How Do Internal Capital Markets Work? Evidence from the Great Recession*

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August 2019

Abstract

We study the inner workings of internal capital markets during the 2008-9 recession using a unique dataset of loans between business-group firms in an emerging market. Intra-group loans increase quickly during the recession. Firms that are more central in the ownership network simultaneously increase lending and borrowing. Acting like simple intermediaries, central firms do not increase net lending. Our results imply that formal control rights are essential for intermediation in internal capital markets, particularly during distress. In line with previous results on winner-picking, receivers of intra-group loans are high-Q, financially-constrained firms, which also perform significantly better than providers during the recession.

Keywords: Internal capital markets, great recession, business groups, centrality, control rights.

JEL Codes: G32

*We thank comments and suggestions from an anonymous referee, Jan Bena (FinanceUC discussant), Arun Chandrasekhar, Raja Kali, Pepita Miquel-Florensa, Carlos Pombo, Carlos Ramírez, Giorgo Sertsios, Andrei Shleifer, Adam Szeidl, Geoff Tate (editor), and seminar participants at the 12th International Conference of FinanceUC, the 6th Annual CIRANO-Sam M. Walton College of Business Workshop on Networks in Trade and Finance, Universidad de los Andes, and Universidad del Rosario. This paper circulated previously with the title "Overlapping Networks of Credit and Control." Larrain acknowledges funding from Proyecto Fondecyt Regular 1180593.

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A business group is a set of firms with a common controlling shareholder. In emerging markets, and in many developed markets, firms affiliated to business groups account for close to 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 at the top. Despite the ubiquity of business groups, the ultimate purpose of such complex ownership structures is still a matter of debate. Some argue that pyramids are instrumental in the abuse of minority shareholders or tunneling (Bertrand, Mehta, and Mullainathan, 2002). Others argue that pyramids provide a natural financial advantage to set up new firms (Almeida and Wolfenzon, 2006b). In this paper we focus on another advantage of the ownership structures of business groups, namely the intermediation of credit during distress.

The literature on the internal capital markets of business groups illustrates the general debate about business groups. While some argue that transfers of resources between affiliated firms are a sign of tunneling (see, for example, Cheung, Rau, and Stouraitis, 2006; Jiang, Lee, and Yue, 2010), others argue that those transfers can alleviate financial constraints (see, for example, Almeida, Kim, and Kim, 2015; Buchuk et al., 2014; Gopalan, Nanda, and Seru, 2007). This literature has been centered around outcomes, such as investment, profitability, and stock returns, to judge the efficiency of internal transfers. In this paper, instead, we dig deeper into the inner workings of internal capital markets. Inspecting the mechanism can help us to identify the advantage of internal transactions over market transactions, and ultimately to disentangle tunneling from a financial advantage.

We study the response of Chilean business groups to the recession of 2008-9. Our hand-collected dataset of intra-group loans covers more than a decade (2001-2013), which is infrequent in the business group literature. One of the advantages of a long time series is that we can compare internal capital markets during distress and normal times. Also, in our data we map the ownership structure of each group, so that we can document the interaction between control links and internal credit relationships. This is a key advantage to understand how internal capital markets actually work.

Our main finding is that firms that are more central in the ownership structure act like intermediaries in the internal capital market during the crisis. In the model of Stein (1997), internal capital markets are organized as a two-layer allocation process, where shareholders delegate to headquarters the subsequent allocation of capital to individual projects. We find that this role of headquarters is played by central firms in business groups. Central firms, which as shown by Almeida et al. (2011) are used by

groups to control other firms, have the necessary control rights to redistribute resources across firms and enforce payments.

Central firms increase lending and borrowing more strongly during the crisis than other group firms. The likelihood of developing a credit relationship between any pair of firms during the crisis increases with the centrality of the firms involved, even after controlling for direct ownership between them. In line with a role as pure intermediaries, the increase in lending and borrowing is simultaneous, so central firms do not increase intra-group *net* lending. 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 or investment opportunities (Tobin's Q), can explain away the effect of centrality in our empirical tests. Central firms are not commercial banks, as perhaps is the case in Japanese groups (Hoshi, Kashyap, and Scharfstein, 1991), which could explain their advantage to intermediate. On the contrary, the evidence points towards control rights as the defining feature of central firms and source of their advantage to intermediate.

The novelty of our approach comes from relating formal control rights with the transfer of resources between firms. More specifically, we relate the position of a firm in the ownership network (i.e., its centrality) with the intermediation between firms. This has not been done before partly because it requires intimate knowledge of the structure of groups. It is an interesting finding because it underscores a key advantage of internal capital markets over regular market intermediation, namely that internal credit relationships are permeated by control rights that ease financial contracting at times of distress. Ownership provides the strongest form of control rights in the sense that assets or projects can be easily disposed of or modified by the ultimate owner (Grossman and Hart, 1986; and Hart and Moore, 1990).

When compared to the previous literature on business groups, our results highlight the mechanics of the intermediation more than the ultimate efficiency of internal transfers. None of the previous papers studies the role of centrality in intra-group transfers, although many show that transfers create value during distress. For example, Almeida, Kim, and Kim (2015) find that by using internal transfers Korean groups were able to sustain investment in high-growth firms during the Asian crisis. Santioni, Schiantarelli, and Strahan (2017) find that internal transfers reduced the failure rate of Italian group firms during the recent European crisis.[1] Gopalan, Nanda, and Seru (2007) find similar

[1]The advantage of Santioni, Schiantarelli, and Strahan (2017) with respect to our setup is their matched bank-firm data, and hence that they are able to connect their results with the health of banks during the crisis. The advantage of our setup is in relating a group's ownership structure with the flows of the internal capital market. Santioni, Schiantarelli, and Strahan (2017) only know the

results on the bankruptcy rate of group firms in India. In line with this previous evidence, we also find that internal transfers create value. Receivers of intra-group loans have higher Tobin's Q than providers, which is consistent with Stein (1997)'s model of winner-picking, and have characteristics associated with financial constraints (e.g., small firms with low cash holdings). Receivers perform better than providers during the crisis. We also compare group to non-group firms, after a careful matching procedure to control for selection effects (see Almeida and Wolfenzon, 2006b, Almeida, Kim, and Kim, 2015). We find that receivers perform significantly better than non-group firms with 3.8% higher ROA on average over the 5 years after the crisis.

Our results on intra-group intermediation expand the role of central firms documented by Almeida et al. (2011). Their results show that central firms are used by groups to set up and acquire firms that have low profitability (i.e., low pledgeability). We show that central firms have a simultaneous role redistributing resources during distress. Our results also make an interesting connection to the networks literature, since we use measures of centrality that are employed in several other applications (see Jackson, 2008).

Finally, our results contribute to the broader literature on internal capital markets (Stein, 2003). Most of this literature is based on conglomerates and within-firm reallocation. Business groups are formed by independent corporations, each one with its own ownership and capital structure, but similar mechanisms apply to both groups and conglomerates. Our results are centered around the mechanism, more than the outcomes of internal capital markets that are explored in Giroud and Mueller (2015), Matvos and Seru (2014), or Shin and Stulz (1998) among others. Our emphasis on the mechanism allows us to identify more precisely one of the advantages of internal capital markets (i.e., credit intermediation during distress) and the source of this advantage (i.e., control rights). Our results confirm the predictions of Stein (1997)'s model, where intermediaries within the group shift resources between different projects. These intermediaries –central firms in business groups– can redistribute resources precisely because they are endowed with the necessary control rights.

A final caveat regarding the limitations of our analysis is in order. Our empirical design is in essence a differences-in-differences approach comparing central and non-central firms during the crisis. We find evidence in favor of the parallel-trend assumption, namely that central and non-central firms face similar trajectories before the shock. It seems reasonable to assume that the structure of business groups is not

aggregate borrowing position of a firm within the group, but they cannot follow individual loans like we do.

endogenous to the crisis since the shock was external to the country and largely unanticipated. Chilean business groups were formed well before the crisis, mostly in the 1980s, and their structure has been very stable (see Donelli, Larrain, and Urzúa, 2013, and Larrain and Urzúa, 2016). Although we do not find that the structure of business groups changed in anticipation or during the crisis, we admit up-front that we cannot solve the endogeneity of group structure in a general sense. 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 goes beyond the possibilities of our analysis. Besides a reverse-causality story, it is hard to tell an omitted-variables story for our results. The most obvious firm characteristics that are correlated with centrality, such as firm size or leverage, do not account for our results. However, we cannot rule out the possibility that some unobservable variable drives both centrality and the changes in borrowing and lending that we see.

The rest of the paper is organized as follows. Section 1 develops our main hypothesis about intermediation in business groups. Section 2 describes the data and measures of centrality. Section 3 shows the main results. Section 4 concludes.

1. Intermediation in Internal Capital Markets

Business groups have a mixed reputation. Khanna and Yafeh (2007) illustrate the debate by saying that business groups are sometimes considered paragons and other times parasites. One particular area of debate is the rationale behind control pyramids (Morck, Wolfenzon, and Yeung, 2005). On the one hand, the *tunneling hypothesis* argues that the separation of ownership and control, which is typical of pyramids, gives the controlling shareholder the opportunity and the incentive to abuse minority shareholders (Bertrand, Mehta, and Mullainathan, 2002; Johnson et al., 2000). Outright theft, as in Shleifer and Wolfenzon (2002), is a strong form of tunneling. Related-party transactions, which are not mediated by markets, can sometimes hide the abuse of the controlling shareholder (Cheung, Rau, and Stouraitis, 2006; Djankov et al., 2008).

On the other hand, the *financial advantage hypothesis* argues that pyramidal ownership can alleviate financial constraints (Almeida and Wolfenzon, 2006b; Masulis, Pham, and Zein, 2011). In particular, pyramids allow controlling shareholders to access all of the cash-flows of an intermediate firm to invest in new firms. The controlling shareholder has only access to her share of dividends from the intermediate firm if she plans to finance the new firm on her own. The financial advantage can be particularly relevant to setup capital-intensive firms with little current cash-flow (see Almeida et al.,

2011; and Bena and Ortiz-Molina, 2013).

Intra-group loans spur a similar debate as groups in general. Under the tunneling hypothesis, intra-group loans are prone to abuse since they are related party-transactions. For instance, there is evidence that loans between related firms are a sign of tunneling in China (Jiang, Lee, and Yue, 2010) and Mexico (La Porta, López-de-Silanes, and Zamarripa, 2003). On the other hand, Buchuk et al. (2014), Gopalan, Nanda, and Seru (2007), and Santioni, Schiantarelli, and Strahan (2017) argue that loans alleviate financial constraints in their samples of Chilean, Indian, and Italian groups respectively.

In this paper we focus on understanding *how* is the intermediation of intra-group loans done within groups. The focus of previous papers has been to evaluate the ultimate benefits or the efficiency of these loans. By inspecting the mechanism we can further disentangle tunneling from the financial advantage.

In the model of Stein (1997), corporate headquarters have two advantages. First, headquarters have an informational advantage to monitor several projects simultaneously. Second, and crucially, headquarters have the control rights to redistribute resources across firms. Control rights imply that assets and projects can be easily disposed of or modified (see Grossman and Hart, 1986; and Hart and Moore, 1990). In Stein (1997)'s model it is efficient to set up a two-layer allocation process where shareholders delegate to headquarters the subsequent allocation of capital to individual projects. This implies that headquarters act like intermediaries within the group. Like regular intermediaries, headquarters pool resources across firms and redistribute them. The difference with regular intermediaries is that headquarters can force this redistribution because of the control rights they have.[2] Headquarters work in a winner-picking fashion, allocating funds to relatively good projects by taking funds from relatively bad projects.[3]

In the business group literature, Almeida et al. (2011) identify central firms as key players in the within-group allocation of capital. Central firms are defined by their endowment of control rights, in particular, central firms are used by the ultimate controlling shareholder to invest in other firms. Figure 1 provides a stylized example of a business group. A family (F), or their holding company, is typically the controlling

[2]There is less risk in an intra-group loan than in comparable market debt, because the intra-group loan carries more control rights. This advantage of business groups over regular intermediaries can potentially explain the puzzle of missing high-yield markets in many emerging economies (Becker and Josephson, 2016).

[3]This redistributive role of headquarters can even provide incentives for the managers of individual firms to produce hard information (Stein, 2002). Hard information is useful to convince headquarters about the quality of projects.

shareholder at the top of the pyramid. Central Firm C is used to directly or indirectly control the other four firms in the group (A, A', B, and B'). It is natural to think of central Firm C as Stein (1997)'s headquarters –compiling information and redistributing resources among firms– given its position in the ownership structure. As part of the redistributive role of central firms we should see intra-group loans flowing to and from Firm C.

