Overlapping Networks of Credit and Control

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Abstract

Business groups are networks of firms connected by ownership links. We study the reaction of these networks to the 2008-9 crisis using a unique dataset of Chilean intra-group loans. Internal credit increases swiftly during the crisis. Firms that are more central in the ownership network simultaneously increase lending and borrowing. Like pure intermediaries, central firms keep net lending relatively constant. Central firms do not experience a significant fall in profitability relative to the average group firm, although receivers of intra-group loans perform significantly better. Our results show that control rights are essential for credit intermediation at times of distress.

Keywords: Business groups, networks, centrality, internal capital markets.

JEL Codes: G32

Business groups are networks of firms connected through ownership links. Large business groups can link together hundreds of firms (e.g., the Tata group in India). In emerging markets, and in many developed markets, firms affiliated to business groups account for approximately half of all listed firms, and an even larger fraction of GDP (see Khanna and Yafeh, 2007; Morck, Wolfenzon, and Yeung, 2005). A business group is typically organized as a pyramidal ownership structure with the controlling shareholder (most likely a family) at the top of the pyramid. Minority shareholders and debtholders interact with the controlling shareholder in different layers of the control pyramid. Despite the ubiquity of business groups, a comprehensive explanation for the ultimate purpose of such complex ownership structures is still a matter of ongoing research.

In this paper we explore one advantage of business groups that is particularly valuable at times of financial distress, namely the intermediation of credit between affiliated firms. Our results showcase the easiness of financial contracting within business groups in comparison to financial contracting in markets. Unlike credit relationships with market intermediaries, a key advantage of business groups is that credit relationships inside business groups are permeated by control rights in the sense that assets or projects can be easily disposed of or modified by the ultimate owner (see Grossman and Hart, 1986; and Hart and Moore, 1990). We focus on the firms that operate as intermediaries within the group, the links that support these credit relationships, and the consequences of this intermediation. Overall, the evidence in this paper helps us to understand the advantages of the complex ownership structures that underlie business groups.

We study the response of Chilean business groups to the crisis of 2008-9. We hand-collect a data set of ownership structures and intra-group loans to study credit networks at the micro level. Access to this highly detailed dataset is one of the main advantages of our study. The sample covers more than a decade (2001-2013), which allows us to compare the behavior of networks during distress and normal times. It is infrequent to have data on business groups, or in fact any type of network, for such a long period of time.

Our first finding is that internal borrowing and lending increases rapidly during the crisis. The average listed firm starts 1.5 lending relationships and one borrowing relationship with other firms inside the group. Credit activity between group firms remains high during the recovery of 2010, but it then reverses to pre-crisis levels. In other words, the internal credit network unfolds during distress and then contracts when the economic situation is normalized. Although affiliated firms have access to internal credit during distress, they do not necessarily receive continuous support.

Consistent with this view is the fact that most of the increase in intra-group loans is reported as short-term loans.

The increased activity of credit networks during the crisis is not uniformly distributed among firms. We find that firms that are more central in the ownership network behave as credit intermediaries within the group by increasing intra-group lending and borrowing simultaneously. In line with their role as pure intermediaries, central firms do not increase intra-group *net* lending (lending minus borrowing), and they do not experience an increase in market leverage, i.e., debt with banks or bondholders. We also find that the likelihood of forming a credit relationship between two firms in the group during the crisis increases with the centrality of the firms in the pair, even after controlling for the presence of direct ownership links between the two firms.

The intermediation role of central firms is not apparent in traditional theories of internal capital markets (see Stein, 2003). In those theories firms become net lenders or borrowers according to their relative standing in the group in terms of investment opportunities or tunneling opportunities. For example, funds should flow *directly* from firms with financial slack to firms in need. However, in those models control rights within the conglomerate are assumed to be absolute. Instead, in business groups where firms are independent corporations, the control rights of the controlling shareholder are limited by the rights of minority shareholders and debtholders. In such a world, the intermediation of central firms, i.e., the fact that loans follow established control relationships up and down the pyramid rather than taking shortcuts, avoids conflicts with these other investors.

Besides their position in the ownership structure of the group, what other features characterize central firms? During the crisis central firms become "internal banks" by receiving and extending loans to other group firms. This is not, however, the regular line of business of central firms. Central firms are not commercial banks, as could be the case in Japanese groups (Hoshi, Kashyap, and Scharfstein, 1991), since our data excludes all financial firms by construction. Central firms are not holding companies at the top of control pyramids either. Central firms are typically larger, more levered, and have more liquid stocks than the average group firm. However, none of these characteristics, or others such as profitability, investment opportunities (Tobin's Q), and cash-flow rights of the controlling shareholder, can explain away the effect of centrality in our empirical tests.

We find that central firms do not suffer a loss in profitability or poor stock returns relative to other group firms during the crisis. The point of reference for this compar-

ison is the average group firm. Net receivers of intra-group loans have relatively high profitability during the crisis, which is consistent with the idea that business groups support the profitability of some firms or that they are able to "pick winners" when they allocate capital among affiliated firms. In comparison to a matched sample of synthetic controls taken from standalone firms, central firms perform worse during the crisis, perhaps a sign of the costs of accommodating the shock that impacts the entire group. In the recovery after the crisis, both central firms and receivers perform significantly better than standalone firms.

This paper contributes to several strands of the literature. To the best of our knowledge we are the first to identify the intermediation advantage of business groups with a network perspective. There are multiple market frictions that business groups can alleviate. For example, pyramidal ownership can lift financial constraints that affect small and capital intensive firms (see Almeida and Wolfenzon, 2006; and Bena and Ortiz-Molina, 2013). We emphasize that business groups have a clear advantage over intermediaries in the credit market, especially during distress, because they retain control rights while lending. This advantage in intermediation is a plus for large business groups, which otherwise have a mixed reputation in the literature (see Khanna and Yafeh, 2007).

The underlying control relationships in business groups facilitate the flow of credit, in particular in the case of distressed borrowers (see Aghion and Bolton, 1992). According to the assessment of rating agencies, an intra-group loan is akin to junior debt in terms of payment priority, i.e., it is relatively risky debt. However, an intra-group loan carries more control rights than similar loans from the market. Lending that overlaps with control links can help reduce the risk of default and moral hazard (e.g., risk-shifting and other owner-debtholder conflicts). Market intermediaries, instead, can only alleviate these risks imperfectly through covenants (Roberts and Sufi, 2009). While the funding needs of distressed firms could be met by well-developed markets for high-yield or junk bonds, these markets tend to be underdeveloped in emerging economies (Becker and Josephson, 2016). Hence, one interpretation of our results is that the credit networks of business groups are substitutes for poorly developed high-yield markets. Alternatively, markets are not well developed precisely because business groups take care of high-yield lending in a more efficient way.

The network perspective, previously applied to social networks and customer-supplier networks among others, helps us to handle complex groups with multiple firms. The concept of centrality in the networks literature, in particular betweenness centrality, is a standard measure of the importance of a member in connecting others in a network

(Jackson, 2008). Hence, it lends itself naturally to the idea of intermediation in business groups. Almeida, Park, Subrahmanyam, and Wolfenzon (2011) develop their own measure of centrality, which identifies firms that control other firms in a business group. They do not relate their measure of centrality to standard measures of centrality in the networks literature, nor do they relate their measure to intermediation between firms.

There is a recent literature on the bright and dark sides of intra-group loans.[1] The main advantage of intra-group loans lies in alleviating financial constraints. Gopalan, Nanda, and Seru (2007) show that Indian groups use intra-group loans to give support to firms that receive bad cash-flow shocks. Buchuk, Larrain, Munoz, and Urzúa (2014) show that groups in Chile use loans to boost the investment of group firms. The main disadvantage is the potential abuse of minority shareholders. Jiang, Lee, and Yue (2010) argue that intra-group loans in Chinese companies are a way to tunnel resources out of companies. In Mexico lending between banks and firms controlled by the same owners also appears to be a sign of tunneling (La Porta, López-de-Silanes, and Zamarripa, 2003). Our results speak against a view of intra-group loans as pure tunneling. For example, it is hard to square with tunneling the fact that some firms act as lenders and borrowers at the same time. Our results add to the financial advantages of business groups, and more precisely to their advantage in the intermediation of risky debt during distress.

Internal capital markets are particularly active during periods of distress. Our results are broadly consistent with previous evidence of intra-group equity investments during the Asian crisis in Korea (Almeida, Kim, and Kim, 2015), the performance of groups during the recent crisis in Europe (Lins, Volpin, and Wagner, 2013; Santioni, Schiantarelli, and Strahan, 2017), and the reallocation of capital in U.S. conglomerates during the subprime crisis (Matvos and Seru, 2014). None of these papers studies the intermediation of credit between firms like we do.

Finally, our results contribute to the emerging literature of networks in finance.[2] Acemoglu, Ozdaglar, and Tahbaz-Salehi (2015) and Elliott, Golub, and Jackson (2014)

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[1]There are analogous bright and dark sides to internal capital markets in conglomerates of fully-owned subsidiaries. Conglomerates can be better at picking the best projects available and redistributing funds among them (Giroud and Mueller, 2015; Khanna and Tice, 2001; Shin and Stulz, 1998; Stein, 1997). However, rent-seeking from divisional managers and cross-subsidies can lead to inefficient investment (Ozbas and Scharfstein, 2010; Rajan, Servaes, and Zingales, 2000; Scharfstein and Stein, 2000).

[2]For example, the literature has studied the effect of customer-supplier networks in production and market returns (Ahern, 2016; Barrot and Sauvagnat, 2015); elite networks and the allocation of credit (Haselmann, Schoenherr, and Vig, 2016); networks of directors and firm performance (Khwaja, Mian, and Qamar, 2011; Carney and Child, 2016); executive networks and firm policies (Cai and Szeidl, 2016; Shue, 2013); among others.

study contagion and stability in financial networks. We study a network's attempt to act as buffer for a shock that affects all of its members, such as the global recession. Our results are interesting for the networks literature in several respects. First, we find that more central firms are the key agents that help smooth an aggregate shock. Network centrality is related to the diffusion of information and peer effects in other types of networks (Jackson, 2014). Second, we have the advantage of observing different networks as they are hit by the same shock, and hence we can compare across networks with different characteristics (e.g., industrial diversification). Third, we find that network links of a given type (control links in our case) have implications for the development of other network relationships (credit links in our case).[3]

The endogenous formation of networks is a matter of ongoing research in the literature (see Chandrasekhar, 2016). We admit up-front that we cannot fully resolve this issue with the data at hand. It is reasonable to assume that the formation of business groups is not endogenous to the recession of 2008-9. First, business groups were formed well before the crisis. Second, the shock was largely unanticipated. Third, ownership structures barely changed during the crisis. Still, although our identification strategy can be considered to be conservative, the bigger question of why business groups are born and how they evolve in the long-run (for example, as protection for shocks) is something that we defer for future research.

The rest of the paper is organized as follows. Section 1 reviews the main hypotheses regarding loans in business groups. Section 2 describes the data and the main network measures. Section 3 shows the main results. Section 4 concludes.

1 Hypotheses development

There are bright and dark sides to intra-group loans as with internal capital markets in general (Stein, 2003). Our focus, and the novelty of this paper, is the intermediation advantage, which falls on the bright side of intra-group loans.

1.1 The intermediation advantage

The key ingredient that makes intra-group loans feasible is that business groups retain control rights while lending. Control rights mean that the controlling shareholder of the business group can decide what to do with the assets of each firm (within certain

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[3]Others have found that network structure itself affects the flow of favors in social networks (Jackson, Rodriguez-Barraquer, and Tan, 2012).

limits as we explain below). Hence, we refer to control rights in the sense of Grossman and Hart (1986) and Hart and Moore (1990). In terms of Figure 1, if for whatever reason Firm A has cash to spare and Firm B needs cash, then the loan between A and B can simply be made. Even if firms A and B are not directly related by ownership links, both firms are under the same controlling shareholder (Firm C), so approval for the loan can in principle be easily obtained. Ownership relationships support credit relationships because control gives a lever that is not typically available to arms' length creditors. As seen in Aghion and Bolton (1992), giving control to creditors can boost the debt capacity of a firm.[4] This is especially valuable for financially constrained firms that are pressed to find new sources of funds.

In principle, the control-rights theory of intra-group loans does not provide an intermediation advantage to any particular firm within the business group. This happens because any contractual link between firms can be drawn if control rights are absolute. However, controlling shareholders in business groups do not have absolute rights, as they have within conglomerates of fully-owned subsidiaries. Controlling shareholders in business groups are limited by the rights of minority shareholders and debtholders, which are granted by corporate law and private contracts (e.g., covenants). In terms of Figure 1, if Firms A and B are independent corporations, as they typically are in business groups, with their own capital and ownership structures, then the rights of the controlling shareholder (Firm C) are limited by the rights of minority shareholders and debtholders in Firms A and B.

In a world with conflicting rights, the intermediation of the loan between Firms A and B by Firm C is beneficial. Control rights are the essence of this intermediation advantage of Firm C, which has direct ownership links to A and B as seen in Figure 1. Firm A retains more control when lending to C than to B, and Firm C has more control over B than what A has over B.

The advantages of Firm C in intermediating the loan are twofold. First, Firm C has a stronger position as creditor of B than Firm A, because C directly controls B. The interests of Firm C are fully represented in the board of Firm B, while the interests of Firm A are only indirectly represented through C. Firm B pays dividends to C, but not to A. Since Firm C is a shareholder of B, the debt payments of B to C are akin to dividends, which in part explains why credit rating agencies consider the intra-group debt of B as analogous to preferred shares or subordinated debt instead of senior debt.

Second, from the point of view of Firm A, Firm C is a better debtor than Firm B. Strategic default in Firm B is a possibility in a direct loan from A to B, while the

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[4]See Tirole (2006), chapter 10, for a textbook treatment.

presence of C as intermediary avoids strategic default in B. Firm A can repay itself the loan made to C by withholding future dividends, but there is no such direct claim over B's cash flows.[5]

The intermediation of Firm C can avoid several conflicts. The minority shareholders and debtholders of Firm A can be lukewarm about the loan to B, because they have no direct claim over B's cash flows. The minority shareholders of A can dispute the transaction, for example, using legal remedies for related-party transactions (see Djankov, La Porta, López-de-Silanes, and Shleifer, 2008).[6] Debtholders can respond by increasing A's cost of debt. For example, debt covenants can preempt a transaction between related parties like this loan. Overall, the intermediation by Firm C reduces conflicts between the owner of A (i.e., Firm C) and the minority shareholders and creditors of Firm A at a minimal, mostly administrative, cost.[7]

It is trivial to see in Figure 1 that Firm C is a good intermediary between A and B. However, this idea is not straightforward to extend to more complicated ownership structures. To our advantage, the networks literature has developed measures of *centrality*, which is the key attribute of agents that are better at connecting others in a network (Jackson, 2008). Centrality can be understood as a generalization of the position of Firm C in Figure 1.

Based on the idea of *centrality* we take three specific predictions to the data:

1. Central firms are likely to be intermediaries in business groups. This means that central firms should lend and borrow at the same time, but not have a strong net lending (or borrowing) position.

2. Given that financial needs are likely to increase during periods of distress, central firms should be more active during a crisis than in normal times.

3. Given that central firms are not necessarily the origin or final destination of loans, their performance should not be significantly different from the average group firm.

