓	✓	✓	✓	✓	✓
Splr FE	✓	✓	✓	✓	✓	✓
Country-Industry-Year FE	✓		✓		✓	
Industry-Year FE		✓		✓		✓
Country-Year FE		✓		✓		✓
Obs.	4,165	4,520	4,772	5,152	4,182	4,538