Credit relationships with central firms have another convenient feature that can be called "dividend matching." Since central firms are shareholders of the other firms in the group, the future repayment of intra-group loans can be made with dividends. In terms of Figure 1, Firm A can repay itself the loan made to C by withholding dividends.[4] Also, Firm B pays dividends to its shareholder C, so the loan payment of B to C is akin to paying dividends.[5]

The advantage of central firms to redistribute should be particularly valuable at times of distress when the cost of external funds goes up (see Gopalan and Xie, 2011; Matvos and Seru, 2014), which leads us to our main prediction:

Main Prediction: *Central firms behave like intermediaries in business groups, particularly during distress. Central firms lend and borrow from other firms in the group, but they do not have a strong net lending position.*

Tunneling is the prominent alternative hypothesis. Tunneling predicts that loans should flow upwards in the pyramid (e.g., from A to C, or even from A to F in Figure 1), since controlling shareholders should have higher cash-flow rights in firms that receive intra-group loans (Bertrand, Mehta, and Mullainathan, 2002). From the tunneling point of view it is not clear that intra-group lending should increase during periods of distress. For example, Philippon (2006) argues that investors are less willing to tolerate abuse during bad times and, hence, intra-group loans should decline.

Figure 1 also illustrates a more subtle alternative hypothesis, which still falls under the financial advantage umbrella, where central firms play no role in pooling and redis-

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

[5]Dividend matching is mostly an advantage of loans between firms with direct ownership links. The key complication when there is no direct ownership link is dividend "leakage". As dividends go up in the pyramid there is leakage to outside shareholders that also have to be paid (dividends cannot discriminate between shareholders). Dividend leakage can also explain the advantage of loans over dividends (and related cross-equity investments) as a way to redistribute resources across group firms. There is no leakage to outside investors when lending between firms: all resources end up with the firm in need. Dividends and equity issues also require more cumbersome and lengthy approval processes (e.g., calling a shareholders' meeting). Despite the potential disadvantages of dividends, Gopalan, Nanda, and Seru (2014) show that dividends are used to fund equity investments in other affiliated firms in a large sample of groups.

tributing resources. This is the case of the lateral loan between firms A' and B'. For instance, firm A' can have financial slack and firm B' can be financially constrained. In practice, nothing guarantees that the slack in A' perfectly matches the needs in B', and that there is no need for an intermediary that pools and redistributes group resources.

In our empirical section we also study predictions that have been explored before by the internal capital markets literature. For example, we study the winner-picking behavior of business groups, or that the receivers of intra-group loans should have relatively better investment opportunities than the providers of intra-group loans (Stein, 1997). These predictions are not new, but if confirmed they strengthen the case against tunneling as the motivation behind internal transfers.

2. Data Description

2.1 Data on Ownership Structures

We start with all firms (in groups or standalone) listed in the Chilean stock market in the period 2001-2013. This starting point is dictated by data availability. Listed firms report financial statements and ownership structures regularly to the local stock market regulator (Superintendencia de Valores y Seguros, SVS). There is no systematic way of compiling comparable information for private firms. In listed firms there is also a meaningful separation of ownership and control, and hence a relevant mass of minority shareholders.

Learning the identity of the ultimate controlling shareholder of each firm is far from straightforward. Financial statements typically report links between corporations, but not the names of individual shareholders. We uncover the identity of the controlling shareholder by checking annual reports and the financial press. Controlling shareholders are 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 stable across long periods of time in the Chilean market (see Donelli, Larrain, and Urzúa, 2013).

From the universe of listed firms we define a business group as a set of two or more listed firms, together with their related private firms, that have a common controlling shareholder (see Buchuk et al., 2014). Listed firms report ownership links with private firms in two ways. First, there is a list of firms that consolidate with each listed firm. Consolidation means that the firm exerts a "controlling influence" over the other firm in an accounting sense. In practice, consolidation typically implies an ownership stake

above 50%. Importantly, two firms can consolidate with each other even if there is no direct ownership link between them. For instance, in Figure 1 firm C controls firm A and firm A controls firm A', so A' consolidates with C, although C has no direct stake on A'.

Consolidation follows accounting principles, but economic control can involve a much lower stake. Hence, we supplement the consolidation list with a second list of related investments. This list has information about firms in which the reporting firm has a large and permanent investment, although the type of influence does not imply consolidation. Related investments typically involve ownership stakes between 10% and 50%. Since these stakes are large, we include related investments in a group if their parent has been identified as a group firm.[6]

Using all this information we find that during the period of 2001-2013 there are 22 business groups composed of approximately 80 listed firms and 1,000 private firms. As an example, Figure 2 shows a simplified version of the Claro group in the year 2007. 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 a shipping company. Quemchi, Marinsa and Navarino are mostly holding companies.

Chilean legislation prohibits loops in cross-holdings (for example, firms A and C simultaneously having ownership stakes on each other). 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, since 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% ($= 51\% \times 76.3\%$), meaning that for each dollar of dividends distributed by Navarino, the Claro family ultimately receives 38 cents, despite the fact that the family controls a stake of 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.

Two caveats about the ownership data are in order. First, our data excludes financial firms such as commercial banks, mutual fund companies, pension fund administrators, and so on. This is not a big omission for our purposes because lending between

[6] If two or more groups have stakes in a firm we assign the firm to the group with the largest stake. This happens very rarely in our sample.

banks and related firms is heavily restricted in the Chilean market since the 1980s. Second, although we are able to identify the private firms that belong to each group, we do not know the direct ownership stakes between pairs of private firms in the group, if they exist. In terms of our previous example, if C is a listed firm, and A and A' are private firms that consolidate with C, then we know that C, A, and A' belong to the same group. We also know the stake between C and A. However, we do not know the stake between A and A'. Put differently, we only know the stake in any direct link that involves at least one listed firm. In the empirical analysis we discuss potential biases and corrections for this unobservable component of the ownership network.

2.2 Data on Intra-Group Loans

Listed firms are required to report to the SVS the loans made to related firms.[7] Hence, we have the universe of lending relationships between group firms where at least one of the firms is a listed firm. This information is available from 2001, which marks the start of our data. The notes to financial statements identify the lending firm and the borrowing firm, together with the maturity of the loan (short-term or long-term), and the outstanding amount at the end of the 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. However, the interest rate and the precise maturity of the loan are not reported in financial statements. Loans between corporations are not reported to banking regulators, and hence they do not appear in credit bureau data.

As an illustration of our data, 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 see a loan 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, as already illustrated in Figure 1.

[7] Although the vast majority of related loans correspond to intra-group loans, not all related loans are intra-group loans. For example, a loan between two companies that have a director in common is legally considered 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 credit relationship. We exclude those loans where there is no ownership link (direct or indirect) between the lending firm and the borrowing firm.

Table 2 characterizes the 6,079 loans in our data according to the type of ownership relationship between the lending firm and the borrowing firm. First, one third of the loans are made between firms with a direct ownership link (e.g., the loan between firms A and C in Figure 1). Two thirds of the loans are made between firms that have no direct link between them (e.g., the loan between firms A' and C in Figure 1). Second, we split observations according to the direction of the loan relative to the control relationship. If the lending firm controls the borrowing firm we say that the loan goes "down" ("up" means the opposite direction). "Lateral" loans are made between firms that exert no direct control between them (e.g., the loan between firms A' and B' in Figure 1, or potentially between A' and B or B' and A). Naturally, the loan cannot go laterally when there is a direct ownership link between the firms. We find that loans going down are more frequent than loans going up (41% vs 29% in the last column of Table 2). This already casts doubts on the tunneling hypothesis, because loans are supposed to go up under that hypothesis. Up and down loans are more frequent than lateral loans, which only represent 30% of the data. Finally, loans between listed firms represent 17% of the data, while loans between listed and private firms represent 83%.

Table 3 gives summary statistics for lending and borrowing relationships in business groups. We consider two samples. The first sample includes all listed and private firms, with a total of 10,027 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. The average firm in this sample has 0.67 lending relationships and 0.66 borrowing relationships.

In the second sample we focus on listed firms. 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 with other group firms (listed or private). From the consolidated financial statements we take 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 (=book 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 firm-year observations where dividends are more than 30% of earnings, which is the mandatory dividend set by Chilean law. We also report variables that use stock market data such as Tobin's Q (=market equity plus

book debt over book assets), the market-to-book equity ratio, stock returns, and stock liquidity (volume traded over total market capitalization for a particular stock).

Finally, we report a measure of the industrial integration of a firm with the rest of its group. Integration refers to how much of its input (output) a firm buys (sells) from (to) other firms in the group. Following Khanna and Yafeh (2005) we first classify firms into industries using the industry classification from the 2002 input-output matrix provided 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 integration for each pair of firms, and finally we average for a single firm across all the pairs where it is present in the group. 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

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 a network, or how important a firm is in connecting other firms within a business group.[8] 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:

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

We compute centrality in the full network of firms (listed and private) of each group. We employ unweighted betweenness for our main tests, but as shown in the appendix

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

the results are robust to using weighted betweenness where each link is weighted by the ownership stake between the firms. The example in Figure 1 can illustrate the measure of betweenness. Firm C has the highest centrality (1.6) since it belongs to most of the shortest paths within the group except for those that connect A to A' and B to B'. Firms A and B have a medium level of centrality (0.8), while the centrality of firms F, A', and B' is zero because they are not part of the shortest path to any other firm (the starting firm is not counted in the shortest path to other firms).

We use degree centrality as a secondary measure of centrality. 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 3 reports summary statistics for the measures of centrality. The average betweenness in the full sample is 0.014, 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 about 10 times more likely than private firms to be in the connecting path between two firms. The average degree is 1.58 in the full sample and 9.3 among listed firms.[9]

Table 4 shows characteristics for central and non-central firms, all of them listed, in the year before the crisis (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.[10] Differences in cash-flow rights imply that central firms are not at the top of control pyramids (i.e., central firms are not simply holding companies). For example, as seen in Figure 2 of the Claro group, central firms (Elecmetal and Vapores) are in the middle of the pyramid.

Two caveats are in order. First, Almeida et al. (2011) develop their own measure of centrality, which identifies firms that control other firms in a business group. In this paper we focus on standard measures of centrality that have the advantage of relating

[9]Note that some private firms in the full sample have zero degree, which may seem counterintuitive (it suggests that these firms are not related by ownership 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.

[10]In Table 4 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.

our results to the vast networks literature.[11] Almeida et al. (2011) do not relate their own measure with standard measures, although in practice both measures identify the same firms as being central in a group. Standard measures also have the added value of focusing on intermediation between firms, which is important from the point of view of internal capital markets (although not the focus of Almeida et al., 2011).

Second, all of our measures of centrality are based on the *ownership network*. We do not use the structure of credit links to describe the network, because it can be mechanically related to credit activity within the group. 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 are not necessarily relevant for credit intermediation since those ties do not carry control rights with them.

2.4 The Great Recession

We can safely assume that the recession of 2008-9 was an exogenous shock from the perspective of the Chilean economy. In Figure 3 Panel A 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 negative growth (January through July). Since we have annual data we expect to find most traces of the crisis in 2009. The year 2010 marked a steep recovery. 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 earthquake reconstruction – explain the strong growth seen in the rest of 2010.

Figure 3 Panel B reports the yield spread between risky and safe corporate bonds in the Chilean market.[13] The spread increased quickly during the 2008-9 crisis, breaking

[11] For example, the emerging literature of networks in finance has studied contagion in financial networks (Acemoglu, Ozdaglar, and Tahbaz-Salehi, 2015; Elliott, Golub, and Jackson, 2014); 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, 2015); executive networks and firm policies (Cai and Szeidl, 2018; Shue, 2013); among others.

[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 avoid seasonal patterns.

[13] We show the spread between domestic $A-$ and AAA bonds. We use $A-$ bonds because the time series of bond indexes below $A-$ have frequent jumps. Such jumps are related to additions and deletions from the index since few bonds below $A-$ exist. See Becker and Josephson (2016) for missing high-yield markets.

the downward trend observed since the early 2000s. The cost of debt financing for risky firms (relative to safe firms) increased close to 300 basis points in just a few months.

3. Empirical Results

3.1 Internal Capital Markets over Time

We first study the time series of credit relationships by running 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, after cleaning any time-invariant difference across firms. We run separate regressions for the full sample and for listed firms. Standard errors are clustered at the firm level. As can be seen in the appendix, all of our main results are robust to clustering at the business-group 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, close to 0.1 new lending relationships (Panel A) are created in the full sample in 2009, together with a similar number of new borrowing relationships (Panel B). The increase in lending relationships among listed firms is stronger at about 1.3 new relationships 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 Panels A through D.