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[5]The situation is analogous to trade credit between suppliers and customers. The threat of withholding supply explains why suppliers give credit to customers in the first place.

[6]Chile is a market with strong investor protection. For example, the level of the anti-self dealing index (0.63) computed by Djankov, La Porta, López-de-Silanes, and Shleifer (2008) is comparable to the U.S. (0.65).

[7]Regarding other investors in this example, the minority shareholders of C are aligned with C's controlling shareholder since the loan is happening downstream in the control pyramid. The minority shareholders and debtholders of B do not need to be persuaded since their firm is getting financing through this loan. The debtholders of C might complain, but it is unlikely since there is no reason to believe that the default probability of C changes.

The third prediction comes from the fact that net lending remains low, and therefore that intermediation does not modify the main sources of revenue of central firms. The point of reference is also important for Prediction 3. As seen in Almeida and Wolfenzon (2006), there is selection of firms with certain characteristics into groups, and hence group firms are inherently different from non-group firms. So, the performance we refer to in Prediction 3 is evaluated in comparison to other group firms. The comparison against standalone firms has to be adjusted for this selection effect.

The idea that ownership links facilitate credit relationships in business groups may appear tautological, but it is not. The predictions that we test are based on a specific and narrow premise, namely that central firms in the *ownership network* should act as intermediaries. Business groups can be characterized by other types of links, such as customer-supplier relationships, family ties, and so on. We test whether one particular type of centrality, *ownership centrality,* is related to loan intermediation within the group. Other types of centrality (e.g., industrial centrality, family centrality) are not necessarily relevant for credit intermediation since those ties do not necessarily carry control rights with them.

1.2   Other theories of intra-group loans

Other bright-side theories argue that intra-group loans alleviate financial constraints. Groups have a financial advantage because many of the frictions (e.g., asymmetric information or agency problems) that affect external funds are dampened within the group. Firms in business groups can raise more funds than stand-alone firms, and business groups can allocate funds in a smarter way than markets since they are better informed (business groups are better at "winner-picking"; Stein, 2003). In line with less binding financial constraints, Gopalan, Nanda, and Seru (2007) show that affiliated firms receive support from other group firms in order to avoid bankruptcy. Buchuk, Larrain, Munoz, and Urzúa (2014) show that receivers of intra-group loans are capital-intensive, small firms that subsequently increase fixed investment.

This financial advantage is focused on the ultimate use of funds, and the consequences for investment and profitability. We emphasize the intermediation within the group. Under these theories firms with financial slack within the group are the origin of loans and constrained firms are the destination of loans. However, these theories are silent about the intermediation of the loan because absolute control rights are typically assumed.

There are two main alternatives on the dark side of intra-group loans. First, intra-

group loans can be used for tunneling. Tunneling refers to the abuse of minority shareholders by the controlling shareholder (Bertrand, Mehta, and Mullainathan, 2002; Johnson, La Porta, López-de-Silanes, and Shleifer, 2000). Cash-flow diversion, as in Shleifer and Wolfenzon (2002), is a strong form of tunneling. Related-party transactions, which are not mediated by markets, can sometimes mask abuses from the controlling shareholder (Djankov, La Porta, López-de-Silanes, and Shleifer, 2008). The key prediction of tunneling is that controlling shareholders should have higher ultimate ownership (higher cash-flow rights) in firms that receive intra-group loans.[8] The terms of the loan, such as interest rates or duration, should also be advantageous for the borrowing firm. Along these lines, Jiang, Lee, and Yue (2010) argue that intra-group loans in Chinese business groups are mostly explained by tunneling.

A second alternative is that, even if the controlling shareholder is benevolent, intra-group loans can be used for inefficient subsidies across firms. Rent-seeking between managers of different group firms can distort the allocation of capital (see Rajan, Servaes, and Zingales, 2000; and Scharfstein and Stein, 2000). The main prediction of these models is that inefficiencies are more severe when the divergence in investment opportunities across firms is stronger.

2 Data description

2.1 Data on ownership structures

We define a business group as a set of two or more listed firms with a common controlling shareholder. All groups include private firms related to the listed firms. We require the presence of listed firms in our definition for two reasons. First, listed firms report financial statements regularly to the local stock market regulator (Superintendencia de Valores y Seguros, SVS). There is no systematic way of compiling information for private firms. Second, the presence of listed firms implies that there is a relevant mass of minority shareholders, and hence a meaningful separation of equity ownership and control. During our sample period of 2001-2013 we collect data on 22 groups comprising approximately 80 listed firms and 1,000 private firms. Our data excludes financial firms (commercial banks, mutual fund companies, pension fund administrators, etc.).

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[8]Whether recessions increase or decrease tunneling is an open question. On the one hand, controlling shareholders are likely to suffer cash shortages and therefore engage in more tunneling. On the other hand, firms have less cash in recessions and therefore there are fewer opportunities for diverting cash. Also, the tolerance of minority shareholders for such behavior is likely to be lower during bad times (Philippon, 2006).

This is not a big omission because lending between banks and related firms is heavily restricted in the Chilean market since the aftermath of the debt crisis in the 1980s.

Ownership links are reported in the notes to financial statements in two ways. First, there is a list of firms that consolidate with the reporting firm. Consolidation means that the firm exerts a "controlling influence" over the other firm. In practice, this typically implies an ownership stake above 50%. The notion of control in financial statements follows accounting principles, and it is not necessarily the same as economic control, which may involve a much lower stake. Two firms can consolidate with each other even if there is no direct ownership link between them, for instance, if X owns Y and Y owns Z, then Z consolidates with X, although X has no direct stake on Z. Second, there is a list of related investments, which contains firms where the reporting firm has a significant and permanent investment, although the type of influence is non-controlling (in the accounting sense). With both sources of ownership data we are able to define the set of firms –public and private– that belong to each business group.

The notes report the direct ownership stake of the reporting firm on the firms that consolidate with it and the firms reported as related investments, if there is a direct link. Because of reporting standards we do not know the direct ownership stake between private firms in the group. In terms of our previous example, if X is a listed firm, and Y and Z are private firms, then we know the stake between X and Y, but not the stake between Y and Z. We only know the stake in any direct link involving a listed firm (with another listed firm or with a private firm). In the empirical analysis we discuss potential biases and corrections for this unobservable component of the ownership network.

Learning the identity of the ultimate controlling shareholder in a group is much harder. This happens because financial statements typically report links between corporations, but the names of individual shareholders are rarely reported. We uncover the identity of the controlling shareholder by checking the composition of boards, annual reports, and the financial press. Controlling shareholders are mostly families, foreign multinationals, or small groups of large investors who act in a coordinated way. The state is not a relevant controlling shareholder of listed firms in Chile. The ownership stakes of controlling shareholders are typically stable across long periods of time in the Chilean market (see Donelli, Larrain, and Urzúa, 2013).

As an example Figure 2 shows a simplified version of the Claro group in the year 2007 (the group has changed since then). The Claro group has 7 listed firms and multiple private firms. The group is spread out in several industries. Elecmetal is a steel manufacturer; Cristales is a glass manufacturer; Viña Santa Rita is a winery;

and Vapores is in the shipping business. Quemchi, Marinsa and Navarino are mostly holding companies.

As seen in Figure 2 Chilean legislation prohibits loops in cross-holdings (for example, firm X having a stake in firm Y, and firm Y simultaneously having a stake in firm X). This implies that ownership only flows downstream from the top of the control pyramid. The computation of cash-flow rights of the controlling shareholder is much easier given this feature of Chilean pyramids. We only need to multiply the ownership stake corresponding to each link of the pyramid. For example, the cash-flow rights of the Claro family in Navarino are 38.9% (= 51% × 76.3%), meaning that for each dollar of dividends distributed by Navarino, the Claro family ultimately receives 38 cents, despite the fact that the ownership stake controlled by the family in Navarino is 76.3%. As Navarino's dividends go up in the pyramid, other minority shareholders are paid off, in this case the minority shareholders of Quemchi. The difference between cash-flow rights and controlling stakes grows larger as we move down in the pyramid. For example, the controlling stake of the Claro family in Santa Rita is 77.5%, but the family receives slightly less than 20% of Santa Rita's dividends.

2.2   Data on intra-group loans

Since the crisis of the mid-1980s Chilean companies are required by law to report related loans in the notes to financial statements. Since 2001 the SVS has compiled this information electronically. The notes identify the firm that is lending and the firm that is borrowing, together with the maturity of the loan (short-term or long-term), and the outstanding amount at the end of each year. Loans that are repaid in full within the year do not appear in our data. Chilean regulation requires that related loans are made at a comparable market rate. Sometimes the interest rate and the precise maturity of the loan are reported in the annual reports, but this information is generally missing from financial statements. Many loans correspond to short-term accounts payable with zero interest.

By merging the ownership data with the related-loans data we get a sample of intra-group loans. Not all related loans are intra-group loans. For example, a loan between two companies that share a common director is legally considered to be a related loan, but the two companies can be in different business groups. The notes to financial statements report the nature of the relationship between the two firms with a loan. We exclude those loans where there is no ownership link (direct or indirect) between the lending firm and the borrowing firm. Given the nature of the firms that

report the information, we can only observe lending relationships where at least one of the firms is a listed firm, but we do not observe lending relationships between private firms.

Table 1 shows the intra-group loans of the Claro group in 2007. There are 21 loans: 6 involve pairs of listed firms, and 15 involve listed-private pairs. The last column reports the direct ownership stake between the firms in the pair. A direct ownership link exists in many loans, but not all. For instance, Vapores has a 50% stake in San Antonio, a private company that owns docking facilities on the Chilean coast. We observe loans between Vapores and San Antonio, but also between Marinsa (Vapores' parent) and San Antonio, although there is no direct ownership link between them. In other words, a direct ownership link is not a prerequisite for a loan, or loans can sometimes "jump" the direct chain of control.

Table 2 gives summary statistics for lending and borrowing relationships in business groups. We consider two samples. The first sample includes all public and private firms, with a total of 13,612 firm-year observations. Firms with zero relationships in this sample are firms that belong to a business group, but that do not lend nor borrow from a listed firm in the group. Firms in this sample have an average of 0.560 lending relationships and 0.558 borrowing relationships.

In the second sample we focus on listed firms alone. Listed firms have two advantages. First, we observe their entire network of ownership and credit relationships, and second we observe financial data that is unavailable for private firms. A listed firm has an average (median) of 4.22 (3) lending relationships and 3.77 (2) borrowing relationships inside the group, with either listed or private firms. From the consolidated financial statements of each listed firm we get book assets, measures of profitability such as return on assets (ROA=EBIT/book assets) and return on equity (ROE=earnings/book equity), property, plant and equipment (PPE), cash holdings (=short term assets/book assets), and external leverage (=financial debt/book assets) which does not take into account intra-group loans. The cash-flow rights of the controlling shareholder are computed by multiplying all of the ownership links up to the top of each control pyramid. Extraordinary dividends are defined as a dummy variable for observations where dividends are more than 30% of earnings, which is the mandatory dividend set by Chilean law. We report variables that use stock market information such as Tobin's Q (=market equity plus book debt over book assets), the market-to-book ratio for equity, stock returns, and stock liquidity (volume traded for a particular stock over total volume traded in the market).

Finally, we report a measure of the industrial integration of a firm with the rest of

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the group. Integration refers to how much of its input (output) a firm buys (sells) from
(to) other firms in the group. Like Khanna and Yafeh (2005) we first classify firms
into industries using the industry classification from the 2002 input-output matrix pro-
vided by the U.S. Bureau of Economic Analysis. For each pair of firms in the group we
compute the degree of upstream integration (towards the supplier) and downstream
integration (towards the client) between their industries in the input-output matrix.
We take the average of upstream and downstream integration as the measure of inte-
gration for each pair of firms, and finally we average for a single firm across all the pairs
where it is present. The average integration in our sample is 3.6%, which means that
the average group firm can buy (sell) 3.6% of its inputs (products) within the group.

2.3   Measures of network centrality

We define network characteristics according to the ownership structure of the business
group. We do not use the structure of credit links themselves to describe the net-
work, which would be mechanically related to credit activity. In principle there is no
guarantee that the ownership network overlaps with the credit network. However, as
mentioned in our hypotheses, there are good reasons to expect a connection between
control rights and credit flows.

Centrality measures the position of a node in a network, or in our case, a firm in a
business group. There are several measures of centrality depending on the particular
application of interest (Jackson, 2008). We focus on betweenness, which measures the
advantages of an agent as intermediary within the network.[9] In other words, how
important a firm is in connecting other firms within the business group. For example,
imagine that the business group needs to move \$1 between firms k and j. Betweenness
measures whether firm i is a good intermediary between k and j.

More precisely, define $P(kj)$ as the number of shortest paths between firms k and j
taking into account direct ownership links, and $P_i(kj)$ as the number of shortest paths
between firms k and j that include firm i. The ratio $P_i(kj)/P(kj)$ gives an idea of how
important firm i is to connect k and j. Averaging across all firms in a business group
with n firms gives the betweenness centrality of firm i:

$$Centrality_i^{betweenness} = \sum_{\substack{k \neq j \\ i \notin \{k,j\}}} \frac{P_i(kj)/P(kj)}{(n-1)(n-2)/2} \tag{2.1}$$

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[9]See Choi, Galeotti, and Goyal (2017) for the use of betweenness as measure of intermediation in
other networks.

We use degree centrality as a secondary measure of centrality. The degree is the number of links that a node has in a network. In our case the degree is simply the number of firms to which a firm is connected through direct ownership links: firms in which the firm has ownership stakes, plus firms that have an ownership stake in the firm.

Table 2 reports summary statistics for the measures of centrality in our analysis. The average betweenness in the full sample is 0.011, meaning that only about 1% of shortest paths contain the average firm in a business group. The average betweenness among listed firms is 0.137, which implies that listed firms are almost 14 times more likely than private firms to be in the connecting path between two firms. The average degree is 1.3 in the full sample and 9.3 among listed firms.[10]

Table 3 shows characteristics for central and non-central firms, all of them listed, in the year 2007. Central firms are those at the top quartile of the sample distribution of betweenness in that year. We find that central firms are significantly larger, more levered, have lower cash flow rights of the controlling shareholder, and more liquid stocks.[11] Differences in cash-flow rights imply that central firms are not at the top of control pyramids. Hence, central firms are not typically holding companies. As seen in Figure 2 with the Claro group, more central firms (Elecmetal and Vapores in this case) are in the middle of the pyramid. Later on we take into account observable differences between central and non-central firms in our empirical analysis. Although the averages in Table 3 suggest that central firms have more lending and borrowing relationships than non-central firms before the crisis, these differences are not statistically significant.

2.4 The crisis of 2008-09

The crisis of 2008-09 was a global phenomenon. We can safely assume that it was an exogenous shock from the perspective of the Chilean economy. In Figure 3 we plot the 12-month growth rate of industrial production in Chile.[12] Most of 2008 showed robust growth with an average of 3.3%. Instead, the year 2009 had 7 consecutive months of

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[10]Note that some private firms in the full sample have zero degree, which may seem counterintuitive (it suggests that these firms are not related to any other firm). The problem is that, although we know these firms belong to a group because they consolidate with other group firms or because group firms invest in them, we do not have information on the *direct* ownership links that relate these firms to other group firms. This happens because ownership links between private firms are not reported.