Our results imply that internal capital markets unfold during the crisis and then contract during normal times, or that internal capital markets provide emergency funds during distress. This is consistent with the idea that internal capital markets cover short-run liquidity needs, as in Gopalan, Nanda, and Seru (2007). Panels E and F in Figure 4 show short-term and long-term borrowing separately (the results for lending are analogous). We see that the increase in credit is concentrated among short-term

loans instead of long-term loans, which reinforces the idea of internal capital markets as providers of short-run liquidity.[14]

The time series variation that we see in credit relationships is not seen in ownership relationships (see Panels G and H in Figure 4). While new intra-group loans appear during the crisis, there is no evidence of new equity investments in other group firms at the same time. Moreover, there is little movement in ownership relationships across the entire sample period 2001-2013. This is consistent with the general stability of ownership structures in this market (Donelli, Larrain, and Urzúa, 2013), and the fact that most Chilean business groups were structured in the 1980s and 1990s (Larrain and Urzúa, 2016).

3.2 The Role of Centrality during the Crisis

3.2.1 Likelihood of Forming Lending Relationships

We approach our main prediction in two complementary ways. First, we study the formation of lending relationships by looking at the universe of potential firm pairs in 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. The universe 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. We count each pair of firms only once. We do not consider pairs between private firms because, due to reporting standards, we cannot observe loans between them. The regression is as follows:

$$\begin{aligned} Lending_{ij,t} \;=\; & (\beta_1 crisis_t + \beta_2 recovery_t + \beta_3 post_t) \times pair\ includes\ central_{ij} \\ & + (\gamma_1 crisis_t + \gamma_2 recovery_t + \gamma_3 post_t) \times ownership_{ij} \\ & + \mu_{ij} + \delta_{gt} + \epsilon_{ijt}, \end{aligned} \tag{3.2}$$

where $Lending_{ij,t}$ is the dummy variable for when there is a loan between firms i and j in year t. The variables $crisis_t$, $recovery_t$, and $post_t$ are dummy variables for the years 2009, 2010, and 2011-13 respectively. The variable $pair\ includes\ central_{ij}$ is a dummy equal to 1 if the pair of firms includes a central firm as defined in Table 4, 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 start with individual firm fixed effects

[14] If anything, there seems to be a negative trend in long-term credit relationships during the sample. This may be explained by the low interest rates that characterize this period around the world, and which made market credit relatively cheap.

μ_i and μ_j, but then include fixed effects for firm pair (μ_{ij}) that absorb individual firm fixed effects and any pair characteristic that is constant in time. Group fixed effects interacted with year dummies are represented by δ_{gt}, which implies that we basically compare pairs with and without central firms within each group and year. Standard errors are double-clustered by each firm in the pair.

As seen in columns 1-4 of Table 5, ownership has a positive and significant effect on average on the likelihood of forming credit relationships. A direct ownership link between firms increases the likelihood of lending to twice the sample average (= 0.179/0.089 from column 1). Controlling for ownership represents a strong test for centrality because we implicitly partial out the direct relationships that central firms have with other firms. We focus solely on the role of central firms to intermediate between firms with which they are not directly connected. Given this tough control it is perhaps not surprising that the average impact of centrality is small and not significant (column 2). However, when we interact centrality with the period dummies we find a positive and significant impact during the crisis. In column 2 the coefficient on the interaction of centrality and crisis (0.033; t-stat 2.7) implies that the likelihood of forming credit relationships during the crisis increases by 37% (= 0.033/0.089) if the pair includes a central firm. The interactions of centrality with the recovery period and the post period are not significant, showing that the effect is specific to the crisis.

In column 3 of Table 5 we test a related hypothesis. The connection to a central firm can help enforce direct loans between firms. Rather than intermediating the loan itself, the central firm can monitor the direct loan between two affiliated firms and potentially intervene if there is default. In order to implement this idea we include a dummy for pairs of firms linked to central firms, but that are not central firms themselves. In column 3 we find that the average effect of being linked to a central firm is negative (-0.035, t-stat -2.18), i.e., two firms are less likely to lend to each other if they are linked to a central firm. This is consistent with the idea that firms on average lend and borrow from the central firm instead of from each other. We also interact the new dummy with the crisis, recovery and post indicators. The interaction with crisis is positive and significant (0.024, t-stat 2.01 in column 3), but the effect disappears when we include our interactions with the centrality dummy (column 4).

Columns 5 through 8 in Table 5 include pair fixed effects, which absorb the average effects of ownership and other pair characteristics. Our main interaction of the crisis dummy with the centrality dummy remains significant and of similar magnitude compared to the previous columns. The time-varying effects of ownership and the dummy for pairs linked to central firms are not significant when pair fixed effects are included.

3.2.2 Evolution of Lending Relationships at the Firm-Level

We now look at the firm level instead of the pair level. 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 that builds upon equation (3.1):

$$y_{it} = \delta_t + \beta^{'}(\delta_t \times centrality_i) + \mu_i + \epsilon_{it}. \tag{3.3}$$

The set of time effects δ_t is interacted with centrality for each firm. The omitted year is 2008, so all comparisons are relative to that year. 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 (3.3). We can see that the cross-sectional effect of centrality on lending and borrowing is significant during 2009, but not before the crisis. Table 4 already showed that the difference in lending relationships between high and low centrality firms is not significant during 2007. Figure 5 confirms that the effect is only significant during the crisis, or that there are no trends pre-dating the crisis.

The absence of pre-trends supports the differences-in-differences approach. The absence of pre-trends is not obvious, in fact we can imagine sources of variation that would invalidate our approach. One such story would be that the boom that precedes the crisis leads to significant restructuring of groups. Under this story, central firms are simply firms in booming sectors that end up in a central position because they are cash-rich and participate in many acquisitions. The increase in lending and borrowing would be a reflection of previous acquisition activity or relatedness between industries (e.g., trade credit), and not a product of their advantage to intermediate during the crisis. This story is not consistent with the fact that there is no unusual increase of lending and borrowing in central firms during the boom years (2001-2007). We do not see either a restructuring of groups during the boom, which would imply movements in ownership relations (see Panels G and H of Figure 4).

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 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 relationships of each firm. 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 more involved in 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 is 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 parsimonious version of equation (3.3):

$$y_{it} = (\beta_1 crisis_t + \beta_2 recovery_t + \beta_3 post_t) \times centrality_i + \delta_{gt} + \mu_i + \epsilon_{it}, \tag{3.4}$$

When we study the full sample of firms we use group-year fixed effects (δ_{gt}) instead of the year fixed effects (δ_t) since many of the relevant comparisons are within group. In the smaller sample of listed firms we use year fixed effects since it is often the case that a group has only two listed firms in a given year. The appendix shows that our results still go through among listed firms if group-year effects are included (see Table A.1).

The first column of Table 6 shows the positive effect of centrality on credit relationships (lending plus borrowing relationships) during the crisis (coeff. 1.062, t-stat 3). The effect of centrality is also significant during the recovery year (coeff. 0.870, t-stat 2.36), but it is not significant in the post period (coeff. 0.444, t-stat 1.10). One could think that the effect of centrality is mechanical given that listed firms are the ones reporting loans and all central firms are listed firms. The fact that the effect of centrality is seen *within* listed firms (column 5) proves that suspicion wrong.[15]

When we study lending and borrowing separately (columns 2-3 and 6-7 of Table 6) we find that the effect of centrality is positive in both during the crisis. The coefficients are economically large. For example, one standard deviation change in centrality increases lending relationships by 0.59 (column 2), which represents one third of the standard deviation of lending relationships. The effects are slightly stronger for lending relationships (0.590 vs 0.472 in the full sample, and 0.664 vs 0.538 among listed firms).

The last column in each panel of Table 6 uses net lending (lending minus borrowing relationships) as dependent variable. We find that centrality does not affect net lending,

[15] We use the same measure of betweenness in the full sample and in the sample of listed firms.

which implies that its impact on lending is similar to its impact on borrowing. This result is important to distinguish the role of central firms as intermediaries in internal capital markets from other perspectives of business groups. For example, if central firms are large firms (see Table 4), then it is perhaps natural to see these firms lending more to small firms that are financially constrained during the recession. However, it is hard to reconcile the finding that both lending and borrowing go up with a simple financial constraints story.

We can also run the differences-in-differences estimation separately for short-term and long-term credit relationships. We find that the positive effect of centrality comes mainly from short-term relationships (see Table A.2 in the appendix). This fits with the idea that central firms are engaged in liquidity provision during the recession more than on continuous support for other group firms.

3.2.3 Alternative Hypotheses and Robustness

In an ideal experiment centrality would be randomly assigned before the crisis. However, as implied by Table 4, central firms are systematically bigger, more levered, have more liquid stocks and lower cash-flow rights of the controlling shareholder. These characteristics can potentially explain the increase in lending and borrowing during the crisis. It is straightforward to test this idea by interacting the time dummies (crisis, recovery, and post) with firm characteristics. Results are reported in Table 7. Overall, we find that the effect of centrality is not absorbed by any of these other variables. The coefficient on centrality is quite stable regardless of the pre-crisis controls included in the regression.[16]

Under the tunneling hypothesis, cash-flow rights drive the incentives of the controlling shareholder to transfer resources between firms (Bertrand, Mehta, and Mullainathan, 2002). Instead, we find that cash-flow rights have no differential impact during the crisis (column 1 in Table 7).

Within the financial advantage hypothesis we could argue that central firms are providers or receivers of funds because of other correlated characteristics, and not because of their position in the ownership structure. For example, central firms tend to be bigger firms, and therefore less financially constrained. However, log-assets interacted with the time dummies are never statistically significant (column 2). Tobin's Q is a standard indicator of investment opportunities, but it does not drive away the effect of centrality (column 3). Central firms can also have better access to external funds

[16] Splitting the analysis of the impact of alternative control variables in Table 7 into lending and borrowing relationships separately does not change the main message. See Table A.3 in the appendix.

(e.g., because they have lower leverage or more liquid stocks in columns 4 and 5), or have more internal funds (e.g., higher cash holdings in column 6). We do not find that any of these firm characteristics explains the impact of centrality.

A final alternative hypothesis is that the control network overlaps with other networks that drive the activity of internal capital markets. A prominent possibility is the internal network of industrial relationships. We find that the degree of industrial integration of a firm with its business group is not an indicator of more credit relationships during the crisis (column 7). This also suggests that intra-group loans are not simply trade credit.

The appendix provides a battery of robustness checks for the main regressions in Tables 6. First, the results do not vary significantly if we use other measures of centrality. In Table A.4 we use weighted betweenness and in Table A.5 we use degree with very similar results. 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.[17] They 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.5 for the case of all firms should be scaled by 0.317. The authors explain that no results are known regarding the bias when using betweenness centrality.

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.6). The results are also robust to several changes to the sample definition and the regression specification: excluding holding companies, which some could argue play the role of intermediaries in groups (Table A.7); winsorizing the main dependent variables to reduce the impact of potential outliers (Table A.8); restricting attention to firms with overlap in the propensity score distribution for centrality as suggested by Crump et al. (2009) (Table A.9); and clustering standard errors by business group (Table A.10).[18]

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

[18] This is not our preferred clustering method because we only have a small number of clusters in this case (22 groups). In Table A.10, and on top of the regular clustered standard errors, we also report clustered standard errors that correct for the bias that few clusters can produce. Although we lose some significance in the sample of listed firms (e.g., p-values of 6%), in the full sample our results

3.2.4 Amounts of Intra-Group Intermediation

In Table 8 Panel A we look at the total amount of intermediation (lending + borrowing) done by each firm. We first study the sample with all firms, and then we condition on firms with some positive amount of lending or borrowing within the group to look at the pure intensive margin. We compute amounts in local currency (million pesos) since most intra-group loans are defined in these terms. The rest of the regression specification is the same as in equation (3.3), in particular we include firm and group-year fixed effects that absorb average levels of intermediation along those dimensions.

Total intermediation (short term + long term) does not increase significantly with centrality during the crisis or later (column 1). However, short-term intermediation increases (column 2), and the effect is particularly noticeable when we condition on those firms with some participation in the internal capital market (column 5). For those firms, one standard-deviation increase in centrality increases short-term intermediation during the crisis by 4.9 million pesos (t-stat 2.13), which is close to the conditional average of short-term intermediation (5.3 million pesos). We cannot reject that the coefficients for the interactions with crisis, recovery, and post periods are the same, but the amount of short-term intermediation may also be affected by the substitution of long-term loans, which are falling or flat at the time (see columns 3 and 6).

The total amount of intermediation is different from the net lending position of each firm (lending − borrowing), which we study in Panel B of Table 8. We do not find any significant relationship between net lending and centrality during this period. This is consistent with the lack of effect on net lending relationships seen in Table 6.

In Table 9 we look at the likelihood of increasing intermediation by more than a given amount. For example, the unconditional likelihood of increasing short-run intermediation by 15 million pesos (roughly 30,000 USD) in a given year is about 1% in the full sample. The coefficients in columns of short-term intermediation are consistently larger than those of total intermediation. For short-term intermediation the coefficient on the interaction of crisis and centrality is in general larger than the coefficient on other interactions. For example, in column 4 we find that the likelihood of increasing short-run intermediation by 15 million pesos for a max-centrality firm is 4.3% (t-stat 2.2) during the crisis, but only 3% (t-stat 1.6) during the recovery and 1.4% (t-stat 1.5) in the post period. This shows that the biggest increases in intermediation by central firms can be attributed to the crisis.

go through even after this correction.

3.3 Real Effects

In this section we study the consequences of internal capital markets as studied before in the literature. For this section we need firm-level financials, so we limit our analysis to listed firms. We first perform within-group comparisons since Stein (1997)'s winner-picking prediction is essentially a relative statement within the group. Although all group firms may have access to positive-NPV projects, the business group allocates more capital to the firm with the highest marginal return of investment inside the group.

We also compare group firms to non-group firms, which is informative because winner-picking allows for two interpretations. First, projects can be inherently good or bad, and the business group simply redistributes funds between them. Second, the support of the business group can produce better projects. Some projects can be good in expectation, or have better potential than other projects, but without the help of the group this potential may not materialize. This is the case, for example, if firms are financially constrained. In both cases, the business group benefits from the reallocation of capital.

The comparison between group and non-group firms can help in the distinction between purely *picking* better projects and *producing* better projects. We can argue that the support of the internal capital market adds value if we find ex-post differences between group firms and non-group firms of similar characteristics and investment opportunities (i.e., Tobin's Q).

3.3.1 Within-Group Evidence

Central firms play the role of intermediaries during bad times, as seen in the previous section. Most other group firms are receivers or providers of funds. We define receivers as non-central firms that increase their net borrowing position (borrowing minus lending relationships) in 2009. This keeps the focus on new loans during the crisis. Providers are defined analogously. There are only a few firms that are neither central firms, nor receivers, nor providers during the recession.

Table 10 shows differences between receivers, non-receivers (i.e., a mix of central firms, providers, and others), and providers the year before the crisis. On average, receivers have higher Tobin's Q than non-receivers (1.43 vs 1.20), which is consistent with winner-picking (Giroud and Mueller, 2015; Shin and Stulz, 1998, and Stein, 1997). The difference in Tobin's Q is only marginally insignificant (p-value 13% when we include group fixed effects), which can be expected due to the small sample. Receivers are

smaller firms, with lower cash holdings, and lower leverage than non-receivers. However, they have higher PPE growth than non-receivers (0.13 vs 0.10). The picture that appears from these comparisons is similar to the one in the previous literature, namely receivers in internal capital markets are firms with better investment opportunities (Tobin's Q), but financially constrained (see Almeida, Kim, and Kim, 2015; Buchuk et al., 2014; and Gopalan, Nanda, and Seru, 2007).

In Table 11 we run a differences-in-differences regression using as dependent variable firm-level outcomes. The dummy *Receiver* is an indicator variable for receivers, and it is interacted with our previous dummies for crisis, recovery, and the post period. We show two panels in Table 11 that only differ in terms of sample selection. In Panel A, non-receivers are the excluded category in the regression. In Panel B we drop central firms, so the excluded category is approximately providers. The appendix (Table A.11) shows regressions using a dummy for providers instead of receivers, and the results are the mirror image of those reported in Table 11.

In columns 1 and 2 of both panels in Table 11 we find that receivers have significantly higher ROA and ROE than other group firms during the crisis. Although profitability is an ex-post measure, on average it should be highest for receivers if groups allocate funds where the expected value of funds is highest. Receivers also invest more (higher growth in PPE) and enjoy higher sales growth during the recovery (columns 3 and 4), although the effects are only significant at the 10% level. Tobin's Q is also marginally higher for receivers during the crisis and recovery. In general, the coefficients are larger in magnitude in Panel B that excludes central firms, which implies that identification comes from the comparison of receivers and providers, and that central firms stand in the middle.

One may not be interested in all providers, but only on providers to central firms, which we study in Table 12. We find that providers to central firms have lower profitability and stock returns during the crisis. The effects are significant at the 10% level. In the recovery period the effects become stronger. For instance, in the ROE regression the coefficient on the interaction between recovery and provider to central is -0.102 (t-stat -2.48). The stock returns of providers are 34 percentage points lower during recovery (column 5, t-stat -2.78), and Tobin's Q goes down by 0.31 (column 6, t-stat -3.13). Interestingly, providers increase external leverage during the crisis and recovery period (column 7). This suggests that providers use their market access to give support –through central firms– to receivers in the group.

3.3.2 Comparison with Non-Group Firms

The previous results are based on within-group comparisons. We now study whether internal capital markets only redistribute funds in a smart way or truly enable a differential performance of affiliated firms. In order to answer this question we need to make comparisons of group firms and non-group firms that have access to similar investment opportunities.

The main challenge to compare the behavior of group and non-group firms is that firms are selected into business groups (see Almeida and Wolfenzon, 2006b). In order to overcome this challenge we follow the synthetic control methodology proposed by Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010).[19] We build a synthetic control for each firm in our treatment sample (i.e., receivers, providers, or central firms) using firms in the control sample (i.e., non-group firms). The synthetic match minimizes the difference with the treated firm in the pre-crisis period. Based on Almeida and Wolfenzon (2006b) and Almeida, Kim, and Kim (2015), we create a synthetic control for each group firm based on size (log assets), profitability (ROA, ROE), leverage, growth in PPE, and crucially Tobin's Q, which accounts for investment opportunities.

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

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

where $\widehat{X}_{it} = \sum_{j \in \text{Control group}} w_j^i X_{jt}$, 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. The sample period for the pre-crisis matching goes between 2004 and 2008. We report treatment effects and 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 non-group firms. Each placebo group has the same sample size as the real treatment group. Following Acemoglu et al. (2016), and to increase the precision of

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

our estimates, we drop those firms with a matching quality in the lowest 5% of the empirical distribution.

Table 13 reports results for our three treatment groups: receivers, providers, and central firms. In terms of ROA, receivers do not perform significantly different than controls during the year of the crisis. However, they perform significantly better in the recovery year (6.3%, p-value$<$ 1%) and subsequent years. The cumulative effect on receivers is large: 3.8% higher ROA on average over 5 years (2009-2013). Hence, although there is no short-run effect on receivers when compared to non-group firms, they can sustain higher profitability for a longer time. Central firms have significantly lower ROA than control firms in the year of the crisis (-1.7%, p-value$<$ 1%), but perform significantly better in the recovery year (5.2%, p-value$<$ 1%). Differences between central firms and controls are not significant later on. The performance of providers is similar to central firms, although with a stronger fall during the recession (-2.9%, p-value$<$ 1%), and a weaker recovery (3.8%, p-value$<$ 1%). This evidence is consistent with the idea that business groups suffer a short-term hit while accommodating the aggregate shock, but recover faster than comparable non-group firms. The recovery more than compensates for the cost paid by business group firms during the crisis.

Figure 7 shows the average of ROA_{it} and $\widehat{ROA}_{it}$ for treated firms, each with their own set of synthetic controls. We see the low profitability of treated firms (receivers, providers, and central firms) compared to control firms during the year of the crisis (2009). The underperformance is strongest in providers, and almost non-existent in receivers. During the recovery and subsequent years, receivers and central firms have higher profitability than control firms. The cumulative difference is clearly positive, specially for receivers.

The effects on external leverage (which excludes intra-group loans) in Table 13 suggest that one channel through which profitability is sustained is by lifting financial constraints and hence allowing receivers to have relatively high levels of market debt. Receivers have 4.4% higher leverage during the crisis when compared to non-group firms (p-value$<$ 5%). This difference persists for two more years, before becoming insignificant and then negative in 2013. The behavior of providers is interesting, since it suggests that providers increase debt during the crisis (2.9%, p-value$<$ 1%) to provide for the rest of the group. Also, central firms never have leverage higher than control firms, which emphasizes their role as intermediaries within the group rather than as direct providers of funds. Figure 7 summarizes the dynamics of leverage during this period.

Although the relative performance of receivers and providers suggests that internal

capital markets are efficient, this does not have to be interpreted in an unconditional way. First, our results speak of reallocation during a recession, and not in other periods. Second, we do not really know what is the optimal allocation of capital in groups. Perhaps receivers should have received even more capital than what they are receiving, and providers should have provided even more capital. Finally, groups are so big in emerging economies such as Chile that they may impose negative externalities on the economy as a whole (see Almeida and Wolfenzon, 2006a, on this last point). Overall, although redistribution goes in the right direction, it is hard to say if there is too much or too little redistribution as predicted by dark-side theories of internal capital markets (see, for example, Matvos and Seru, 2014; Rajan, Servaes, and Zingales, 2000; and Scharfstein and Stein, 2000).

4. Conclusions

We study the behavior of business groups during 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, in line with their role as intermediaries in internal capital markets. In Stein (1997)'s model of internal capital markets, central firms can play this role because they are endowed with control rights that allow them to redistribute resources across firms. In line with previous results in the literature, receivers of intra-group loans are high-Q, financially constrained firms, which also perform significantly better than providers during the recession. Receivers do not perform better than non-group firms during the crisis, but they perform significantly better in subsequent years and keep high leverage.

When compared to the previous literature on business groups, our results highlight the mechanics of the intermediation more than the ultimate efficiency of the transfers. The novelty of our approach comes from relating formal control rights with the transfer of resources between group firms. More specifically, we relate the position of a firm in the ownership network (i.e., its centrality) with the intermediation between firms. Our finding underscores a key advantage of internal capital markets over regular market intermediation, namely that internal credit relationships are permeated by strong control rights that ease financial contracting at times of distress.

Our results are relevant for regulators of securities markets and financial stability. Many securities regulators are suspicious of intra-group loans because of their potential for tunneling. Our results show that there can be a rationale behind these loans, and

that minority investors are not necessarily worse off in the long run if group firms are allowed to lend to each other. At the same time, it is worth noting that in our sample intra-group loans are made under strict rules about disclosure and loan characteristics (e.g., interest rate) that reduce the chance of tunneling. In terms of financial stability, our results show that central firms in groups perform banking-like intermediation during bad times. Whether this intermediation can be a source of contagion and systemic risk (see the annual report of the Bank of Israel, 2009, chapter 4) is something that requires more research.

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Figure 1: **Ownership and Credit Links**