[11]In Table 3 we present standard p-values and p-values from permutation tests based on Monte Carlo simulations (500 random permutations) to deal with the small sample size. The key advantage of permutation tests is their validity even with very small samples and regardless of the distributional characteristics of the data.

[12]The monthly index of economic activity is known as IMACEC. We compute the log-change in the index with respect to the same month the previous year in order to account for seasonal patterns.

negative growth (January through July), and hence it was the main year of the crisis in Chile. Since we have annual data we expect to find most traces of the crisis in 2009.

The year 2010 marked a steep recovery from the crisis. There was a large earthquake on February 27, 2010, that disrupted production for several weeks in many areas, and which explains the almost zero growth in March 2010. The recovery from the crisis –added to the efforts of the reconstruction – explain the strong growth seen in the rest of 2010.

3 Empirical results

3.1 The evolution of credit relationships over time

We first document the increasing activity of intra-group lending during the crisis. We run the following simple regression:

$$y_{it} = \delta_t + \mu_i + \epsilon_{it}, \tag{3.1}$$

where y_{it} is the number of intra-group lending or borrowing relationships of firm i in year t, δ_t is a set of year fixed effects (excluding the year 2008), and μ_i is a set of firm fixed effects. The coefficient δ_t captures the difference in credit relationships during year t and year 2008, taking into account any time-invariant differences across firms. We run separate regressions for the full sample and for listed firms. Standard errors are clustered at the firm level.

Figure 4 shows the estimated time effects (δ_t) from the regression above, together with 95% confidence bands. There is no significant difference between any of the years before the crisis (2001-2007) and 2008 in terms of lending or borrowing. In other words, there is no obvious trend before the crisis. The main year of the crisis, 2009, shows a marked increase in lending and borrowing relationships. On average, in 2009 close to 0.1 new lending relationships (Panel A) are created in the full sample, and similarly for new borrowing relationships (Panel B). The increase in lending relationships among listed firms is stronger at about one new relationship on average (Panel C), which is twice as big as the increase in borrowing relationships (Panel D). This is consistent with the idea that listed firms more often lend than borrow from private firms. The high level of credit activity persists during 2010, but it reverts afterwards. By 2013 credit relationships are not statistically different from 2008 in any of the samples. The time series variation that we find implies that the internal credit network unfolds during the crisis and then contracts during normal times. These results suggest that internal

credit is a source of emergency funds in distress more than a continuous source of support.

The time series variation that we see in credit relationships is not seen in ownership relationships (Panels E and F in Figure 4). While new intra-group loans appear during the crisis, there is no evidence of new equity investments in other group firms. Given the existence of preemptive rights for all shareholders, equity issuance is more cumbersome in Chile than in other markets (for example, see the Korean experience during the Asian crisis as documented by Almeida, Kim, and Kim, 2015).

3.2   The role of centrality in intra-group lending

We perform a differences-in-differences estimation, where the crisis period provides time-series variation and centrality provides cross-sectional variation. Centrality is measured as betweenness in 2007. We standardize centrality using the mean and standard deviation of the variable in 2007, so coefficients can be interpreted as the effect of increasing centrality by one standard deviation.

Before the main differences-in-differences estimation we run the following version:

$$y_{it} = \delta_t + \beta' \left(\delta_t \times centrality_i \right) + \mu_i + \epsilon_{it}, \tag{3.2}$$

where the set of time effects δ_t is interacted with centrality for each firm. The coefficients on these multiple interactions allow us to see time changes in the cross-sectional effect of centrality. Figure 5 shows the estimated β coefficients from equation (3.2). We can see that the cross-sectional effect of centrality on lending and borrowing is significant during 2009, but not before the crisis. Table 3 already showed that the differences of lending relationships between high and low centrality firms are not significant during 2007. Figure 5 confirms that the effect is only significant during the crisis, or that there are no different trends pre-dating the crisis. The absence of pre-trends supports the differences-in-differences approach. It is also important to note that the effect of centrality can be seen both in lending and borrowing relationships, like what we would expect from an intermediary.

Figure 6 provides a graphical illustration of the importance of time-series and cross-sectional variation in our estimation. We show the impact of the crisis in two particular business groups (Claro and Ponce) . The left-hand-side panel shows credit relationships in 2007, and the right-hand-side panel in 2009. Each link between nodes represents an intra-group loan. The darker nodes are more central firms in the ownership network in 2007. The size of the nodes is related to the number of lending and borrowing rela-

tionships of each firm, i.e., the degree of each firm in the credit network. We normalize the size of each node by the degree distribution of the credit network in 2009, so the nodes in both figures are comparable. A larger node represents a firm involved in more intra-group loans. Both groups show an increase in lending activity in 2009 with respect to 2007 as seen by the number of links between firms. This increase in activity if focused on more central firms, which can be seen in that darker nodes (central firms) become larger.

Our main differences-in-differences estimation is a more parsimonious version of equation (3.2):

$$y_{it} = \beta'(crisis_t + recovery_t + post_t) \times centrality_i + \delta_t + \mu_i + \epsilon_{it}, \qquad (3.3)$$

where $crisis_t$, $recovery_t$, and $post_t$ are dummy variables for the years 2009, 2010, and 2011-13 respectively. Standard errors are clustered by firm.

The first column of Table 4 shows the positive effect of centrality on credit relationships (lending plus borrowing relationships) during the crisis (coeff. 1.042, t-stat 2.77). The effect of centrality is also significant during the recovery year (coeff. 0.875, t-stat 2.30), which shows that many credit relationships last much longer than the crisis. In the post period (2011-13) the effect of centrality is not significant (coeff. 0.425, t-stat 1.02). The importance of centrality can be seen *within* the subset of listed firms in column 5 of Table 4. Listed firms represent only a subset of firms, but all central firms are listed firms.

When decomposing total credit relationships we find that the effect of centrality is positive in both lending and borrowing during the crisis. The coefficients are slightly larger for lending relationships (0.585 vs. 0.457 in the full sample, and 0.664 vs. 0.538 among listed firms). The effects are economically large. For example, one standard deviation change in centrality increases 0.585 lending relationships (column 2 in Table 4), which represents one third of the standard deviation of lending relationships.

The last column for each panel in Table 4 uses net lending (lending minus borrowing relationships) as dependent variable. We find that centrality does not affect net lending, which means that the impact of centrality on lending relationships is similar to its impact on borrowing relationships. This result is important to differentiate the network perspective from other perspectives of business groups. For example, if more central firms are larger firms (see Table 3), then it is perhaps natural that these firms lend more to small firms that are financially constrained during a recession. However, it is hard to explain *both* borrowing and lending going up simultaneously. The network

perspective makes it easier to understand why some firms become intermediaries within a group.

Table 5 decomposes credit relationships into short-term and long-term according to the maturity of the loan as reported in financial statements. We see that the increasing level of credit relationships and the effect of centrality are mostly seen in short-term loans (Panel A). This is consistent with the idea that internal capital markets provide support to cover short-run liquidity needs, as in Gopalan, Nanda, and Seru (2007), but not necessarily for long-run investment. We do not find a significant impact of centrality in long-term credit relationships during the crisis (Panel B). If anything, there seems to be a negative effect on long-term credit relationships during the recovery. This may also be explained by the low interest rates that characterize this period around the world, and which made market credit relatively cheap. Figure A.1 in the appendix is in the style of Figure 4, but decomposing short-term and long-term loans. It reinforces the idea that the increase in credit relationships is concentrated among short-term loans instead of long-term loans.

3.3   Robustness

In an ideal experiment centrality would be randomly assigned before the crisis. However, as implied by Table 3, centrality is not randomly assigned. Central firms are bigger, more levered, have more liquid stocks and lower cash-flow rights of the controlling shareholder. These characteristics can potentially explain the surge in lending and borrowing during the crisis. It is straightforward to test this idea within our main regression by interacting the time dummies (crisis, recovery, and post) with firm characteristics. Results are reported in Table 6. Overall, we find that the effect of centrality is not absorbed by any of these variables. The coefficient on centrality is quite stable regardless of the pre-crisis controls included in the regression.[13]

Under the tunneling hypothesis, cash-flow rights drive the incentives of the controlling shareholder to transfer resources between firms. Instead, we find in Table 6 that cash-flow rights have no differential impact during the crisis. An important alternative hypothesis is that central firms are just bigger firms, and therefore naturally more exposed to internal lending and borrowing. However, log-assets interacted with the crisis, recovery, and post dummies are never statistically significant. Tobin's Q is a standard indicator of investment opportunities, and under the financing advantage hypothesis, high-Q firms should be receivers of internal funds. Again, as seen in Table 6, Tobin's Q

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[13]Splitting the analysis of the impact of alternative control variables in Table 6 into lending and borrowing relationships separately does not change the main message. See Table A.1 in the appendix.

does not drive away the effect of centrality. Central firms can also have better access to external funds (e.g., because they have lower leverage or more liquid stocks), or have more internal funds (e.g., higher cash holdings). We do not find that any of these firm characteristics has explanatory power for credit relationships during the crisis. Finally, the degree of industrial integration of a firm with its business group is not an indicator of more credit relationships during the crisis, suggesting that intra-group loans are not simply trade credit.

The appendix provides a battery of robustness checks for the main regressions in Tables 4 through 6. The results do not vary significantly if we use degree as measure of centrality instead of betweenness (Table A.2). We prefer betweenness because it is theoretically closer to a measure of intermediation within a network. One of the advantages of degree centrality is that the econometrics for this network statistic are better known in the case of a partially unobserved network. Remember that one issue with our network is that we have ownership data for listed firms and their links to listed and private firms, but not between private firms. Chandrasekhar and Lewis (2016) study regressions where degree centrality is the explanatory variable.[14] The authors show that the coefficient of centrality is correctly estimated in the regression where the sample is restricted to network members with observable links (listed firms in our case). When using all network members the estimated coefficient must be multiplied by $1 - (1 - \psi)^2$, where ψ is the sampling rate. Given a sampling rate of 0.174 in our case, the coefficients in Table A.2 for the case of all firms should be scaled by 0.317. The authors argue that no results are known regarding the bias when using betweenness centrality.

We also apply several changes to the sample definition and the regression specification. A placebo test that places the crisis dummy in 2004 shows that the difference between central and non-central firms does not precede the financial crisis (Table A.3). The results are robust to excluding holding companies, which some could argue play the role of intermediaries in groups (Table A.4); winsorizing the main dependent variables to reduce the impact of potential outliers (Table A.5); adding business group-year fixed effects, which implies that our results are robust to using only within group-year variation (Table A.6); restricting attention to firms with overlap in the propensity score distribution as suggested by Crump, Hotz, Imbens, and Mitnik (2009) (Table A.7); and clustering standard errors by business group (Table A.8).

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[14]Our case of network sampling is similar to what they call star subgraph sampling.

3.4 Heterogeneity across groups

In order to understand what increases the need for intermediation we explore the heterogeneity of the main results to group characteristics. First, we split groups into more and less pyramidal groups. We measure the pyramidal shape of a group with the cash-flow rights of the controlling shareholder in the average firm. Lower cash-flow rights are an indication that the control pyramid has more layers, and hence we call it a more pyramidal group. We find in Table 7 that central firms are more active in more pyramidal groups, which can be expected since firms can be far apart in the ownership structure of those groups, and hence there is more need for intermediation.

In theory there can be more opportunities for risk-sharing when the group has a more diversified industrial structure (see Khanna and Yafeh, 2005). Different industries can experience uncorrelated shocks, and hence an internal capital market can exploit gains from sharing those shocks. It is harder to accommodate an aggregate shock, such as the crisis that we study. Still, different industries can have different sensitivities to the aggregate shock, and therefore there can be benefits from risk-sharing among group firms.

In the second panel of Table 7 we split groups according to the number of industries in which each group operates. Groups that have firms in more industries are highly diversified groups. We do not find that central firms are increasing their credit relationships more strongly in highly diversified groups. If anything, we find the opposite. This result suggests that credit intermediation between group firms does not relay on mediating between industries with different sensitivities to aggregate shocks.

Rajan, Servaes, and Zingales (2000) show that the degree of cross-subsidization in conglomerates is stronger when the divergence in Tobin's Q between subsidiaries is larger. As suggested in Section 1 something similar should happen in the internal capital markets of business groups. However, in Table 7 we find that there is more activity of central firms during the recession when the divergence in Tobin's Q within the group is small. Our interpretation is that intra-group loans during the recession are not related to long-run prospects, such as those captured by Tobin's Q, but instead to short-run liquidity needs.

3.5 Likelihood of forming lending relationships

We study the formation of lending relationships by looking at the universe of potential firm pairs within each group. We define a dummy equal to one when there is a lending relationship between a pair of firms in the group in a given year, and zero otherwise.

We count each pair of firms only once. The number of potential relationships in a group is the total number of firm pairs that can be formed between listed firms, and listed and private firms. We do not consider pairs between private firms because, by construction, we cannot observe them. The regression is as follows:

$$
\begin{aligned}
Lending_{ij,t} \;=\; & \beta^{'}(crisis_t + recovery_t + post_t) \times \max[centrality_i, centrality_j] \\
& + \gamma^{'}(crisis_t + recovery_t + post_t) \times ownership_{ij} \\
& + \lambda \max[centrality_i, centrality_j] + \pi\,ownership_{ij} \\
& + \delta_t + \mu_{ij} + \epsilon_{ij,t},
\end{aligned}
\tag{3.4}
$$

where $Lending_{ij,t}$ is the dummy variable for when there is a loan between firms i and j in year t. The variable $\max(centrality_i, centrality_j)$ is the highest level of centrality in the pair, so we can assess the likelihood of a credit relationship where at least one of the firms involved is a central firm. The variable $ownership_{ij}$ is a dummy for pairs with a direct ownership link between the firms. We also include fixed effects for time, firm or firm pair (μ_{ij}, which absorb individual firm fixed effects μ_i and μ_j). Standard errors are double-clustered by each firm in the pair.

As seen in Table 8, the likelihood of forming lending relationships during the crisis increases with the centrality of the pair (coefficient 0.088, t-stat 2.31). The average of $Lending_{ij,t}$ is 0.094 and the standard deviation of $\max(centrality_i, centrality_j)$ is 0.15, therefore a one-standard-deviation change in centrality increases the likelihood of starting a relationship during the crisis by 14% ($= 0.088 \times 0.15/0.094$) This already controls for pair fixed effects that absorb the average effect of ownership and centrality.

We focus on the pure effect of centrality since we control for ownership between the firms in each pair. Still, documenting the effect of ownership on lending is already a relevant result in line with the control rights theory of capital structure (Roberts and Sufi, 2009). Ownership has a positive effect on average (column 1 in Table 8). However, this effect does not have relevant variation across time, as implied by the insignificant interactions with the crisis dummy and the recovery dummy. In other words, direct ownership always matters, but it does not matter more during the crisis.

3.6 Real effects

3.6.1 Within group evidence

Our first focus is the performance of central firms vis-à-vis other group firms during the crisis. We run the main differences-in-differences regression using as dependent variable

measures of profitability (ROA, ROE) and stock market performance. Within stock market performance we consider the market-to-book ratio, returns, and extraordinary dividends.

Table 9 shows that centrality does not affect firm performance during the year of the crisis, despite the increasing lending and borrowing. The lack of an effect on stock market returns shows that minority shareholders do not receive worse returns for investing in central firms vis-à-vis other group firms.[15] We do not find evidence in favor of extraordinary dividends, which could also be a source of funding for firms above central firms in the control pyramid (see Gopalan, Nanda, and Seru, 2014, for the use of dividends in Indian groups). Finally, central firms do not increase external leverage during the crisis, which also fits with the previous finding that central firms do not need to finance a strong net lending position.

In Table 10 we focus on the firms that increased their net borrowing position (borrowing minus lending relationships) during the crisis. The dummy *Net Receiver in '09* is an indicator variable for these firms, and it is interacted with our previous time dummies for crisis, recovery, and the post period. We find that these firms had significantly higher ROA and ROE than other group firms during the crisis. This is consistent with the idea that new loans are used to sustain profitability in some firms, or that groups are good at "picking winners", i.e., more profitable firms (see Giroud and Mueller, 2015; Shin and Stulz, 1998, and Stein, 1997). These firms also had higher increases in investment (growth in PPE) and sales growth on the recovery after the crisis, although the effects are only marginally significant.

Results in both panels of Table 10 are similar. The sole difference between Panels A and B is the sample selection. In Panel A the excluded category in the regression is a mix of central firms, net providers of loans, and other group firms. In Panel B we drop central firms, so the excluded category is approximately firms that are net providers of loans (there are only a few firms that are neither receivers, nor providers of loans, nor central firms). The appendix (Table A.9) shows regressions using a similar dummy for net providers of loans and the results are the mirror image of those reported in Table 10.

One may not be interested in all providers, but only on providers to central firms, which we study in Table 11. We find that providers to central firms have lower profitability during the crisis, and, interestingly, that providers increase leverage. This

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[15]Ahern (2016) finds that more central firms in customer-supplier networks have higher average returns arguably because of their higher systematic risk. We measure centrality with respect to the ownership network of the business group and not to customer-supplier networks.

result is consistent with the idea that providers are using their market access to give support –through central firms– to receivers in the group.

3.6.2   Comparison with standalone firms

The main challenge to compare the behavior of group firms and standalone firms is that these firms can be radically different (see the selection into business groups in Almeida and Wolfenzon, 2006). In order to overcome this challenge we follow the synthetic control methodology proposed by Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010).[16] We build a synthetic control for each firm in our treatment group (i.e., central firms or receivers as defined in the previous section) using firms in the control group (i.e., standalone firms). The synthetic match minimizes the difference with the treated firm in the pre-crisis period. One of the advantages of this methodology is that it controls for unobserved factors that affect the common trend in the treatment and control groups (Abadie, Diamond, and Hainmueller, 2010).

Given that our sample includes several treated firms, we follow a strategy similar to Acemoglu, Johnson, Kermani, Kwak, and Mitton (2016). We first construct the synthetic control for each firm and then we aggregate individual treatment effects weighting by the quality of the match.[17] Our estimate takes the following form:

$$\theta(t) = \frac{\sum_{i \in \text{Treatment group}} \frac{ROA_{it} - \widehat{ROA}_{it}}{\sigma_i}}{\sum_{i \in \text{Treatment group}} \frac{1}{\sigma_i}}, \tag{3.5}$$

where $\widehat{ROA}_{it} = \sum_{j \in \text{Control group}} w_j^i ROA_{jt}$, with w_i^j being the optimal weights obtained from the minimization of pre-crisis differences in characteristics. $1/\sigma_i$ measures the goodness of fit for each match, hence better matches are given more weight in the estimation. Following the main selection variables proposed by Almeida and Wolfenzon (2006), we use five characteristics to create the synthetic control: log of assets, ROA, ROE, leverage, and growth in PPE. The sample period for the pre-crisis matching goes from 2004 to 2008. We focus on ROA as outcome variable since it is the most widely available measure of performance for group firms and standalone firms.

Figure 7 shows the average of ROA_{it} and $\widehat{ROA}_{it}$ in the case of central firms and receivers, each with their own set of synthetic controls. We can see that treated firms

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[16]See Almeida, Kim, and Kim (2015) for a related matching estimator in the case of group firms and standalone firms.

[17]Also following Acemoglu, Johnson, Kermani, Kwak, and Mitton (2016), and to increase the precision of our estimates, we drop those firms with a matching quality in the lowest 5% of the empirical distribution.

(central firms or receivers) have lower profitability than control firms during the year of the crisis (2009), although the differences are small in magnitude. One possible interpretation is that group firms suffer a short-term hit because, at the end of the day, the business group has to accommodate a shock that affects all of its affiliated firms. Notice that the underperformance is stronger in central firms relative to their controls, and almost non-existent in receivers. During the recovery year (2010) and subsequent years, treated firms have higher profitability than controls and the differences are much larger than during the crisis. Hence, we can argue that the stronger recovery more than compensates for the apparent cost paid by business group firms during the crisis.

In Table 12 we present the estimates of $\theta(t)$ for central firms and receivers. Column 1 shows the treatment effects while columns 2 and 3 show the confidence intervals at 1% and 5% levels. $\theta(t)$ is significant at 5% when not contained in the 5% confidence interval. The confidence intervals are constructed using 1,000 random draws for placebo treatment groups taken from the sample of standalone firms. Each placebo group has the same sample size as the real treatment group (seen in the last column of Table 12). We confirm the initial findings seen in Figure 7. Central firms do worse than controls in the year of the crisis (-1.5%), but significantly better in the recovery year (5.2%). Differences between central firms and controls are not significant later on. Receivers do not perform significantly worse than controls during the year of the crisis. However, receivers do significantly better in the recovery year (3.2%) and subsequent years. It is possible to argue that intra-group credit relationships, many of which go beyond the recovery year of 2010 (see Figure 4), allow receivers to sustain higher profitability for longer than comparable standalone firms.

4   Conclusions

Business groups are networks of firms. We study the reaction of these networks to the crisis of 2008-9 using a unique dataset of intra-group loans in Chile. Intra-group lending increased swiftly during the crisis. Firms that were more central in the ownership network increased internal lending and borrowing at the same time. Central firms did not experience a significant fall in profitability relative to the average group firm during the crisis. Receivers of intra-group loans perform significantly better than central firms. Receivers do not perform better than standalone firms during the crisis, but they perform significantly better than standalone firms in subsequent years. Overall, our results show that control links, such as those that relate firms in a business group, ease financial contracting at times of distress.

The network perspective provides new insights when compared to previous theories of business groups. It allows us to highlight the advantage of business groups in credit intermediation. The endogenous formation of networks is a matter of ongoing research in the networks literature (see Chandrasekhar, 2016). Along those lines, the question of why business groups are born as networks of firms and how they evolve in the long-run is an interesting avenue for future research.

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Figure 1: **Ownership and credit links**
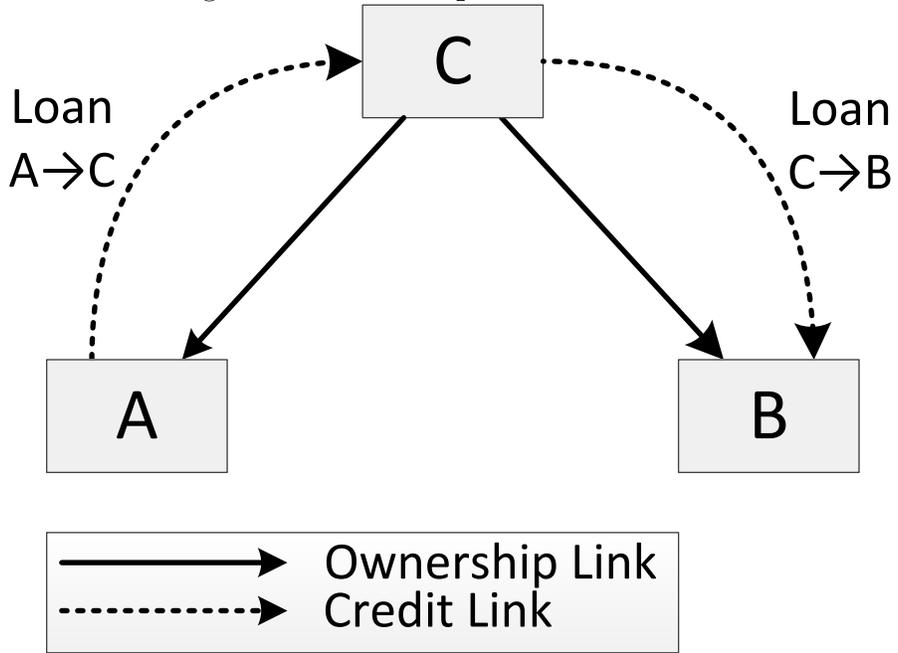
Figure 2: **Ownership structure of Claro group**
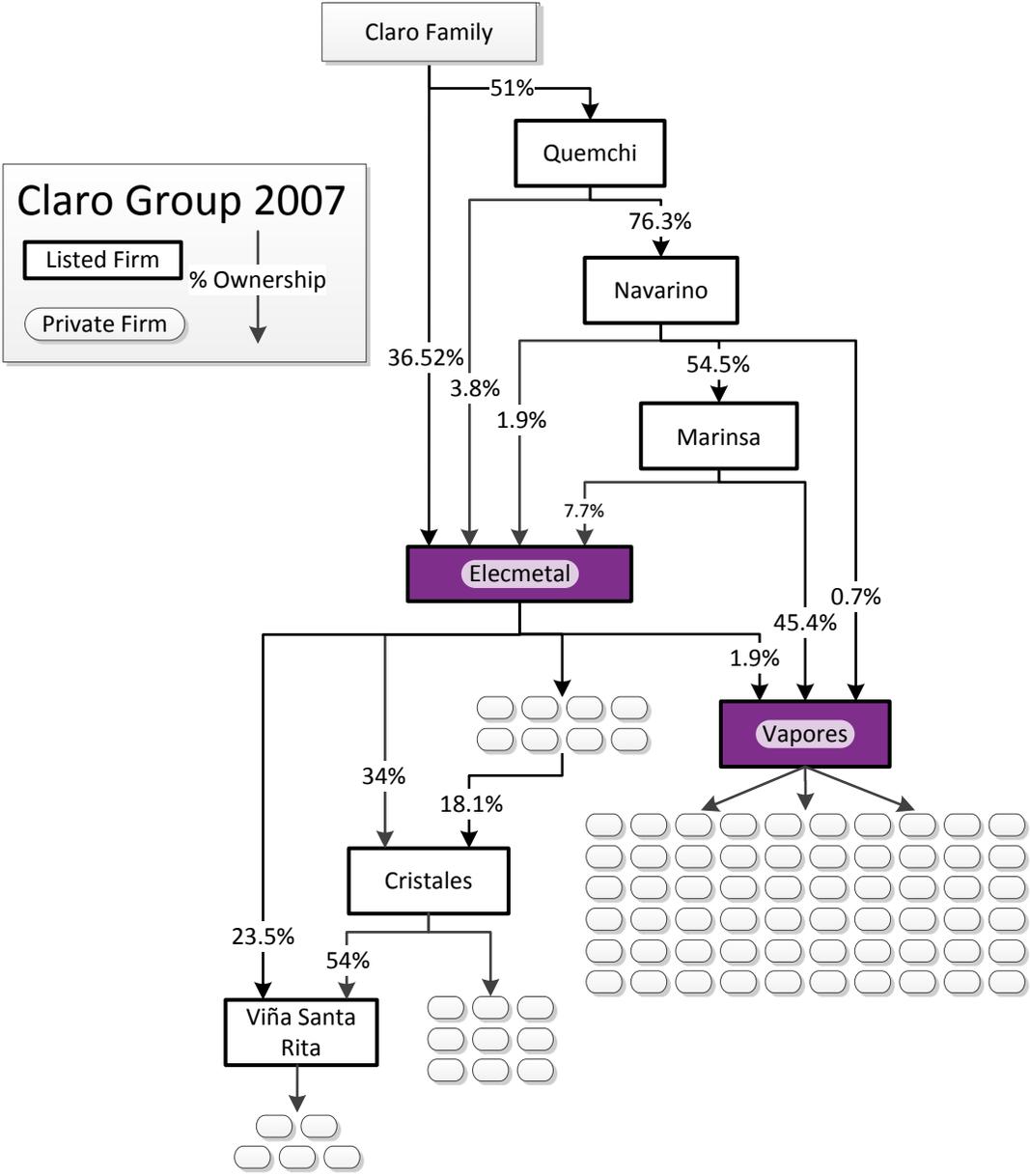
Notes: This figure shows the ownership structure of the Claro group in 2007. Firms in dark shade are the two most central firms based on betweenness centrality in the ownership network.

Figure 3: **Industrial activity**
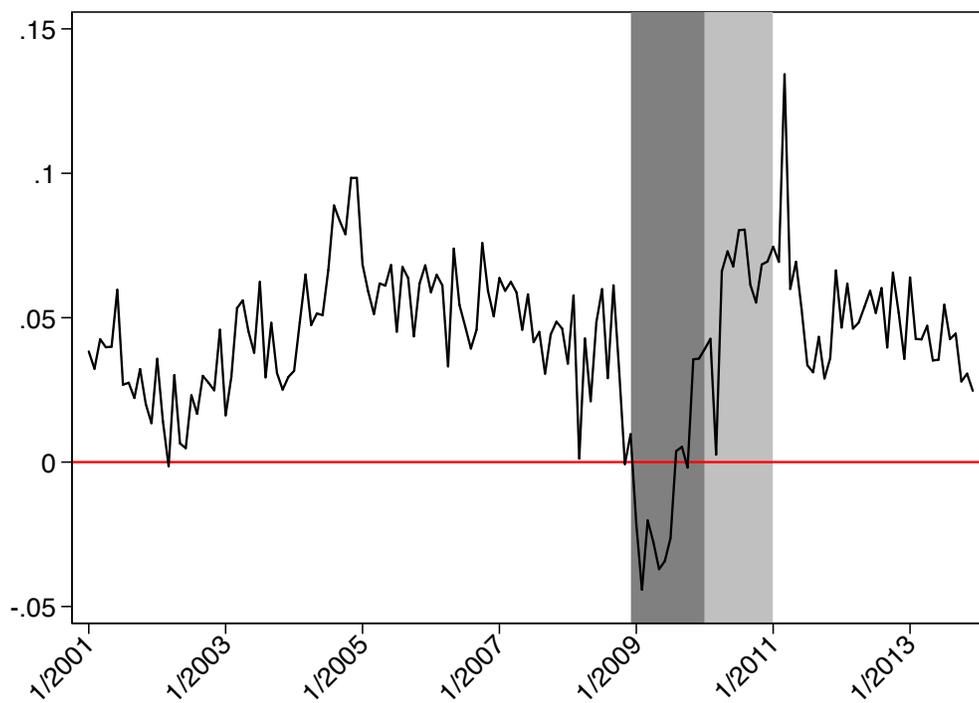
Notes: This figure shows the time series of Chilean 12-month log change in industrial activity (IMACEC). The darker grey area shows the *crisis* period, while the lighter grey area shows the *recovery* period.