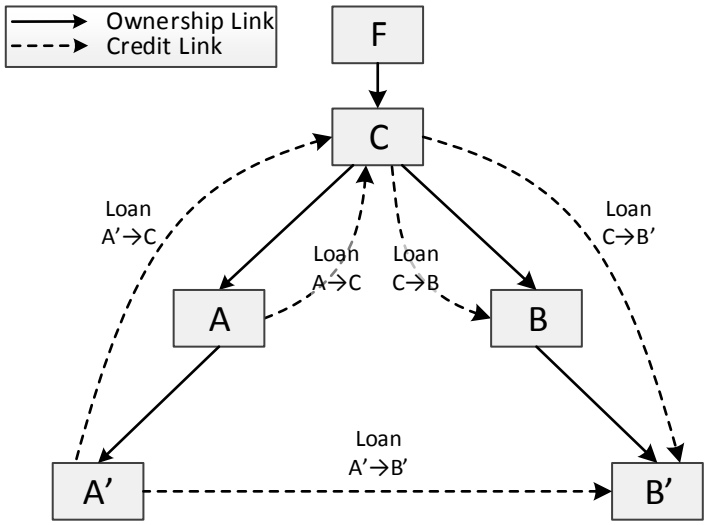
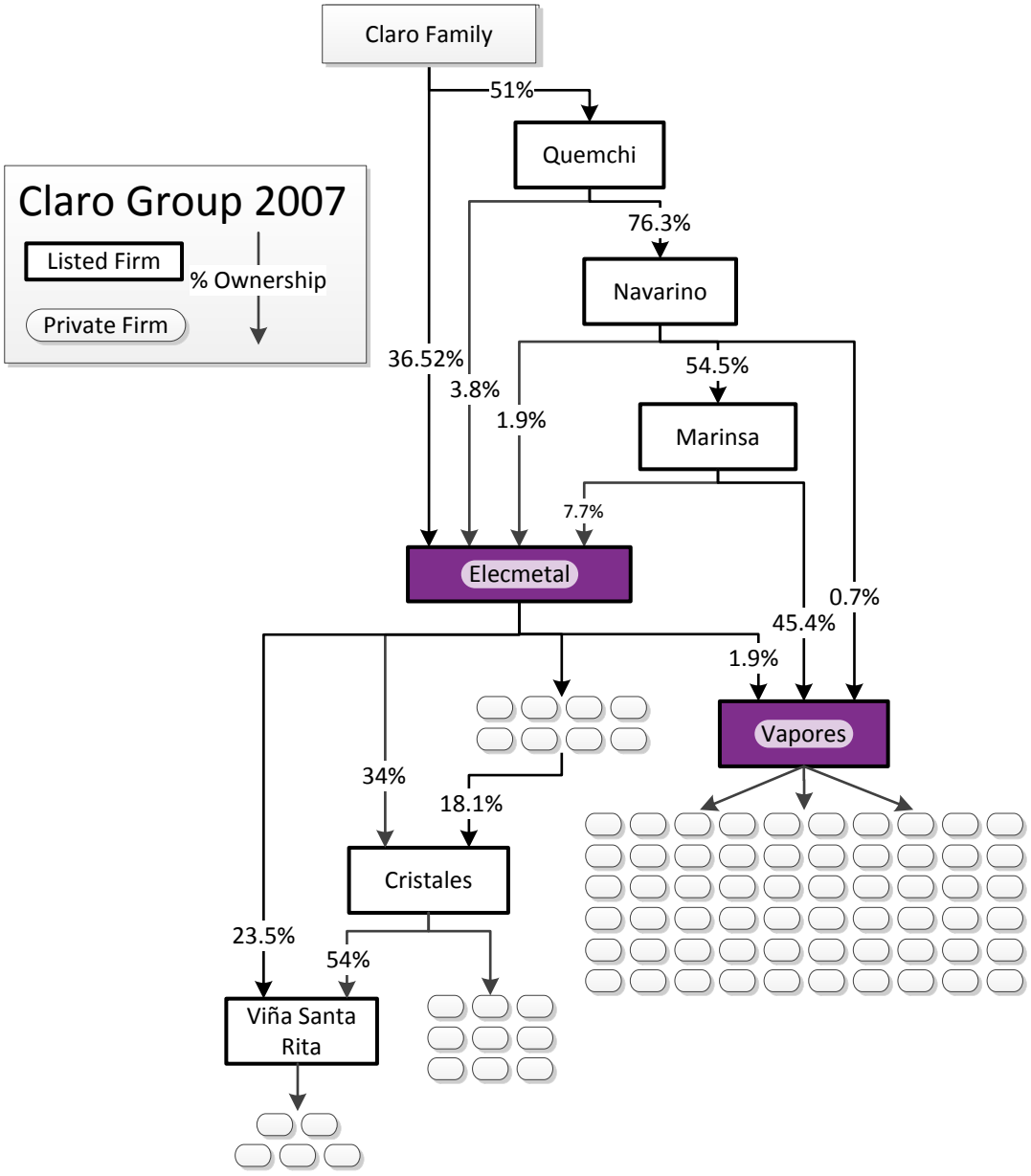
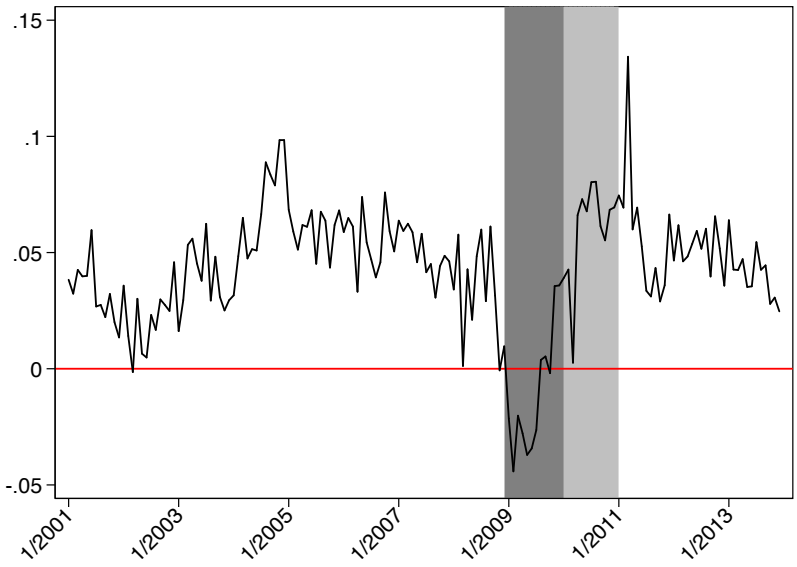


Figure 2: **Ownership Structure of Claro Group**

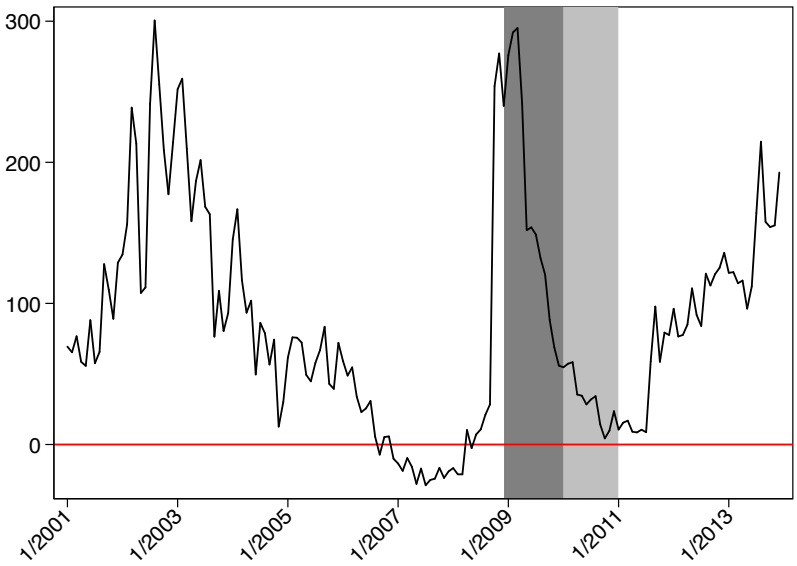


Notes: This figure shows the ownership structure of the Claro group in 2007. Firms in dark shade are the two most central firms based on betweenness centrality in the ownership network.

Figure 3: **The Great Recession in Chile**



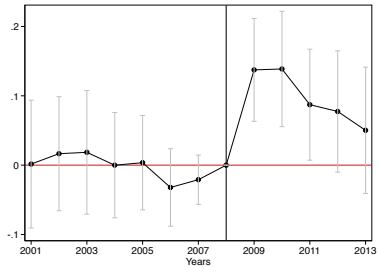
A. Industrial Activity



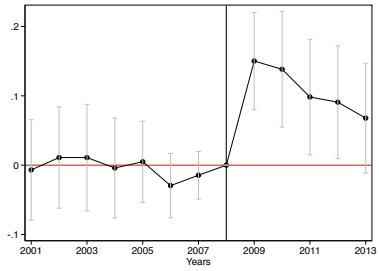
B. Yield Spread

Notes: Panel A shows the time series of Chilean 12-month log change in industrial activity (IMACEC). Panel B presents the yield spread of A− versus AAA Chilean corporate bonds. The darker grey area shows the *crisis* period, while the lighter grey area shows the *recovery* period.

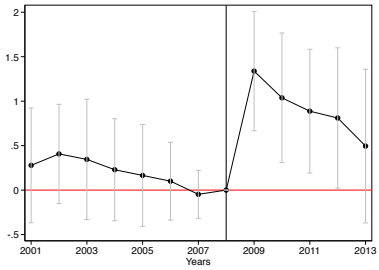
Figure 4: **Lending and Borrowing Relationships across Time**



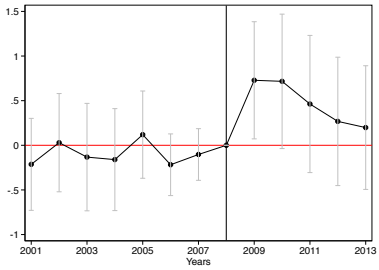
A. Lending - All Firms



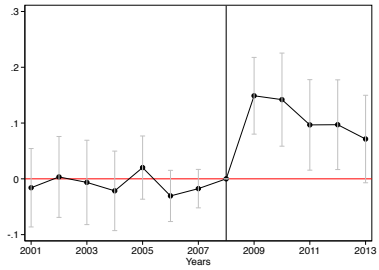
B. Borrowing - All Firms



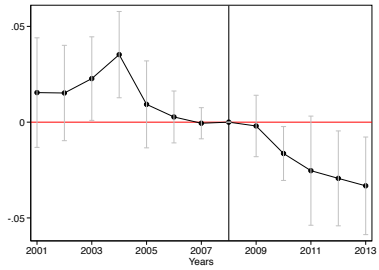
C. Lending - Listed Firms



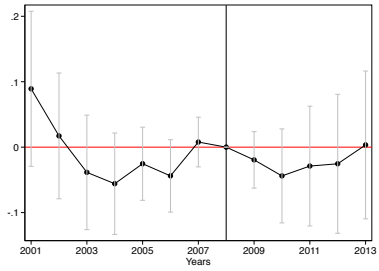
D. Borrowing - Listed Firms



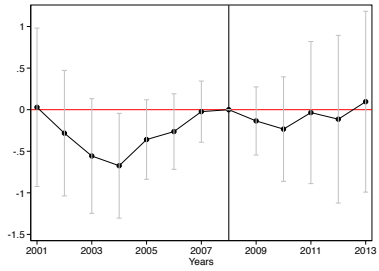
E. Short Term Borrowing - All Firms



F. Long Term Borrowing - All Firms



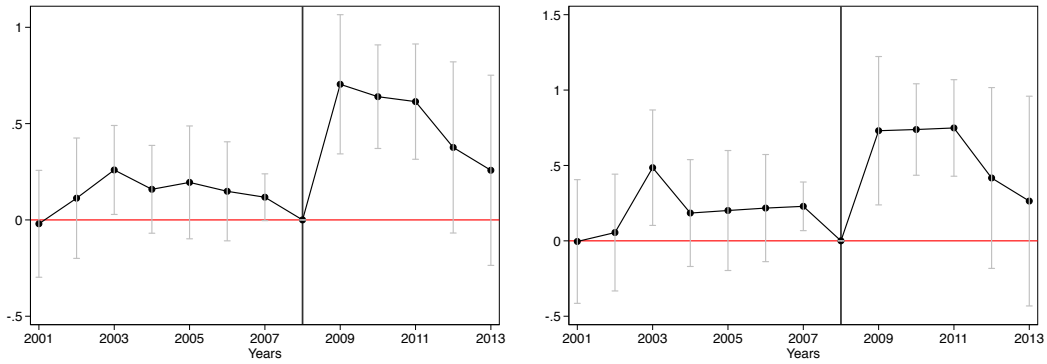
G. Ownership Relationships - All Firms



H. Ownership Relationships - Listed Firms

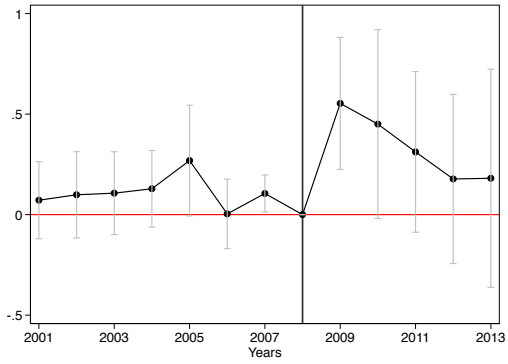
Notes: This figure shows the number of lending, borrowing, and ownership relationships across years for all the firms in our sample and for listed firms. Credit relationships are split into long and short term according what is reported in financial statements. Each dot is a coefficient from a regression of the variable of interest on year dummies excluding year 2008. Grey bars represent 95% confidence intervals.

Figure 5: **The Role of Firm Centrality in Lending and Borrowing Relationships**

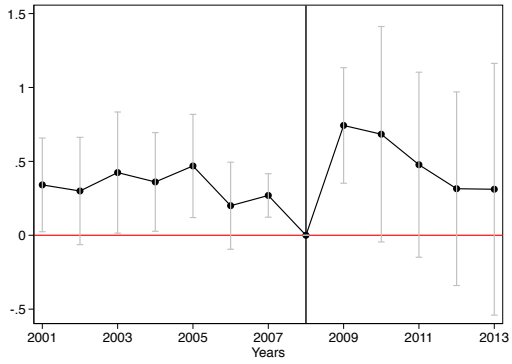


A. Lending - All Firms

B. Lending - Listed Firms



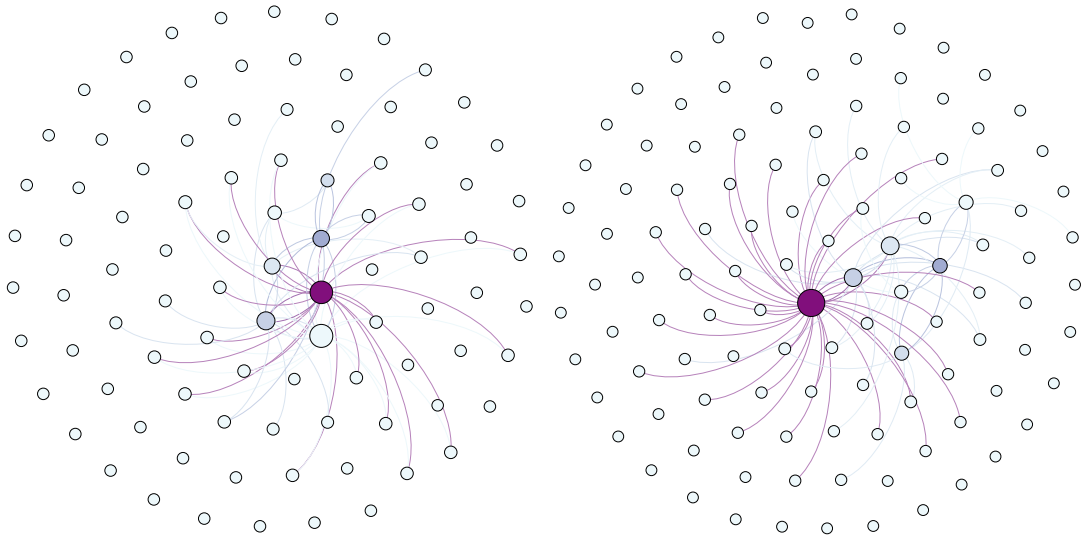
C. Borrowing - All Firms



D. Borrowing - Listed Firms

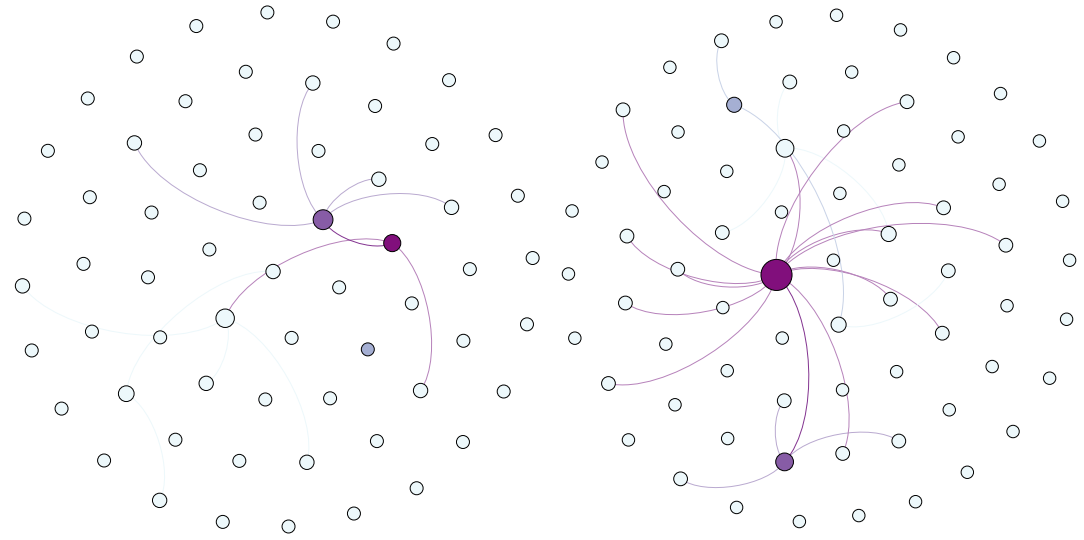
Notes: Each dot in this figure is a coefficient from a regression of the variable of interest on year dummies (excluding year 2008) interacted with centrality in 2007. The dependent variable is the number of lending or borrowing relationships. We run regressions in our sample of all firms or only listed firms. Grey bars represent 95% confidence intervals.

Figure 6: **Network of Intra-Group Loans**



A. Claro Business Group in 2007

B. Claro Business Group in 2009

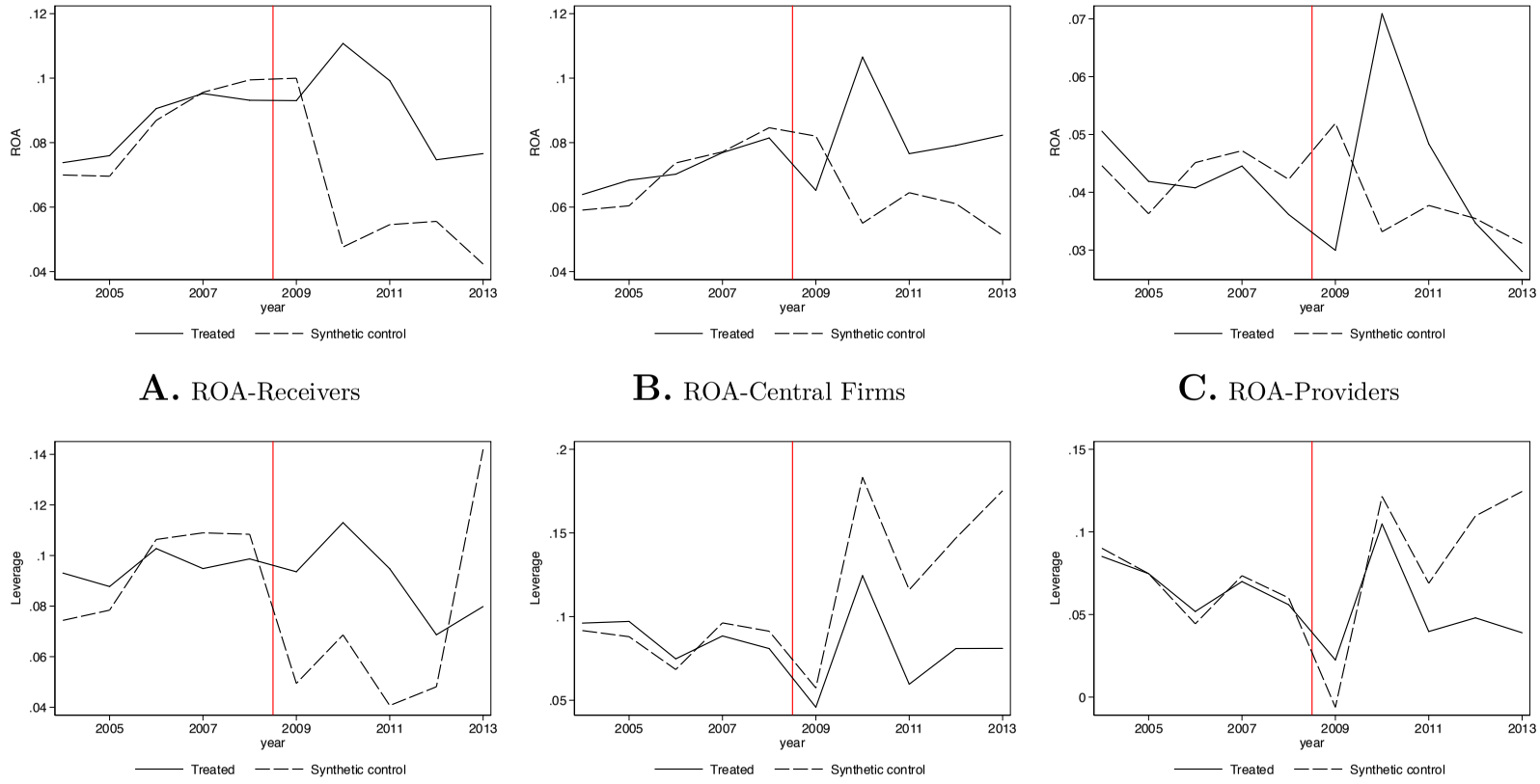


C. Ponce Business Group in 2007

D. Ponce Business Group in 2009

Notes: This figure shows the network of lending and borrowing relationships in 2007 and 2009 for the Claro group (Panels A and B) and the Ponce group (Panels C and D). Each node represents a firm in the business group, 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 node represents 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. Non-Group Firms**



A. ROA-Receivers **B.** ROA-Central Firms **C.** ROA-Providers

D. Leverage-Receivers **E.** Leverage-Central Firms **F.** Leverage-Providers

Notes: This figure shows the average of ROA and leverage for firms in business groups and for synthetic controls based on non-group firms from 2004 to 2013. Treated firms correspond to receivers (panel A and D), central firms (panels B and E), or providers (panels C and F).

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 loan; the related firm is the firm with which the reporting firm has the outstanding balance; direct ownership is the ownership stake of the reporting firm over the related firm. Missing ownership means that either the reporting firm has no direct link to the related firm or that the related firm has stake over the reported firm. Loans are shown only if outstanding balances are larger than a 100,000 USD.

Table 2: **The Direction of Loans in Control Pyramids**

	With direct ownership link		Without direct ownership link		
	Between listed firms	1-listed and 1-private	Between listed firms	1-listed and 1-private	Total
Up	0.02	0.10	0.03	0.14	0.29
	(128)	(582)	(179)	(871)	(1,760)
Down	0.06	0.15	0.02	0.18	0.41
	(374)	(920)	(129)	(1,099)	(2,522)
Lateral	-	-	0.03	0.26	0.30
			(209)	(1,588)	(1,797)
Total	0.08	0.25	0.09	0.59	1
	(502)	(1,502)	(517)	(3,558)	(6,079)

Notes: This table reports the frequency (number in parenthesis) of intra-group loans according to the borrowing and lending firm and the presence or absence of direct ownership link. Loans go "up" when the borrowing firm controls the lending firm. Loans go "down" when the previous conditions are reversed. "Lateral" loans are made between firms that exert no direct or indirect controlling influence between them.

Table 3: **Summary Statistics**

	Mean	Median	Std. Dev.	Min	Max	# Obs.
			Panel A: All Firms			
L + B relat.	1.33	0	3.52	0	44	10,027
Lending (L) relat.	0.67	0	1.95	0	23	10,027
Borrowing (B) relat.	0.66	0	1.78	0	23	10,027
Betweenness centrality	0.014	0	0.070	0	1	10,027
Degree centrality	1.58	1	3.74	0	65	10,027
			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	0.070	0.066	0.084	−0.496	0.332	880
ROE	0.098	0.099	0.182	−1	0.63	880
Ln Assets	19.6	19.5	1.61	15.3	22.9	880
External leverage	0.365	0.388	0.176	0.0003	0.881	877
PPE Growth	0.029	0.036	0.285	−1	1	877
Cash holdings	0.288	0.244	0.197	0.005	0.991	877
Cash flow rights	0.506	0.501	0.22	0.03	0.981	887
Tobin's Q	1.09	0.978	0.617	0.128	7.41	839
Stock market returns	0.314	0.178	0.603	−0.504	3.33	803
Stock market liquidity	0.122	0.041	0.224	0	2.74	839
Extraordinary dividends	0.658	1	0.475	0	1	887
Mkt to Book equity	1.2	0.937	1.1	0.006	10.7	837
I-O BG Integration	0.036	0.002	0.077	0	0.421	887
Betweenness centrality	0.137	0.066	0.175	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 represent the total number of borrowing/lending relationships a firm has with other firms in the business group. *Betweenness centrality* and *Degree centrality* are measures of centrality in the undirected ownership network. *ROA* (EBIT 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* are 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 market cap), *Extraordinary dividends* (dummy for those firms paying higher dividends than the ones mandated 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.

Table 4: **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	0.292	0.105	0.01	0.01
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).