Figure 4: **Lending, borrowing, and ownership relationships across time**
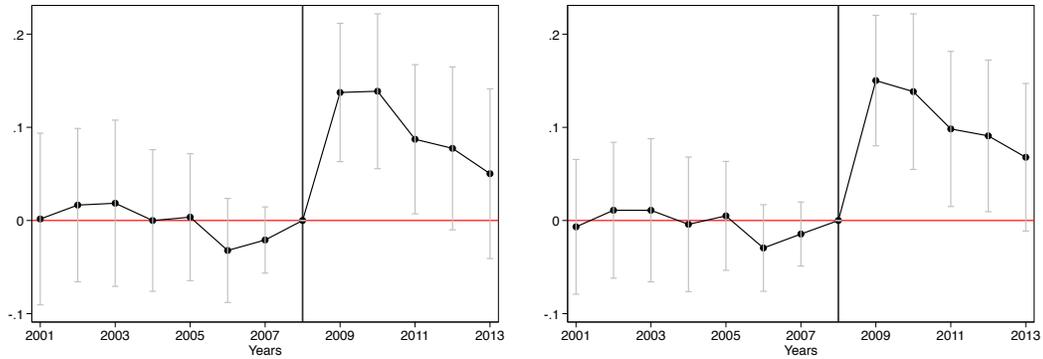
A. Lending - All firms

B. Borrowing - All firms
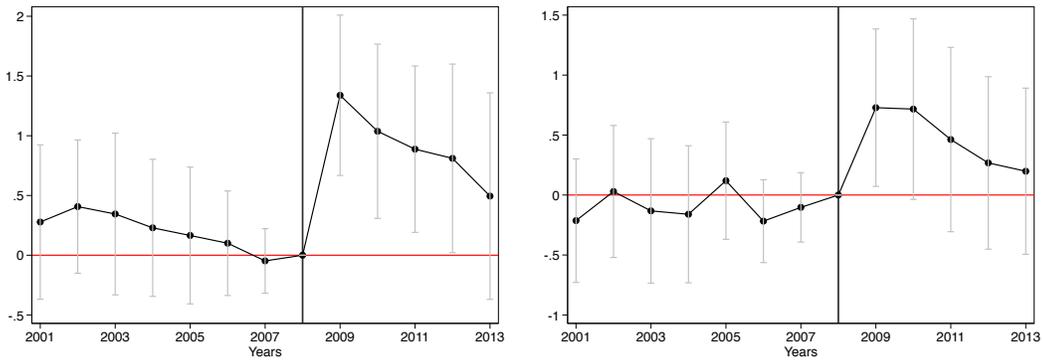
C. Lending - Listed firms

D. Borrowing - Listed firms
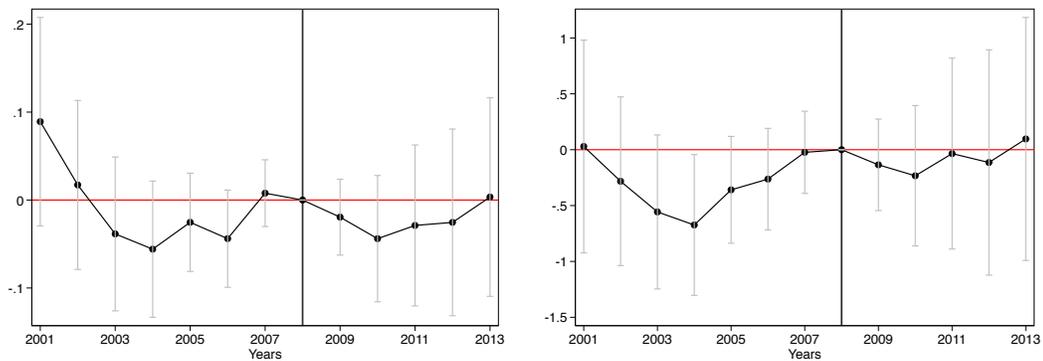
E. Ownership relationships - All firms

F. Ownership relationships - Listed firms

Notes: This figure shows the number of lending, borrowing, and ownership relationships across years for all the firms in our sample and for listed firms. Each dot is a coefficient from a regression of the variable of interest on year dummies excluding year 2008. Grey bars represent the 95% confidence intervals.

Figure 5: **The role of firm centrality in lending and borrowing relationships**
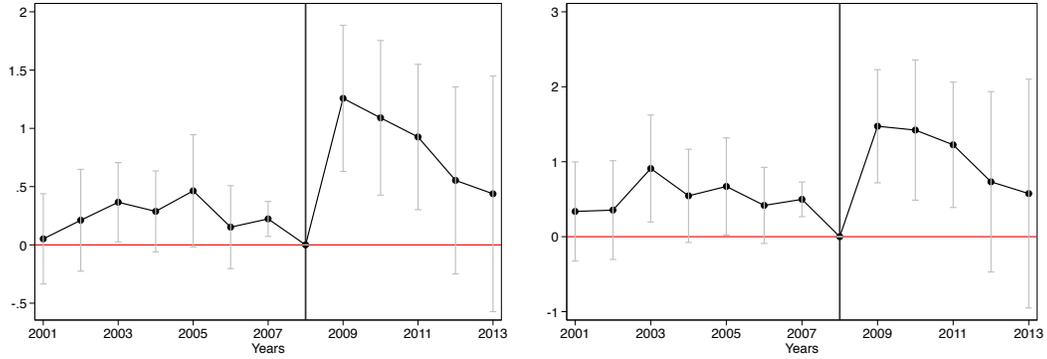
A. Lending + Borrowing - All firms

B. Lending + Borrowing - Listed firms
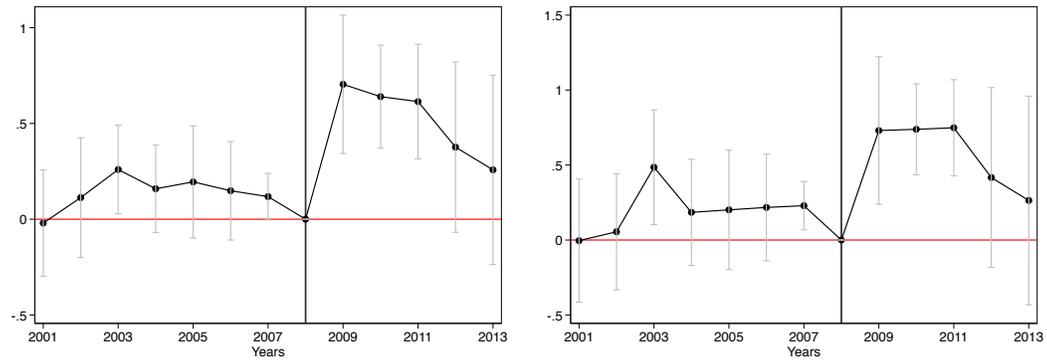
C. Lending - All firms

D. Lending - Listed firms
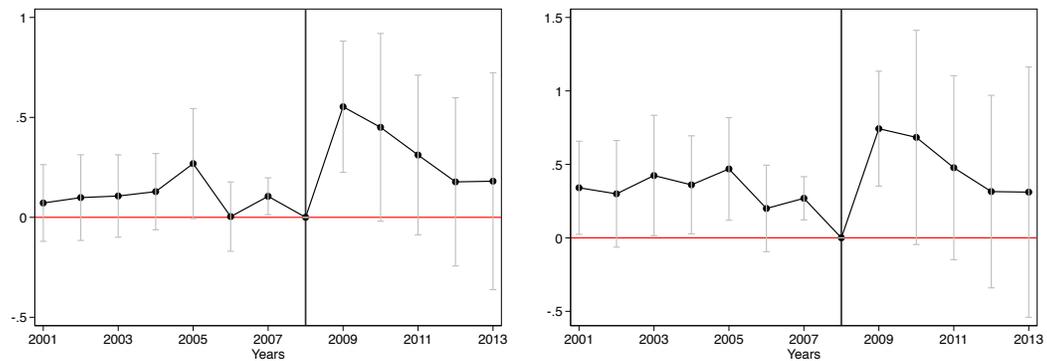
E. Borrowing - All firms

F. Borrowing - Listed firms

Notes: This figure shows the first version of our difference-in-difference specification. Each dot is a coefficient from a regression of the variable of interest on year dummies excluding year 2008 interacted with centrality in 2007. Grey bars represent the 95% confidence intervals.

Figure 6: **Network of internal capital markets**
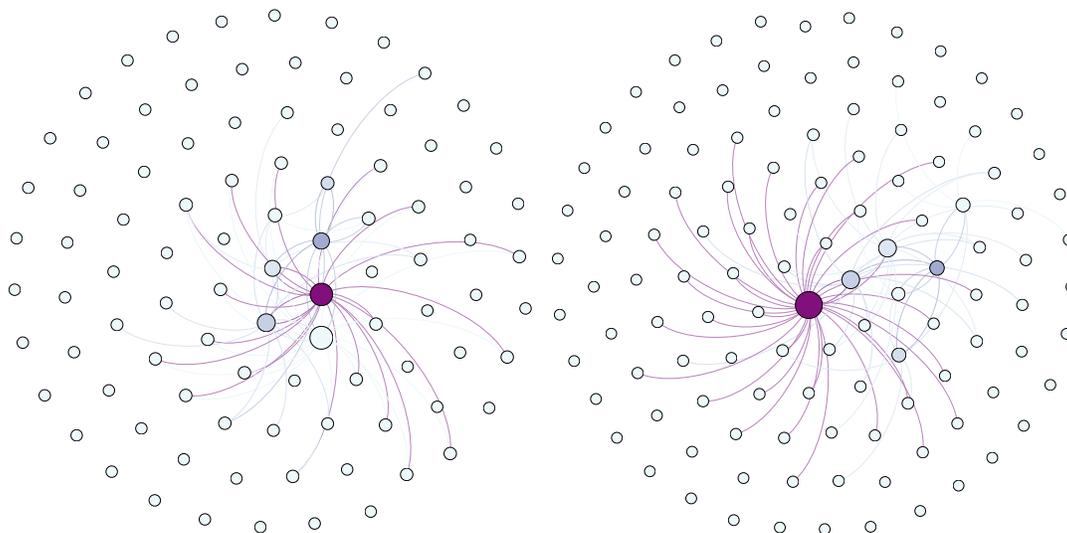
A. Claro Business Group in 2007

B. Claro Business Group in 2009
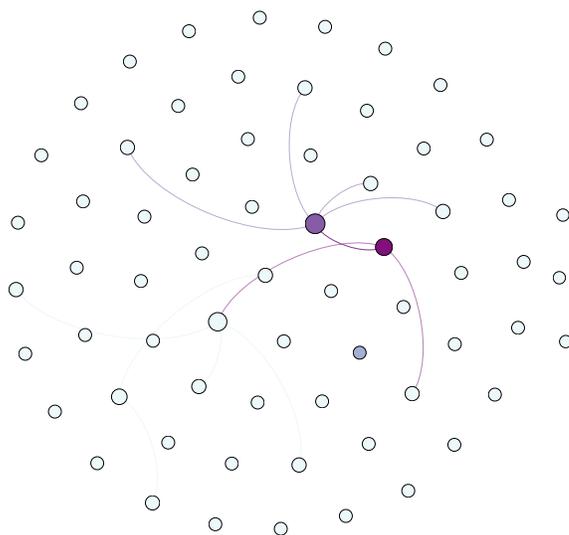
C. Ponce Business Group in 2007
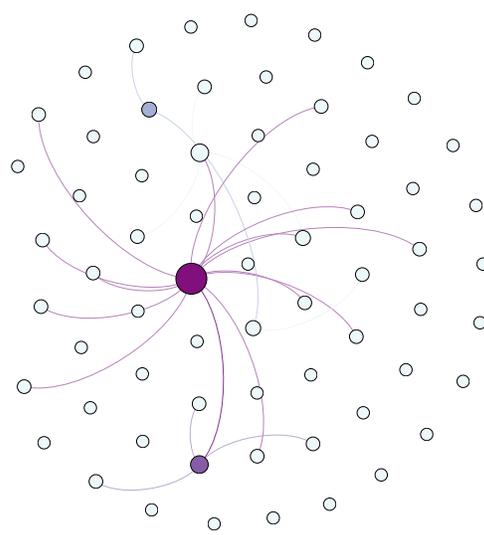
D. Ponce Business Group in 2009

Notes: This figure shows the network of lending and borrowing relationships in 2007 and 2009 for Claro group (Panels A and B) and Ponce group (Panels C and D). Each node represents a firm in these business groups, while a link is an intra-group loan between two firms. The color of the node represents the betweenness centrality of a firm in the ownership network in 2007. The darker the color the more central the firm in 2007. The size of the nodes shows the intra-group loans of a firm in each year relative to the distribution in 2009. In this way the size of the nodes are comparable across years.

Figure 7: **Business group firms vs. synthetic controls**
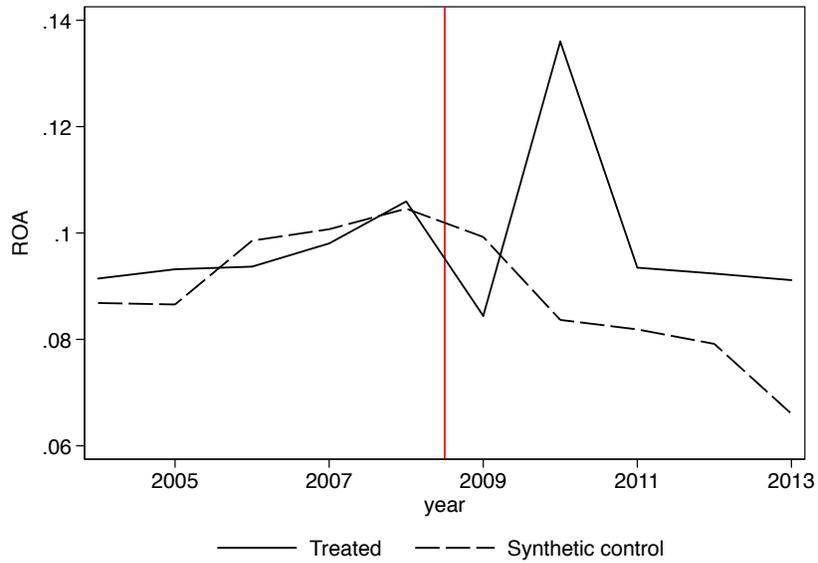
A. Central firms
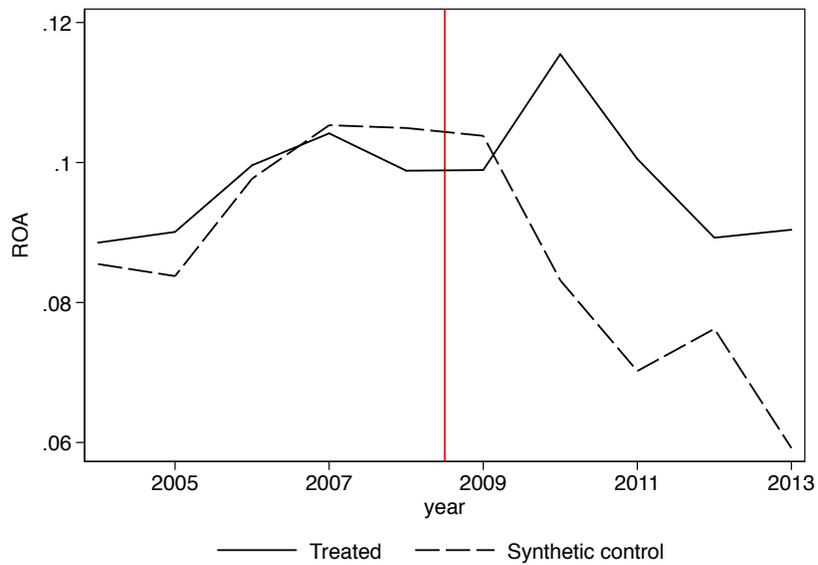
B. Receivers

Notes: This figure shows the average ROA for firms in business groups and synthetic controls based on standalone firms from 2004 to 2013. Panel A shows results for central firms in business groups, while panel B shows results for receivers in business groups.