Table 5: **Likelihood of Lending Relationships**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dummy for lending relationship							
Crisis × Pair includes central firm		0.033**		0.031***		0.027**		0.026**
		(0.012)		(0.011)		(0.012)		(0.012)
Recovery × Pair includes central firm		−0.012		−0.014		0.000		−0.000
		(0.016)		(0.015)		(0.020)		(0.021)
Post × Pair includes central firm		0.020		0.017		0.012		0.012
		(0.017)		(0.014)		(0.011)		(0.011)
Pair includes central firm		0.014		0.017*				
		(0.015)		(0.009)				
Crisis × Pair linked to central firm			0.024**	0.019			0.016	0.011
			(0.012)	(0.012)			(0.010)	(0.011)
Recovery × Pair linked to central firm			0.009	0.012			0.007	0.007
			(0.014)	(0.014)			(0.012)	(0.012)
Post × Pair linked to central firm			0.020	0.020			0.009	0.007
			(0.018)	(0.018)			(0.011)	(0.012)
Pair linked to central firm			−0.035**	−0.039**				
			(0.016)	(0.015)				
Crisis × Ownership link	−0.014	−0.022	−0.016	−0.023	−0.017	−0.025	−0.019	−0.026
	(0.022)	(0.022)	(0.021)	(0.021)	(0.025)	(0.024)	(0.025)	(0.024)
Recovery × Ownership link	−0.010	−0.006	−0.011	−0.007	−0.019	−0.019	−0.020	−0.020
	(0.032)	(0.032)	(0.027)	(0.026)	(0.032)	(0.032)	(0.031)	(0.032)
Post × Ownership link	−0.038	−0.043	−0.040	−0.044	−0.030	−0.033	−0.030	−0.034
	(0.036)	(0.035)	(0.027)	(0.027)	(0.036)	(0.035)	(0.036)	(0.035)
Ownership link	0.179***	0.174***	0.183***	0.177***				
	(0.024)	(0.023)	(0.019)	(0.019)				
Observations	46,626	46,626	46,626	46,626	46,626	46,626	46,626	46,626
R-squared	0.101	0.103	0.102	0.104	0.702	0.703	0.702	0.703
BG-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	No	No	No	No	Yes	Yes	Yes	Yes
Avg. Dep. Var.	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089

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 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. *Pair includes central firm* is a dummy that takes the value one if the pair includes a central firm defined as a firm with a centrality above the median of of those firms with a positive betweenness in 2007, *Pair linked to central firm* is a dummy that takes the value at least of of the pair is linked with a central firm defined as a firm with a centrality above the median of of those firms with a positive betweenness in 2007, and *Ownership link* 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 for each firm in the pair. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6: **The Role of Central Firms in Lending and Borrowing Relationships during the Crisis**

	(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	1.062***	0.590***	0.472***	0.118	1.203**	0.664**	0.538**	0.126
	(0.353)	(0.216)	(0.167)	(0.155)	(0.479)	(0.295)	(0.234)	(0.234)
Recovery × Centrality	0.870**	0.507***	0.363	0.144	1.036*	0.612***	0.423	0.189
	(0.368)	(0.165)	(0.244)	(0.196)	(0.521)	(0.205)	(0.365)	(0.281)
Post × Centrality	0.444	0.309	0.135	0.174	0.451	0.335	0.115	0.220
	(0.403)	(0.193)	(0.226)	(0.118)	(0.589)	(0.265)	(0.338)	(0.147)
Observations	10,010	10,010	10,010	10,010	887	887	887	887
R-squared	0.852	0.811	0.826	0.534	0.071	0.059	0.052	0.012
Number of firms	1,034	1,034	1,034	1,034	84	84	84	84
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BG-Year FE	Yes	Yes	Yes	Yes	No	No	No	No
Year FE	No	No	No	No	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* 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 parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7: **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	1.243**	1.007**	1.204**	1.430***	1.229**	1.342**	1.207**	1.337**
	(0.503)	(0.502)	(0.480)	(0.540)	(0.484)	(0.511)	(0.481)	(0.574)
Recovery × Centrality	0.870	1.117**	1.015*	1.460**	1.036**	1.324**	1.116**	1.394***
	(0.544)	(0.504)	(0.515)	(0.589)	(0.508)	(0.537)	(0.522)	(0.515)
Post × Centrality	0.333	0.450	0.431	0.660	0.492	0.713	0.517	0.558
	(0.605)	(0.598)	(0.584)	(0.664)	(0.523)	(0.594)	(0.608)	(0.576)
Crisis × Cash flow rights	2.054							−1.588
	(4.511)							(4.167)
Recovery × Cash flow rights	−5.386							−7.090**
	(3.255)							(2.958)
Post × Cash flow rights	−4.971							−6.892***
	(2.993)							(2.522)
Crisis × Ln Assets		0.564						0.555
		(0.481)						(0.426)
Recovery × Ln Assets		−0.245						0.156
		(0.476)						(0.416)
Post × Ln Assets		−0.005						0.519
		(0.498)						(0.469)
Crisis × Tobin's Q			−0.027					0.322
			(0.832)					(1.063)
Recovery × Tobin's Q			0.872					0.558
			(0.919)					(1.298)
Post × Tobin's Q			0.845					0.600
			(0.909)					(1.195)
Crisis × Leverage				−6.826				−6.971
				(5.984)				(6.208)
Recovery × Leverage				−12.214**				−12.439*
				(5.861)				(6.247)
Post × Leverage				−6.090				−7.674
				(5.627)				(5.833)
Crisis × Cash holdings					−7.010**			−6.008*
					(3.212)			(3.236)
Recovery × Cash holdings					−2.429			−4.271
					(3.286)			(3.278)
Post × Cash holdings					−7.573**			−7.021**
					(3.478)			(2.952)
Crisis × Stock Liquidity						−2.967		−3.597
						(2.664)		(3.223)
Recovery × Stock Liquidity						−6.202**		−3.626
						(2.852)		(2.834)
Post × Stock Liquidity						−5.825*		−2.803
						(3.366)		(3.319)
Crisis × I-O BG integration							0.191	7.408
							(17.892)	(19.854)
Recovery × I-O BG integration							−24.881**	−15.896
							(10.713)	(10.483)
Post × I-O BG integration							−22.849*	−13.237
							(11.979)	(12.945)
Observations	887	887	887	887	887	887	887	887
R-squared	0.091	0.075	0.074	0.090	0.096	0.104	0.115	0.187
Number of firms	74	74	74	74	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 the differences-in-differences estimation for lending and borrowing relationships (L+B) from 2001 to 2013. The sample corresponds to listed firms. *Centrality* 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 3 for definition of pre-crisis firm variables. Robust standard errors clustered at the firm level are reported in parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 8: **Total Amounts of Intermediation and Net Lending during the Crisis**

	(1)	(2)	(3)	(4)	(5)	(6)
	All firms			Conditional on Amount>0		
	Total	ST	LT	Total	ST	LT
Panel A: Lending + Borrowing						
Crisis × Centrality	2.8	4.4*	−1.7	3.5*	4.9**	1.1
	(2.2)	(2.6)	(1.2)	(2.1)	(2.3)	(2.2)
Recovery × Centrality	3.3	6.2*	−2.9*	3.8*	6.6**	−0.3
	(2.3)	(3.4)	(1.6)	(2.1)	(3.0)	(0.7)
Post × Centrality	0.2	6.7*	−6.5*	0.6	6.5**	0.1
	(2.2)	(3.8)	(3.5)	(2.2)	(2.9)	(0.8)
R-squared	0.599	0.659	0.344	0.675	0.754	0.724
Avg. Dep. Var.	3.310	1.826	1.484	9.184	5.315	17.31
Panel B: Lending − Borrowing						
Crisis × Centrality	−0.7	−1.3	0.6	0.3	−0.9	6.2
	(4.1)	(1.4)	(4.5)	(4.1)	(1.7)	(9.6)
Recovery × Centrality	−1.6	−1.4	−0.2	−0.8	−1.1	9.0
	(5.4)	(1.9)	(4.6)	(5.3)	(1.8)	(10.1)
Post × Centrality	−2.3	−0.9	−1.3	−1.6	−0.6	3.9
	(4.1)	(2.0)	(2.3)	(3.7)	(1.9)	(5.3)
R-squared	0.072	0.234	0.066	0.102	0.284	0.139
Avg. Dep. Var.	0.046	−0.025	0.071	0.181	−0.024	1.225
Observations	10,010	10,010	10,010	3,586	3,428	715
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 for intra-group loan amounts from 2001 to 2013. All dependent variables are expressed in millions of Chilean pesos. Panel A presents the total lending plus borrowing for a firm in a given year, while panel B presents the total lending minus borrowing for a firm in a given year. Columns (1) to (3) present results for all firms including those that did not participate in the internal capital market, while columns (4) to (6) is conditional on participating in this market. *Total* refers to short and long-term lending and borrowing, while *ST* and *LT* stand for short and long-term, respectively. *Centrality* 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 parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 9: **Likelihood of Increasing Intermediation and Centrality**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All firms				Conditional on Amount>0			
	Increase > 5M		Increase > 15M		Increase > 5M		Increase > 15M	
	Total	ST	Total	ST	Total	ST	Total	ST
Crisis × Centrality in 07'	0.030	0.041**	0.031	0.043**	0.043	0.055***	0.037	0.051**
	(0.024)	(0.020)	(0.023)	(0.019)	(0.026)	(0.020)	(0.027)	(0.020)
Recovery × Centrality in 07'	0.039*	0.043**	0.025	0.030	0.044**	0.044**	0.030	0.033*
	(0.020)	(0.019)	(0.019)	(0.019)	(0.020)	(0.019)	(0.019)	(0.020)
Post × Centrality in 07'	0.006	0.003	0.014	0.014	0.011	0.005	0.015	0.014
	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)
Observations	10,090	10,090	10,090	10,090	3,666	3,508	3,666	3,666
R-squared	0.327	0.335	0.301	0.337	0.435	0.454	0.426	0.470
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BG-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Avg. Dep. Var.	0.025	0.023	0.010	0.010	0.055	0.054	0.022	0.020

Notes: This table presents a differences-in-differences estimation for likelihood of increasing intermediation from 2001 to 2013. The dependent variable is a dummy based on the change in lending plus borrowing for firm i in year t compared to $t-1$. In columns (1) and (2) ((5) and (6)) the dummy takes the value one if there is an increase in a given year compared to the previous one greater than 5 millions, while in columns (3) and (4) ((7) and (8)) the dummy takes the value one if the increase is greater than 15 millions. Columns (5) to (8) restrict the sample to firms who have a lending or borrowing position greater than zero. *Total* refers to short and long-term lending and borrowing, while *ST* stands for short-term. *Centrality* 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 parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 10: **Ex-Ante Differences by Lending Status during the Crisis**

	Mean			p-value		p-value adding BG FE	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Receiver	Non receiver	Provider	(1)-(2)	(1)-(3)	(1)-(2)	(1)-(3)
Tobin's Q	1.43	1.20	1.21	0.22	0.34	0.13	0.34
Cash holdings	0.26	0.34	0.33	0.18	0.25	0.15	0.16
ROA	0.10	0.09	0.09	0.65	0.75	0.72	0.98
Ln Assets	19.30	19.58	19.39	0.55	0.87	0.43	0.80
External leverage	0.27	0.37	0.30	0.04	0.51	0.16	0.70
PPE Growth	0.13	0.10	0.13	0.62	0.98	0.70	0.70
# Obs	13	61	28				

Notes: This table presents tests for differences in means between receivers, non-receivers, and providers. Receivers (providers) are non-central firms that increase their net borrowing (lending) position in 2009. Net borrowing is defined as borrowing minus lending relationships. Non-receivers are all firms that are not receivers. All variables are measured in 2007. The sample includes only listed firms. Columns (6) and (7) add business group fixed effects to the bi-variate test.

Table 11: **Impact on Receivers**

	(1) ROA	(2) ROE	(3) Δ PPE	(4) Δ Sales	(5) Stock returns	(6) Tobin's Q	(7) External leverage
				Panel A: All Firms			
Crisis × Receiver	0.037**	0.107**	−0.207	−0.027	0.038	0.259	−0.033
	(0.019)	(0.053)	(0.259)	(0.225)	(0.137)	(0.171)	(0.051)
Recovery × Receiver	0.020	0.039	0.626*	0.550*	−0.018	0.366*	0.057
	(0.016)	(0.035)	(0.349)	(0.285)	(0.138)	(0.214)	(0.070)
Post × Receiver	−0.001	0.050	0.172	0.225	−0.071	0.400	0.069
	(0.018)	(0.046)	(0.155)	(0.153)	(0.092)	(0.308)	(0.063)
Observations	880	880	877	877	803	839	877
R-squared	0.061	0.067	0.047	0.046	0.219	0.205	0.104
Number of firms	74	74	74	74	73	74	74
				Panel B: Excluding Central Firms			
Crisis × Receiver	0.042**	0.103*	−0.329	−0.054	−0.085	0.422*	−0.003
	(0.020)	(0.060)	(0.375)	(0.295)	(0.113)	(0.235)	(0.069)
Recovery × Receiver	0.025	0.066	0.956*	0.828*	−0.068	0.554*	0.131
	(0.019)	(0.043)	(0.512)	(0.417)	(0.135)	(0.295)	(0.094)
Post × Receiver	0.009	0.065	0.187	0.304	−0.068	0.647	0.137
	(0.024)	(0.063)	(0.223)	(0.211)	(0.103)	(0.470)	(0.087)
Observations	666	666	664	664	596	628	666
R-squared	0.051	0.067	0.062	0.056	0.209	0.222	0.156
Number of firms	56	56	56	56	55	56	56
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows a differences-in-differences estimation of firm performance and other characteristics. We define *Receiver* as non-central firms that increase their net borrowing position in 2009. Net borrowing is defined as as borrowing minus lending relationships. 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. Robust standard errors clustered at the firm level are reported in parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 12: **Impact on Providers to Central Firms**