Table 1: **Intra-Group loans in Claro group**

Reporting Firm	Related Firm	Direct Ownership %
QUEMCHI	ELECMETAL	3.80
NAVARINO	ELECMETAL	1.90
MARINSA	ELECMETAL	7.71
MARINSA	INVERSIONES Y SERVICIOS RIGEL	.
MARINSA	ORION SERVICIOS MERCANTILES INTEGRADOS	.
MARINSA	SAN ANTONIO TERMINAL INTERNACIONAL	.
MARINSA	SAN VICENTE TERMINAL INTERNACIONAL	.
MARINSA	SERVICIOS PORTUARIOS RELONCAVI	.
ELECMETAL	MARINSA	.
VAPORES	INVERSIONES Y SERVICIOS RIGEL	33.33
VAPORES	ORION SERVICIOS MERCANTILES INTEGRADOS	33.33
VAPORES	SAN ANTONIO TERMINAL INTERNACIONAL	50.00
VAPORES	SAN VICENTE TERMINAL INTERNACIONAL	50.00
VAPORES	SERVICIOS PORTUARIOS RELONCAVI	50.00
CRISTALES	ELECMETAL	.
CRISTALES	SERVICIOS Y CONSULTORIAS HENDAYA	.
CRISTALES	V.T.R. GLOBAL COM	20.00
CRISTALES	VIÑA LOS VASCOS	.
VIÑA SANTA RITA	CRISTALES	.
VIÑA SANTA RITA	ENVASES CMF	.
VIÑA SANTA RITA	SUD. AMERICANA AGENCIA AEREAS Y MARITIMAS	.

Notes: This table shows a sample of loans between firms for the Claro group in 2007. The reporting firm is the firm which reports the information; the related firm is the firm with which the reporting firm has the outstanding balance; direct ownership is the direct ownership stake of the reporting firm over the related firm. Missing ownership values mean either that the related firm has ownership over the reporting firm or that the reporting firm has no direct link to the related firm. Loans are shown only if outstanding balances are larger than a 100,000 USD.

Table 2: **Summary statistics**

	Mean	Median	Std. Dev.	Min	Max	# Obs.
Panel A: All firms						
L + B relat.	1.12	0	3.14	0	44	13612
Lending (L) relat.	.56	0	1.74	0	24	13612
Borrowing (B) relat.	.558	0	1.59	0	23	13612
Betweenness centrality	.011	0	.063	0	1	13612
Degree centrality	1.3	1	3.27	0	65	13612
Panel B: Listed firms						
L + B relat.	7.99	5	7.52	0	44	887
Lending (L) relat.	4.22	3	4.28	0	23	887
Borrowing (B) relat.	3.77	2	3.91	0	23	887
ROA	.070	.066	.084	-.496	.332	880
ROE	.098	.099	.182	-1	.63	880
Ln Assets	19.6	19.5	1.61	15.3	22.9	880
External leverage	.365	.388	.176	.0003	.881	877
PPE Growth	.029	.036	.285	-1	1	877
Cash holdings	.288	.244	.197	.005	.991	877
Cash flow rights	.506	.501	.22	.03	.981	887
Tobin's Q	1.09	.978	.617	.128	7.41	839
Stock market returns	.314	.178	.603	-.504	3.33	803
Stock market liquidity	.0096	.0007	.0214	0	.161	887
Extraordinary dividends	.658	1	.475	0	1	887
Mkt to Book equity	1.2	.937	1.1	.006	10.7	837
I-O BG Integration	.036	.0019	.0767	0	.421	887
Betweenness centrality	.137	.066	.175	0	1	887
Degree centrality	9.3	7	8.65	1	65	887
Panel C: Business Groups						
Number of bus. groups	22					
Number of firms	45.9	31	35.8	3	117	22
Listed firms	4.18	3	2.65	2	11	22

Notes: This table shows summary statistics for three samples: all firms which includes listed and private firms (Panel A), a sample with only listed firms (Panel B), and aggregate statistics at the group level in the year 2007 (Panel C) . The period of the sample is 2001 to 2013. Lending and borrowing relationships measure the total number of borrowing/lending relationships a firm has with other firms in the business group. *ROA* (earnings over total assets), *ROE* (earnings over book equity), *Ln Assets* (logarithm of total assets), *External leverage* (financial debt over book assets), *PPE Growth* (log change in property, plant, and equipment), *Cash holdings* (short-term assets over total assets), *Cash flow rights* is the cash flow right of the controlling shareholder, *Tobin's Q* (market equity plus book debt over book assets), *Stock market returns* (yearly stock market returns), *Stock market liquidity* (traded volume over total traded volume in the same industry), *Extraordinary dividends* (dummy for those firms paying higher dividends than the ones required by law), *Mkt to Book equity* (the ratio of the market value of equity over the book value), and *I-O BG Integration* (the average input-output integration of the firm within the business group) are winsorized at the 1% level of the empirical distribution. *Betweenness centrality* and *Degree centrality* are measures of centrality in the undirected ownership network.

Table 3: **Differences in observables by firm centrality**

| | Mean | | | |
	Central	Non-central	p-value	p-value permutation test
L + B relat.	7.55	6.71	0.61	0.60
Lending (L) relat.	4.33	3.30	0.26	0.27
Borrowing (B) relat.	3.22	3.41	0.83	0.84
ROA	0.10	0.09	0.70	0.69
ROE	0.15	0.14	0.79	0.80
Ln Assets	20.30	19.29	0.01	0.01
External leverage	0.45	0.32	0.00	0.00
PPE Growth	0.11	0.11	0.94	0.94
Cash holdings	0.36	0.32	0.39	0.38
Cash flow rights	0.42	0.54	0.03	0.02
Tobin's Q	1.30	1.22	0.60	0.66
Stock market returns	0.229	0.423	0.16	0.17
Extraordinary dividends	0.888	0.696	0.11	0.13
Stock market liquidity	0.017	0.004	0.00	0.00
Mkt to Book equity	1.69	1.41	0.35	0.34
I-O BG Integration	0.049	0.030	0.35	0.36
# Obs	19	57		

Notes: This table presents tests for differences in means between central and non-central firms in the ownership network in 2007. The sample includes only listed firms. *Central* firms are defined as those firms with betweenness centrality in the top quartile of the empirical distribution in 2007. *p-value* is the p-value of the two-sided difference in means test. *p-value permutation test* is based on Monte Carlo permutation tests (500 permutations). See Table 2 for variables definitions.

Table 4: **The role of central firms in lending and borrowing relationships**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		All firms				Listed firms		
	L + B	Lending	Borrowing	L-B	L + B	Lending	Borrowing	L-B
Crisis × Centrality in 07'	1.042***	0.585***	0.457**	0.128	1.203**	0.664**	0.538**	0.126
	(0.375)	(0.218)	(0.183)	(0.148)	(0.479)	(0.295)	(0.234)	(0.234)
Recovery × Centrality in 07'	0.875**	0.521***	0.354	0.167	1.036*	0.612***	0.423	0.189
	(0.380)	(0.175)	(0.241)	(0.183)	(0.521)	(0.205)	(0.365)	(0.281)
Post × Centrality in 07'	0.425	0.298	0.128	0.170	0.451	0.335	0.115	0.220
	(0.415)	(0.206)	(0.225)	(0.116)	(0.589)	(0.265)	(0.338)	(0.147)
Observations	10,027	10,027	10,027	10,027	887	887	887	887
R-squared	0.040	0.035	0.026	0.005	0.071	0.059	0.052	0.012
Number of firms	1,034	1,034	1,034	1,034	74	74	74	74
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents a differences-in-differences estimation for lending and borrowing relationships from 2001 to 2013. Columns (1) to (4) present results for our full sample of listed and private firms, while columns (5) to (8) show results for our sample of listed firms. *L + B* is defined as the number of borrowing relationships plus lending relationships. *L-B* is defined as the number of lending relationships minus borrowing relationships. *Centrality in 07'* is defined as betweenness centrality in the ownership network in year 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, 2011-2013, respectively. Robust standard errors clustered at the firm level are reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5: **The role of central firms in lending and borrowing relationships by loan duration**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		All firms				Listed firms		
	L + B	Lending	Borrowing	L-B	L + B	Lending	Borrowing	L-B

Panel A: Short term

Crisis × Centrality in 07'	1.071***	0.601***	0.470**	0.132	1.230**	0.662**	0.567**	0.095
	(0.368)	(0.210)	(0.182)	(0.139)	(0.469)	(0.283)	(0.233)	(0.219)
Recovery × Centrality in 07'	0.943**	0.573***	0.370	0.203	1.100**	0.674***	0.425	0.249
	(0.376)	(0.172)	(0.239)	(0.180)	(0.515)	(0.200)	(0.361)	(0.274)
Post × Centrality in 07'	0.479	0.340*	0.139	0.202*	0.491	0.369	0.122	0.247
	(0.410)	(0.203)	(0.222)	(0.116)	(0.581)	(0.263)	(0.333)	(0.149)

Panel B: Long term

Crisis × Centrality in 07'	-0.064	-0.038	-0.026	-0.012	-0.052	-0.022	-0.030	0.008
	(0.055)	(0.045)	(0.017)	(0.039)	(0.090)	(0.070)	(0.028)	(0.057)
Recovery × Centrality in 07'	-0.177***	-0.120***	-0.057***	-0.063	-0.168***	-0.146***	-0.022	-0.124**
	(0.039)	(0.037)	(0.012)	(0.039)	(0.052)	(0.048)	(0.027)	(0.059)
Post × Centrality in 07'	-0.232***	-0.131***	-0.102**	-0.029	-0.135	-0.090*	-0.045	-0.046
	(0.051)	(0.036)	(0.045)	(0.063)	(0.104)	(0.054)	(0.088)	(0.102)

Observations	10,027	10,027	10,027	10,027	887	887	887	887
R-squared	0.040	0.035	0.026	0.005	0.071	0.059	0.052	0.012
Number of firms	1,034	1,034	1,034	1,034	74	74	74	74
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents a differences-in-differences estimation for lending and borrowing relationships from 2001 to 2013. Columns (1) to (4) present results for our full sample of listed and private firms, while columns (5) to (8) show results for our sample of listed firms. Panel A presents the results for short-term loans, while Panel B presents the results for long-term loans. $L + B$ is defined as the number of borrowing relationships plus lending relationships. $L\text{-}B$ is defined as the number of lending relationships minus borrowing relationships. *Centrality in 07'* is defined as betweenness centrality in the ownership network in year 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, 2011-2013, respectively. Robust standard errors clustered at the firm level are reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6: **The role of central firms in lending and borrowing relationships: adding pre-crisis controls**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Lending + Borrowing				
Crisis × Centrality in 07'	1.243**	1.007**	1.204**	1.430***	1.229**	1.073**	1.207**	1.244**
	(0.503)	(0.502)	(0.480)	(0.540)	(0.484)	(0.486)	(0.481)	(0.558)
Recovery × Centrality in 07'	0.870	1.117**	1.015*	1.460**	1.036**	0.957**	1.116**	1.288**
	(0.544)	(0.504)	(0.515)	(0.589)	(0.508)	(0.400)	(0.522)	(0.503)
Post × Centrality in 07'	0.333	0.450	0.431	0.660	0.492	0.382	0.517	0.501
	(0.605)	(0.598)	(0.584)	(0.664)	(0.523)	(0.528)	(0.608)	(0.589)
Crisis × Cash flow rights 07'	2.054							-0.369
	(4.511)							(4.585)
Recovery × Cash flow rights 07'	-5.386							-5.699**
	(3.255)							(2.727)
Post × Cash flow rights 07'	-4.971							-6.286**
	(2.993)							(2.506)
Crisis × Ln Assets in 07'		0.564						0.424
		(0.481)						(0.530)
Recovery × Ln Assets in 07'		-0.245						-0.053
		(0.476)						(0.537)
Post × Ln Assets in 07'		-0.005						0.465
		(0.498)						(0.533)
Crisis × Tobin's Q in 07'			-0.027					0.440
			(0.832)					(1.072)
Recovery × Tobin's Q in 07'			0.872					0.644
			(0.919)					(1.330)
Post × Tobin's Q in 07'			0.845					0.727
			(0.909)					(1.252)
Crisis × Leverage in 07'				-6.826				-7.630
				(5.984)				(6.111)
Recovery × Leverage in 07'				-12.214**				-13.115**
				(5.861)				(6.240)
Post × Leverage in 07'				-6.090				-8.159
				(5.627)				(5.727)
Crisis × Cash holdings in 07'					-7.010**			-6.363*
					(3.212)			(3.239)
Recovery × Cash holdings in 07'					-2.429			-4.532
					(3.286)			(3.249)
Post × Cash holdings in 07'					-7.573**			-7.570**
					(3.478)			(2.941)
Crisis × Stock Liquidity in 07'						31.829		12.055
						(50.788)		(58.836)
Recovery × Stock Liquidity in 07'						18.626		25.678
						(55.258)		(58.680)
Post × Stock Liquidity in 07'						16.238		-0.617
						(53.146)		(57.349)
Crisis × I-O BG integration							0.191	0.011
							(17.892)	(16.794)
Recovery × I-O BG integration							-24.881**	-23.319***
							(10.713)	(8.280)
Post × I-O BG integration							-22.849*	-19.131*
							(11.979)	(10.073)
Observations	887	887	887	887	887	887	887	887
R-squared	0.091	0.075	0.074	0.090	0.096	0.073	0.115	0.182
Number of firms	74	74	74	74	74	74	74	74
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

Notes: This table presents a differences-in-differences estimation for lending and borrowing relationships from 2001 to 2013. Columns (1) to (4) present results for our full sample of listed and private firms, while columns (5) to (8) show results for our sample of listed firms. $L + B$ is defined as the number of borrowing relationships plus lending relationships. $L\text{-}B$ is defined as the number of lending relationships minus borrowing relationships. *Centrality in 07'* is defined as betweenness centrality in the ownership network in year 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, 2011-2013, respectively. See Table 2 for definition of pre-crisis controls. Robust standard errors clustered at the firm level are reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7: **The role of central firms in lending and borrowing relationships: heterogeneity by group characteristics**

	(1)	(2)	(3)	(4)
		Lending + Borrowing		
	All firms	Listed firms	All firms	Listed firms
	Less pyramidal		**More pyramidal**	
Crisis × Centrality in 07'	0.441	0.040	1.417***	1.681***
	(0.419)	(0.829)	(0.475)	(0.495)
Recovery × Centrality in 07'	0.405	0.256	1.183**	1.342*
	(0.370)	(0.680)	(0.567)	(0.712)
Post × Centrality in 07'	-0.004	-0.189	0.664	0.727
	(0.366)	(0.655)	(0.632)	(0.865)
Observations	4,119	391	5,908	496
R-squared	0.018	0.058	0.064	0.098
Number of firms	420	32	614	42
	High diversification		**Low diversification**	
Crisis × Centrality in 07'	1.034**	0.838	1.060*	1.924**
	(0.496)	(0.693)	(0.583)	(0.844)
Recovery × Centrality in 07'	0.728***	0.496*	1.052	2.141*
	(0.233)	(0.249)	(0.729)	(1.138)
Post × Centrality in 07'	0.071	-0.157	0.832	1.617*
	(0.370)	(0.420)	(0.685)	(0.939)
Observations	5,709	524	4,318	363
R-squared	0.033	0.068	0.066	0.153
Number of firms	591	44	443	30
	High Tobin's Q Div.		**Low Tobin's Q Div.**	
Crisis × Centrality in 07'	0.989*	1.431	1.123**	1.133**
	(0.600)	(0.966)	(0.454)	(0.559)
Recovery × Centrality in 07'	1.243*	2.162*	0.528**	0.441
	(0.701)	(1.112)	(0.254)	(0.284)
Post × Centrality in 07'	1.026	1.865*	-0.130	-0.294
	(0.671)	(0.927)	(0.318)	(0.362)
Observations	5,037	418	4,990	469
R-squared	0.081	0.164	0.041	0.095
Number of firms	530	35	504	39
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Notes: This table presents a differences-in-differences estimation for lending and borrowing relationships from 2001 to 2013. Columns (1) and (3) present results for our full sample of listed and private firms, while columns (2) to (4) show results for our sample of listed firms. $L + B$ is defined as the number of borrowing relationships plus lending relationships. Panel A splits the sample by those groups with a more/less pyramidal structure. Panel B shows the results for a sample of firms in a group with high and low diversification, where diversification is measured as the number of industries where the group has firms in 2007. Panel C splits the sample by those groups with high and low Tobin's Q divergence, measured as the standard deviation of firm's Tobin's Q in 2007. *Centrality in 07'* is defined as betweenness centrality in the ownership network in year 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, 2011-2013, respectively. Robust standard errors clustered at the firm level are reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 8: **Likelihood of lending relationships**

	(1)	(2)
	Dummy for lending relationship	
Crisis × Max centrality in 07'	0.074**	0.088**
	(0.037)	(0.038)
Recovery × Max centrality in 07'	0.087**	0.098
	(0.039)	(0.363)
Post × Max centrality in 07'	0.139***	0.139
	(0.040)	(0.917)
Max centrality in 07'	-0.942***	-
	(0.319)	(-)
Crisis × Ownership link in 07'	-0.027	-0.032
	(0.022)	(0.022)
Recovery × Ownership link in 07'	-0.027	-0.036
	(0.026)	(0.026)
Post × Ownership link in 07'	-0.050*	-0.052*
	(0.029)	(0.028)
Ownership link in 07'	0.154***	-
	(0.021)	(-)
Observations	46,651	46,651
R-squared	0.365	0.694
Year Fe	Yes	Yes
Firm1 FE	Yes	No
Firm2 FE	Yes	No
Pair FE	No	Yes
Avg. Dep. Var.	0.016	0.016

Notes: This table shows a pair-level regression for lending relationships. We count each pair of firms only once. The number of potential relationships in a group is the total number of firm pairs that can be formed between listed firms, and between listed and private firms. Our dependent variable is dummy equal to one when there is a lending relationship between a pair of firms in the group in a given year, and zero otherwise. *Max centrality in 07'* is the highest level of centrality in the pair in 2007, and *Ownership link in 07'* is a dummy for pairs with a direct ownership link between the firms in 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, and 2011-2013, respectively. Robust standard errors are double-clustered by each firm in the pair, reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 9: **Impact on central firms**

	(1) ROA	(2) ROE	(3) Mkt to Book Eq	(4) Stock Ret.	(5) Extraordinary Dividends	(6) External Leverage
Crisis × Centrality in 07'	-0.008	-0.035	0.068	0.023	0.003	-0.009
	(0.010)	(0.033)	(0.063)	(0.027)	(0.035)	(0.008)
Recovery × Centrality in 07'	0.010***	0.025*	0.066	0.057*	-0.010	-0.018**
	(0.004)	(0.014)	(0.087)	(0.033)	(0.036)	(0.008)
Post × Centrality in 07'	-0.001	-0.001	0.023	-0.001	0.011	-0.011
	(0.007)	(0.023)	(0.080)	(0.024)	(0.017)	(0.009)
Observations	880	880	834	803	887	877
R-squared	0.070	0.080	0.187	0.222	0.033	0.098
Number of firms	74	74	74	74	73	74
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows a differences-in-differences estimation of firm performance. *Centrality in 07'* is defined as betweenness centrality in the ownership network in year 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, and 2011-2013, respectively. See Table 2 for variables definition. Robust standard errors clustered at the firm level are reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 10: **Impact on receivers**

	(1) ROA	(2) ROE	(3) Δ PPE	(4) Δ Sales	(5) External leverage
Panel A: All firms					
Crisis × Net Receiver in 09'	0.037**	0.107**	-0.207	-0.027	-0.034
	(0.019)	(0.053)	(0.259)	(0.225)	(0.051)
Recovery × Net Receiver in 09'	0.020	0.039	0.626*	0.550*	0.056
	(0.016)	(0.035)	(0.349)	(0.285)	(0.070)
Post × Net Receiver in 09'	-0.001	0.050	0.172	0.225	0.067
	(0.018)	(0.046)	(0.155)	(0.153)	(0.063)
Observations	880	880	877	877	874
R-squared	0.061	0.067	0.047	0.046	0.107
Number of firms	74	74	74	74	74
Panel B: Excluding central firms					
Crisis × Net Receiver in 09'	0.042**	0.103*	-0.329	-0.054	-0.004
	(0.020)	(0.060)	(0.375)	(0.295)	(0.069)
Recovery × Net Receiver in 09'	0.025	0.066	0.956*	0.828*	0.129
	(0.019)	(0.043)	(0.512)	(0.417)	(0.094)
Post × Net Receiver in 09'	0.009	0.065	0.187	0.304	0.135
	(0.024)	(0.063)	(0.223)	(0.211)	(0.087)
Observations	666	666	664	664	664
R-squared	0.051	0.067	0.062	0.056	0.160
Number of firms	56	56	56	56	56
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Notes: This table shows a differences-in-differences estimation of firm performance and other characteristics. We define *Net Receiver* as the number of borrowing relationships minus lending relationships, and *Net Receiver in '09* is defined a dummy for when the change in Net Receiver position from 2008 to 2009 is positive. Panel A includes our whole sample of business group firms, while Panel B excludes those firms with a betweenness centrality in the top quartile in 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, and 2011-2013, respectively. See Table 2 for variables definition. Robust standard errors clustered at the firm level are reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 11: **Impact on net providers to central firms**

	(1) ROA	(2) ROE	(3) Δ PPE	(4) Δ Sales	(5) External leverage
Crisis × Net provider to central	-0.086*	-0.322*	-0.138	-0.421	0.155**
	(0.046)	(0.185)	(0.291)	(0.326)	(0.060)
Recovery × Net provider to central	-0.024	-0.102**	-0.194	-0.451***	0.129**
	(0.027)	(0.041)	(0.197)	(0.117)	(0.051)
Post × Net provider to central	-0.010	-0.160**	-0.970*	-1.204**	-0.081
	(0.016)	(0.061)	(0.511)	(0.584)	(0.086)
Observations	880	880	877	877	874
R-squared	0.070	0.098	0.059	0.070	0.122
Number of firms	74	74	74	74	74
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Notes: This table shows a differences-in-differences estimation of firm performance and other characteristics. We define *Central* as a dummy for those firms in the highest quartile of betweenness centrality in 2007, and *Net provider to central* is defined a dummy for those firms that had a net lending position with central firms in 2009. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, and 2011-2013, respectively. See Table 2 for variables definition. Robust standard errors clustered at the firm level are reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 12: **Business group firms vs. standalone firms**

	(1) Treatment effect	(2) C.I. at 5%	(3) C.I. at 1%	(4) Number of Treated firms
Panel A: Treatment=Central firms				
2009 (Crisis)	-0.015**	[0.014, -0.013]	[0.018, -0.015]	17
2010 (Recovery)	0.052***	[0.030, -0.003]	[0.035, -0.006]	17
2011 (Post)	0.012	[0.041, -0.003]	[0.048, -0.011]	17
2012 (Post)	0.013	[0.037, -0.009]	[0.045, -0.014]	17
2013 (Post)	0.025	[0.028, -0.008]	[0.033, -0.012]	17
Panel B: Treatment=Receivers				
2009 (Crisis)	-0.005	[0.008, -0.007]	[0.011, -0.008]	23
2010 (Recovery)	0.032***	[0.014, -0.003]	[0.017, -0.006]	23
2011 (Post)	0.030***	[0.019, -0.004]	[0.024, -0.006]	23
2012 (Post)	0.013**	[0.018, -0.007]	[0.021, -0.010]	23
2013 (Post)	0.031***	[0.013, -0.005]	[0.016, -0.008]	23

Notes: This table presents treatment effects for central firms and receivers against synthetic controls. Column (1) presents the treatment effect, while column (2) and (3) presents confidence intervals at 5% and 1%, respectively. Confidence intervals are based on placebo treatment groups in 1,000 random samples. Column (4) shows the number of treated firms. The synthetic control is created using 50 standalone firms. Panel A shows the results for those firms with betweenness centrality in the top quartile, while panel B presents the results only for net receivers during the financial crisis as defined in Table 10. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Online Appendix

Figure A.1: **Lending, borrowing, and ownership relationships across time**
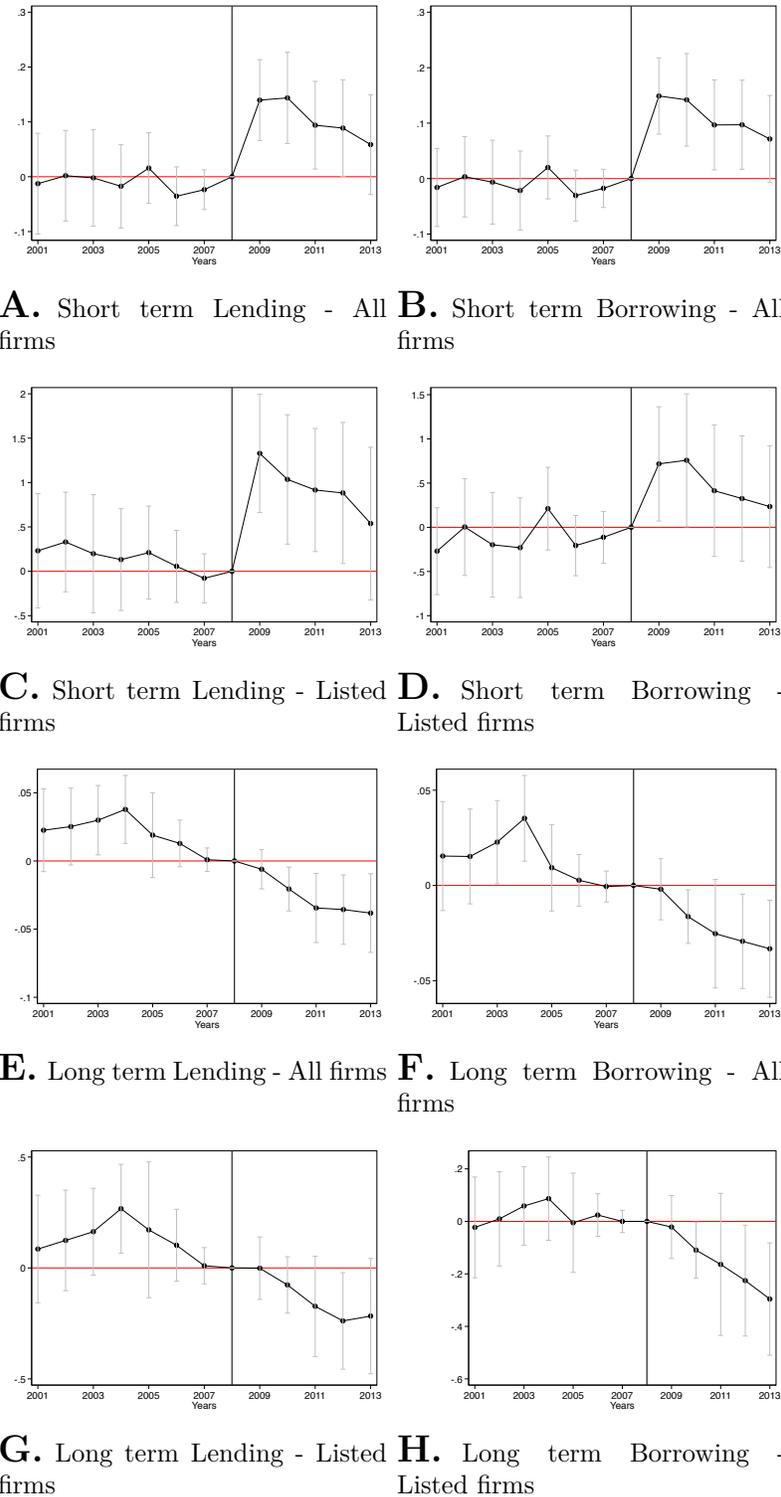
A. Short term Lending - All firms

B. Short term Borrowing - All firms

C. Short term Lending - Listed firms

D. Short term Borrowing - Listed firms

E. Long term Lending - All firms

F. Long term Borrowing - All firms

G. Long term Lending - Listed firms

H. Long term Borrowing - Listed firms

Notes: This figure shows the number of lending, borrowing, and ownership relationships across years for all the firms in our sample and for listed firms. Each dot is a coefficient from a regression of the variable of interest on year dummies excluding year 2008. Grey bars represent the 95% confidence intervals.

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Table A.1: **The role of central firms in lending and borrowing relationships: adding pre-crisis controls**

	(1) Lending	(2) Borrowing	(3) Lending	(4) Borrowing	(5) Lending	(6) Borrowing	(7) Lending	(8) Borrowing	(9) Lending	(10) Borrowing	(11) Lending	(12) Borrowing	(13) Lending	(14) Borrowing	(15) Lending	(16) Borrowing
Crisis × Centrality in 07'	0.684**	0.559**	0.496**	0.496**	0.664**	0.540**	0.763**	0.667**	0.675**	0.554**	0.593*	0.480**	0.668**	0.538**	0.622	0.623**
	(0.303)	(0.248)	(0.231)	(0.231)	(0.296)	(0.235)	(0.335)	(0.254)	(0.304)	(0.224)	(0.321)	(0.232)	(0.294)	(0.239)	(0.376)	(0.241)
Recovery × Centrality in 07'	0.513**	0.357	0.473	0.473	0.599***	0.416	0.875***	0.585	0.613***	0.423	0.632***	0.325	0.649***	0.467	0.772***	0.515
	(0.217)	(0.375)	(0.365)	(0.365)	(0.203)	(0.363)	(0.248)	(0.395)	(0.204)	(0.357)	(0.189)	(0.284)	(0.194)	(0.374)	(0.222)	(0.357)
Post × Centrality in 07'	0.278	0.055	0.169	0.169	0.321	0.110	0.464	0.196	0.356	0.136	0.340	0.042	0.374	0.143	0.360	0.142
	(0.270)	(0.348)	(0.357)	(0.357)	(0.261)	(0.337)	(0.310)	(0.372)	(0.236)	(0.303)	(0.244)	(0.303)	(0.271)	(0.349)	(0.266)	(0.343)
Crisis × Cash flow rights 07'	1.027	1.027													-0.155	-0.214
	(2.765)	(2.181)													(2.764)	(2.351)
Recovery × Cash flow rights 07'	-3.250*	-2.136													-3.897**	-1.802
	(1.925)	(1.634)													(1.704)	(1.489)
Post × Cash flow rights 07'	-2.412	-2.558*													-3.699**	-2.586*
	(1.778)	(1.445)													(1.501)	(1.313)
Crisis × Ln Assets in 07'			0.133	0.133											0.429	-0.004
			(0.250)	(0.250)											(0.343)	(0.245)
Recovery × Ln Assets in 07'			-0.137	-0.137											0.154	-0.207
			(0.263)	(0.263)											(0.342)	(0.258)
Post × Ln Assets in 07'			-0.160	-0.160											0.631*	-0.166
			(0.272)	(0.272)											(0.365)	(0.252)
Crisis × Tobin's Q in 07'					0.025	-0.052									0.264	0.176
					(0.589)	(0.352)									(0.725)	(0.414)
Recovery × Tobin's Q in 07'					0.553	0.319									0.580	0.064
					(0.512)	(0.484)									(0.741)	(0.639)
Post × Tobin's Q in 07'					0.605	0.240									0.658	0.069
					(0.561)	(0.425)									(0.710)	(0.593)
Crisis × Leverage in 07'							-2.972	-3.854							-3.655	-3.974
							(3.616)	(2.527)							(3.662)	(2.644)
Recovery × Leverage in 07'							-7.542**	-4.672*							-8.004**	-5.111*
							(3.636)	(2.569)							(3.874)	(2.633)
Post × Leverage in 07'							-3.748	-2.342							-5.560	-2.598
							(3.520)	(2.485)							(3.610)	(2.443)
Crisis × Cach holdings in 07'									-2.935	-4.075**					-2.291	-4.072**
									(1.889)	(1.739)					(1.831)	(1.877)
Recovery × Cach holdings in 07'									-1.250	-1.179					-2.705	-1.828
									(1.745)	(1.876)					(1.734)	(1.892)
Post × Cach holdings in 07'									-3.738*	-3.836***					-3.402**	-4.168***
									(2.079)	(1.725)					(1.680)	(1.575)
Crisis × Stock Liquidity in 07'											18.404	13.425			0.390	11.665
											(26.441)	(30.814)			(32.199)	(33.155)
Recovery × Stock Liquidity in 07'											-5.248	23.874			-9.869	35.547
											(27.966)	(31.384)			(29.860)	(32.827)
Post × Stock Liquidity in 07'											-1.501	17.738			-25.221	24.604
											(25.531)	(30.658)			(29.565)	(30.613)
Crisis × I-O BG integration													-0.475	0.666	-0.827	0.837
													(9.912)	(8.209)	(9.242)	(7.725)
Recovery × I-O BG integration													-11.276*	-13.605**	-10.227**	-13.092***
													(6.166)	(5.240)	(4.820)	(4.432)
Post × I-O BG integration													-13.326**	-9.523	-11.523**	-7.608
													(6.203)	(5.989)	(5.324)	(5.059)
Observations	887	887	887	887	887	887	887	887	887	887	887	887	887	887	887	887
R-squared	0.073	0.069	0.055	0.055	0.064	0.053	0.076	0.064	0.074	0.077	0.060	0.057	0.093	0.086	0.152	0.146
Number of firms	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents a differences-in-differences estimation for lending and borrowing relationships from 2001 to 2013. *Centrality in 07'* is defined as betweenness centrality in the ownership network in 2007. *Crisis*, *Recovery*, and *Post* are dummies for the year 2009, 2010, and post-2010, respectively. See Table 2 for definition of pre-crisis characteristics. Robust standard errors clustered at the firm level are reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.2: **The role of central firms in lending and borrowing relationships: using degree as centrality measure**

	(1)	(2)	(3)	(4)	(5)	(6)
		All firms			Listed firms	
	L+B	Lending	Borrowing	L+B	Lending	Borrowing
Crisis × Centrality in 07'	1.204***	0.760***	0.444***	1.227***	0.820***	0.408*
	(0.310)	(0.169)	(0.166)	(0.399)	(0.211)	(0.217)
Recovery × Centrality in 07'	0.991**	0.612***	0.378	1.101*	0.700***	0.401
	(0.386)	(0.169)	(0.249)	(0.557)	(0.208)	(0.379)
Post × Centrality in 07'	0.431	0.340	0.091	0.294	0.321	-0.026
	(0.425)	(0.214)	(0.223)	(0.607)	(0.302)	(0.316)
Observations	10,027	10,027	10,027	887	887	887
R-squared	0.053	0.055	0.027	0.074	0.073	0.048
Number of firms	1,034	1,034	1,034	74	74	74
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents a differences-in-differences estimation for lending and borrowing relationships from 2001 to 2013. Columns (1) to (3) present results for our full sample of listed and private firms, while columns (4) to (6) show results for our sample of listed firms. *Centrality in 07'* is defined as degree in the undirected graph of ownership in 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, and 2011-2013, respectively. Robust standard errors clustered at the firm level are reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.3: **The role of central firms in lending and borrowing relationships: using a placebo treatment**

	(1)	(2)	(3)	(4)	(5)	(6)
		All firms			Listed firms	
	L+B	Lending	Borrowing	L+B	Lending	Borrowing
Placebo × Centrality in 07'	-0.033	-0.061	0.027	-0.064	-0.090	0.029
	(0.153)	(0.118)	(0.060)	(0.224)	(0.147)	(0.120)
Observations	3,158	3,158	3,158	278	278	410
R-squared	0.002	0.002	0.002	0.016	0.013	0.020
Number of firms	931	931	931	72	72	72
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents a differences-in-differences estimation using for lending and borrowing relationships from 2003 to 2006. Columns (1) to (3) present results for our full sample of listed and private firms, while columns (4) to (6) show results for our sample of listed firms. *Placebo* is dummy for the year after 2004. Robust standard errors are clustered at the firm level and reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.4: **The role of central firms in lending and borrowing: excluding holdings**

	(1)	(2)	(3)	(4)	(5)	(6)
		All firms			Listed firms	
	L+B	Lending	Borrowing	L+B	Lending	Borrowing
Crisis × Centrality in 07'	1.193***	0.666***	0.527***	1.349***	0.773**	0.575**
	(0.382)	(0.223)	(0.188)	(0.467)	(0.289)	(0.236)
Recovery × Centrality in 07'	0.968**	0.609***	0.359	0.958*	0.626***	0.332
	(0.409)	(0.181)	(0.257)	(0.561)	(0.209)	(0.390)
Post × Centrality in 07'	0.414	0.293	0.121	0.294	0.283	0.012
	(0.444)	(0.220)	(0.240)	(0.628)	(0.286)	(0.358)
Observations	9,738	9,738	9,738	636	636	636
R-squared	0.052	0.046	0.034	0.102	0.086	0.081
Number of firms	1,010	1,010	1,010	53	53	53
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents a differences-in-differences estimation for lending and borrowing relationships from 2001 to 2013. The sample excludes from the analysis those firms that are *holdings*. Columns (1) to (3) present results for our full sample of listed and private firms, while columns (4) to (6) show results for our sample of listed firms. *Centrality in 07'* is defined as betweenness centrality in the ownership network in 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, and 2011-2013, respectively. Robust standard errors are clustered at the firm level and reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.5: **The role of central firms in lending and borrowing relationships: using winsorized lending and borrowing relationships and ownership cetrality**

	(1)	(2)	(3)	(4)	(5)	(6)
		All firms			Listed firms	
	L+B	Lending	Borrowing	L+B	Lending	Borrowing
Crisis × Centrality in 07'	1.043***	0.586***	0.458**	1.204**	0.665**	0.539**
	(0.375)	(0.219)	(0.183)	(0.479)	(0.296)	(0.235)
Recovery × Centrality in 07'	0.876**	0.521***	0.355	1.037*	0.613***	0.424
	(0.380)	(0.175)	(0.242)	(0.522)	(0.205)	(0.366)
Post × Centrality in 07'	0.426	0.298	0.128	0.451	0.336	0.116
	(0.416)	(0.206)	(0.225)	(0.590)	(0.265)	(0.339)
Observations	10,027	10,027	10,027	887	887	887
R-squared	0.040	0.035	0.026	0.071	0.059	0.052
Number of firms	1,034	1,034	1,034	74	74	74
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents a differences-in-differences estimation using for lending and borrowing relationships from 2001 to 2013. Lending and borrowing relationships as well as centrality measures are winsorized at 1% of the empirical distribution. Columns (1) to (3) present results for our full sample of listed and private firms, while columns (4) to (6) show results for our sample of listed firms. *Centrality in 07'* is defined as betweenness centrality in the ownership network in 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, and 2011-2013, respectively. See Table 2 for variables definition. Robust standard errors are clustered at the firm level and reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.6: **The role of central firms in lending and borrowing relationships: adding business group-year fixed effects**

	(1)	(2)	(3)	(4)	(5)	(6)
		All firms			Listed firms	
	L+B	Lending	Borrowing	L+B	Lending	Borrowing
Crisis × Centrality in 07'	1.065***	0.591***	0.473***	1.128**	0.607*	0.521**
	(0.351)	(0.214)	(0.165)	(0.486)	(0.316)	(0.218)
Recovery × Centrality in 07'	0.872**	0.508***	0.364	0.850**	0.480**	0.370
	(0.364)	(0.164)	(0.242)	(0.413)	(0.214)	(0.277)
Post × Centrality in 07'	0.445	0.310	0.135	0.720**	0.482**	0.238
	(0.397)	(0.190)	(0.223)	(0.332)	(0.184)	(0.218)
Observations	10,011	10,011	10,011	829	829	829
R-squared	0.847	0.806	0.822	0.844	0.790	0.813
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
BG-Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents a differences-in-differences estimation using lending and borrowing relationships from 2001 to 2013. All columns include an interaction between between a dummy for each business group and year fixed effects. Columns (1) to (3) present results for our full sample of listed and private firms, while columns (4) to (6) show results for our sample of listed firms. *Centrality in 07'* is defined as betweenness centrality in the ownership network in 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, and 2011-2013, respectively. See Table 2 for variables definition. Robust standard errors are clustered at the firm level and reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.7: **The role of central firms in lending and borrowing relationships: increasing overlap of firm characteristics**

	(1)	(2)	(3)	(4)	(5)	(6)
	Optimal trimming (10.6%)			Trimming at 5%		
	L+B	Lending	Borrowing	L+B	Lending	Borrowing
Crisis × Centrality in 07'	1.328**	0.715**	0.614**	1.324**	0.739**	0.585**
	(0.524)	(0.331)	(0.259)	(0.509)	(0.317)	(0.251)
Recovery × Centrality in 07'	1.271**	0.704***	0.567	1.214**	0.704***	0.510
	(0.590)	(0.222)	(0.425)	(0.567)	(0.218)	(0.405)
Post × Centrality in 07'	0.625	0.400	0.225	0.654	0.415	0.239
	(0.689)	(0.303)	(0.401)	(0.666)	(0.293)	(0.388)
Observations	514	514	514	609	609	609
R-squared	0.091	0.078	0.065	0.078	0.064	0.058
Number of firms	44	44	44	52	52	52
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents difference-in-difference specification for lending and borrowing relationships from 2001 to 2013. This table only includes listed firms. Columns (1) to (3) present results using the optimal trimming of the propensity score suggested by Crump, Hotz, Imbens, and Mitnik (2009), while columns (4) to (6) show results by trimming the top and lower 5% of the propensity score distribution. We estimate the propensity score for the probability of being in the highest quartile of the betweenness centrality in 2007. We use a probit model and we include cash flow rights, Tobin's Q, ROA, logarithm of total assets, leverage and PPE in 2007 as covariates. *Centrality in 07'* is defined as betweenness centrality in the ownership network in 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, and 2011-2013, respectively. All firm characteristics included as independent variables are measured in 2007. See Table 2 for variables definition. Robust standard errors are clustered at the business group level and reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.8: **The role of central firms in lending and borrowing relationships: clustering SE at business group level**

	(1)	(2)	(3)	(4)	(5)	(6)
		All firms			Listed firms	
	L+B	Lending	Borrowing	L+B	Lending	Borrowing
Crisis × Centrality in 07'	1.042**	0.585**	0.457**	1.203**	0.664***	0.538*
	(0.406)	(0.221)	(0.201)	(0.473)	(0.232)	(0.263)
Recovery × Centrality in 07'	0.875*	0.521**	0.354	1.036*	0.612***	0.423
	(0.462)	(0.201)	(0.288)	(0.564)	(0.205)	(0.392)
Post × Centrality in 07'	0.425	0.298	0.128	0.451	0.335	0.115
	(0.521)	(0.264)	(0.266)	(0.606)	(0.274)	(0.342)
Observations	10,027	10,027	10,027	887	887	887
R-squared	0.040	0.035	0.026	0.071	0.059	0.052
Number of firms	1,034	1,034	1,034	74	74	74
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents difference-in-difference specification for lending and borrowing relationships from 2001 to 2013. Columns (1) to (3) present results for our full sample of listed and private firms, while columns (4) to (6) show results for our sample of listed firms. *Centrality in 07'* is defined as betweenness centrality in the ownership network in 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, and 2011-2013, respectively. All firm characteristics included as independent variables are measured in 2007. See Table 2 for variables definition. Robust standard errors are clustered at the business group level and reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.9: **Impact on providers**

	(1) ROA	(2) ROE	(3) Δ PPE	(4) Δ Sales	(5) External leverage
Panel A: All firms					
Crisis × Net Provider in 09'	-0.028	-0.142**	-0.091	0.086	0.042
	(0.020)	(0.064)	(0.162)	(0.310)	(0.038)
Recovery × Net Provider in 09'	-0.009	-0.067**	-0.174	-0.407**	-0.002
	(0.014)	(0.031)	(0.223)	(0.158)	(0.044)
Post × Net Provider in 09'	-0.003	-0.061	-0.236	-0.341*	-0.048
	(0.016)	(0.044)	(0.165)	(0.190)	(0.042)
Observations	880	880	877	877	874
R-squared	0.058	0.079	0.039	0.049	0.103
Number of firms	74	74	74	74	74
Panel B: Excluding central firms					
Crisis × Net Provider in 09'	-0.025	-0.146**	-0.040	0.152	0.020
	(0.020)	(0.063)	(0.219)	(0.373)	(0.050)
Recovery × Net Provider in 09'	-0.011	-0.067**	-0.279	-0.589***	-0.039
	(0.016)	(0.030)	(0.322)	(0.217)	(0.059)
Post × Net Provider in 09'	0.002	-0.046	-0.250	-0.393	-0.101*
	(0.020)	(0.053)	(0.208)	(0.237)	(0.054)
Observations	666	666	664	664	664
R-squared	0.046	0.079	0.048	0.058	0.150
Number of firms	56	56	56	56	56
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Notes: This table shows a differences-in-differences estimation of firm performance. We define *Net Provider* as the number of lending relationships minus borrowing relationships, and *Net Provider in '09* is defined a dummy for when the change in *Net Provider* position from 2008 to 2009 is positive. Panel A includes our whole sample, while Panel B excludes those firms with a betweenness centrality in the top quartile in 2007. *Crisis*, *Recovery*, and *Post* are dummies for the years 2009, 2010, and 2011-2013, respectively. See Table 2 for variables definition. Robust standard errors clustered at the firm level are reported in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.