	(1) ROA	(2) ROE	(3) Δ PPE	(4) Δ Sales	(5) Stock returns	(6) Tobin's Q	(7) External leverage
Crisis × Provider to central	−0.086*	−0.322*	−0.138	−0.421	−0.433*	−0.108	0.156**
	(0.046)	(0.185)	(0.291)	(0.326)	(0.241)	(0.080)	(0.060)
Recovery × Provider to central	−0.024	−0.102**	−0.194	−0.451***	−0.343***	−0.310***	0.130**
	(0.027)	(0.041)	(0.197)	(0.117)	(0.123)	(0.099)	(0.051)
Post × Provider to central	−0.010	−0.160**	−0.970*	−1.204**	0.130	−0.217*	−0.080
	(0.016)	(0.061)	(0.511)	(0.584)	(0.176)	(0.113)	(0.086)
Observations	880	880	877	877	803	839	877
R-squared	0.070	0.098	0.059	0.070	0.227	0.178	0.120
Number of firms	74	74	74	74	73	74	74
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows a differences-in-differences estimation of firm performance and other characteristics. *Provider to central* is a dummy for those firms that had a positive net lending position with central firms in 2009. *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 parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 13: **Business Group Firms vs. Non-Group Firms during the Crisis**

	(1) Treatment effect	(2) C.I. at 5%	(3) C.I. at 1%	(4) Treatment effect	(5) C.I. at 5%	(6) C.I. at 1%	(7) Number of treated firms
			Panel A: Treatment=Receivers				
	ROA			**Leverage**			
2009 (Crisis)	−0.007	[0.003, −0.010]	[0.005, −0.012]	0.044**	[0.001, −0.039]	[0.006, −0.047]	23
2010 (Recovery)	0.063***	[0.015, −0.001]	[0.017, −0.004]	0.044***	[0.024, −0.033]	[0.033, −0.039]	23
2011 (Post)	0.045***	[0.015, −0.009]	[0.018, −0.015]	0.054***	[0.029, −0.043]	[0.037, −0.050]	23
2012 (Post)	0.019	[0.021, −0.007]	[0.026, −0.013]	0.021	[0.030, −0.033]	[0.040, −0.043]	23
2013 (Post)	0.034***	[0.012, −0.008]	[0.015, −0.014]	−0.062***	[0.037, −0.034]	[0.049, −0.041]	23
			Panel B: Treatment=Central Firms				
	ROA			**Leverage**			
2009 (Crisis)	−0.017***	[0.004, −0.014]	[0.008, −0.016]	−0.012	[0.001, −0.048]	[0.007, −0.057]	17
2010 (Recovery)	0.052***	[0.020, −0.002]	[0.024, −0.006]	−0.059***	[0.030, −0.041]	[0.041, −0.048]	17
2011 (Post)	0.012	[0.021, −0.013]	[0.025, −0.020]	−0.056**	[0.035, −0.052]	[0.046, −0.061]	17
2012 (Post)	0.018	[0.029, −0.010]	[0.036, −0.017]	−0.066***	[0.037, −0.040]	[0.049, −0.053]	17
2013 (Post)	0.031	[0.017, −0.011]	[0.021, −0.019]	−0.094***	[0.045, −0.042]	[0.060, −0.050]	17
			Panel C: Treatment=Providers				
	ROA			**Leverage**			
2009 (Crisis)	−0.029***	[0.002, −0.008]	[0.004, −0.009]	0.029***	[−0.001, −0.035]	[0.004, −0.041]	34
2010 (Recovery)	0.038***	[0.012, −0.002]	[0.015, −0.003]	−0.017	[0.020, −0.027]	[0.028, −0.034]	34
2011 (Post)	0.011	[0.012, −0.008]	[0.015, −0.010]	−0.029	[0.023, −0.036]	[0.031, −0.042]	34
2012 (Post)	−0.001	[0.017, −0.006]	[0.021, −0.008]	−0.062***	[0.026, −0.027]	[0.033, −0.037]	34
2013 (Post)	−0.005	[0.010, −0.008]	[0.012, −0.011]	−0.086***	[0.029, −0.027]	[0.039, −0.037]	34

Notes: This table presents treatment effects for central firms, receivers, and providers against synthetic controls for ROA and leverage. Columns (1) and (4) show the treatment effects, while columns (2) and (5) ((3) and (6)) present confidence intervals at 5% (1%). Confidence intervals are based on placebo treatment groups in 1,000 random samples. Column (7) shows the number of treated firms. The synthetic control is created using 50 non-group firms. Panel A shows the results for those firms with betweenness centrality in the top quartile, while panel B and C presents results for receivers/ providers during the crisis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Online Appendix

Table A.1: **The Role of Central Firms in Lending and Borrowing Relationships: Adding Business Group-Year Fixed Effects**

	(1)	(2)	(3)	(4)
	Listed firms			
	L+B	Lending	Borrowing	L−B
Crisis × Centrality	1.143**	0.605*	0.538**	0.067
	(0.529)	(0.348)	(0.233)	(0.268)
Recovery × Centrality	0.865*	0.478**	0.387	0.092
	(0.457)	(0.233)	(0.309)	(0.301)
Post × Centrality	0.715*	0.458**	0.256	0.202
	(0.382)	(0.206)	(0.242)	(0.237)
Observations	829	829	829	829
R-squared	0.876	0.824	0.844	0.613
Firm FE	Yes	Yes	Yes	Yes
BG-Year FE	Yes	Yes	Yes	Yes

Notes: This table presents a differences-in-differences estimation for lending and borrowing relationships from 2001 to 2013 for listed firms. All columns include BG-year fixed effects. All columns include an interaction between between a dummy for each business group and year fixed effects. $L + B$ is defined as the number of borrowing relationships plus lending relationships. *Centrality* 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 parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.2: **The Role of Central Firms in Lending and Borrowing Relationships by Loan Maturity**

	(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	1.090***	0.607***	0.483***	0.124	1.230**	0.662**	0.567**	0.095
	(0.345)	(0.205)	(0.167)	(0.144)	(0.469)	(0.283)	(0.233)	(0.219)
Recovery × Centrality	0.931**	0.557***	0.374	0.184	1.100**	0.674***	0.425	0.249
	(0.363)	(0.161)	(0.242)	(0.193)	(0.515)	(0.200)	(0.361)	(0.274)
Post × Centrality	0.494	0.350*	0.145	0.205*	0.491	0.369	0.122	0.247
	(0.397)	(0.191)	(0.222)	(0.118)	(0.581)	(0.263)	(0.333)	(0.149)
Panel B: Long Term								
Crisis × Centrality	−0.078	−0.053	−0.025	−0.028	−0.052	−0.022	−0.030	0.008
	(0.061)	(0.049)	(0.018)	(0.040)	(0.090)	(0.070)	(0.028)	(0.057)
Recovery × Centrality	−0.191***	−0.137***	−0.054***	−0.083**	−0.168***	−0.146***	−0.022	−0.124**
	(0.039)	(0.035)	(0.013)	(0.036)	(0.052)	(0.048)	(0.027)	(0.059)
Post × Centrality	−0.236***	−0.135***	−0.100**	−0.035	−0.135	−0.090*	−0.045	−0.046
	(0.056)	(0.039)	(0.049)	(0.069)	(0.104)	(0.054)	(0.088)	(0.102)
Observations	10,010	10,010	10,010	10,010	887	887	887	887
R-squared (A)	0.852	0.807	0.827	0.526	0.079	0.068	0.056	0.014
R-squared (B)	0.673	0.650	0.599	0.519	0.096	0.082	0.065	0.025
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
BG-Year FE	Yes	Yes	Yes	Yes	No	No	No	No
Year FE	No	No	No	No	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. $L-B$ is defined as the number of lending relationships minus borrowing relationships. *Centrality* 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 parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.3: **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	0.684**	0.559**	0.496**	0.496**	0.664**	0.540**	0.763**	0.667**	0.675**	0.554**	0.756**	0.586**	0.668**	0.538**	0.675*	0.662***
	(0.303)	(0.248)	(0.231)	(0.231)	(0.296)	(0.235)	(0.335)	(0.254)	(0.304)	(0.224)	(0.310)	(0.257)	(0.294)	(0.239)	(0.385)	(0.249)
Recovery × Centrality	0.513**	0.357	0.473	0.473	0.599***	0.416	0.875***	0.585	0.613***	0.423	0.769***	0.555	0.649***	0.467	0.810***	0.584
	(0.217)	(0.375)	(0.365)	(0.365)	(0.203)	(0.363)	(0.248)	(0.395)	(0.204)	(0.357)	(0.212)	(0.377)	(0.194)	(0.374)	(0.210)	(0.385)
Post × Centrality	0.278	0.055	0.169	0.169	0.321	0.110	0.464	0.196	0.356	0.136	0.507*	0.207	0.374	0.143	0.372	0.186
	(0.270)	(0.348)	(0.357)	(0.357)	(0.261)	(0.337)	(0.310)	(0.372)	(0.236)	(0.303)	(0.267)	(0.341)	(0.271)	(0.349)	(0.249)	(0.349)
Crisis × Cash flow rights	1.027	1.027													−0.991	−0.597
	(2.765)	(2.181)													(2.597)	(2.196)
Recovery × Cash flow rights	−3.250*	−2.136													−4.614**	−2.476
	(1.925)	(1.634)													(1.811)	(1.575)
Post × Cash flow rights	−2.412	−2.558*													−3.941**	−2.950**
	(1.778)	(1.445)													(1.533)	(1.298)
Crisis × Ln Assets			0.133	0.133											0.477*	0.078
			(0.250)	(0.250)											(0.264)	(0.233)
Recovery × Ln Assets			−0.137	−0.137											0.142	0.014
			(0.263)	(0.263)											(0.245)	(0.236)
Post × Ln Assets			−0.160	−0.160											0.512*	0.007
			(0.272)	(0.272)											(0.288)	(0.254)
Crisis × Tobin's Q					0.025	−0.052									0.145	0.176
					(0.589)	(0.352)									(0.705)	(0.433)
Recovery × Tobin's Q					0.553	0.319									0.417	0.141
					(0.512)	(0.484)									(0.694)	(0.662)
Post × Tobin's Q					0.605	0.240									0.464	0.136
					(0.561)	(0.425)									(0.644)	(0.607)
Crisis × Leverage							−2.972	−3.854							−3.224	−3.746
							(3.616)	(2.527)							(3.715)	(2.682)
Recovery × Leverage							−7.542**	−4.672*							−7.645*	−4.795*
							(3.636)	(2.569)							(3.875)	(2.639)
Post × Leverage							−3.748	−2.342							−5.158	−2.516
							(3.520)	(2.485)							(3.688)	(2.496)
Crisis × Cash holdings									−2.935	−4.075**					−1.988	−4.020**
									(1.889)	(1.739)					(1.833)	(1.871)
Recovery × Cash holdings									−1.250	−1.179					−2.376	−1.895
									(1.745)	(1.876)					(1.646)	(2.022)
Post × Cash holdings									−3.738*	−3.836**					−2.873*	−4.147**
									(2.079)	(1.725)					(1.571)	(1.703)
Crisis × Stock Liquidity											−1.951	−1.016			−2.678	−0.919
											(1.534)	(1.279)			(2.112)	(1.514)
Recovery × Stock Liquidity											−3.367**	−2.835**			−2.676	−0.949
											(1.636)	(1.280)			(1.610)	(1.464)
Post × Stock Liquidity											−3.800*	−2.025			−2.371	−0.431
											(1.991)	(1.410)			(1.992)	(1.505)
Crisis × I-O BG integration													−0.475	0.666	4.697	2.711
													(9.912)	(8.209)	(11.356)	(8.978)
Recovery × I-O BG integration													−11.276*	−13.605**	−4.727	−11.169**
													(6.166)	(5.240)	(6.430)	(5.420)
Post × I-O BG integration													−13.326**	−9.523	−6.569	−6.668
													(6.203)	(5.989)	(7.073)	(6.432)
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	0.093	0.070	0.093	0.086	0.159	0.140
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 the differences-in-differences estimation for lending and borrowing relationships from 2001 to 2013. The sample corresponds to listed firms. *Centrality* 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 3 for definition of pre-crisis firm variables. Robust standard errors clustered at the firm level are reported in parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.4: **The Role of Central Firms in Lending and Borrowing Relationships: Using Weighted Betweenness as Centrality Measure**

	(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	1.058***	0.573***	0.485***	0.088	1.211**	0.641**	0.570**	0.072
	(0.352)	(0.215)	(0.166)	(0.155)	(0.495)	(0.307)	(0.241)	(0.243)
Recovery × Centrality	0.868**	0.498***	0.370	0.128	1.082*	0.629***	0.453	0.176
	(0.374)	(0.165)	(0.249)	(0.195)	(0.554)	(0.212)	(0.388)	(0.290)
Post × Centrality	0.455	0.303	0.152	0.152	0.485	0.325	0.160	0.166
	(0.400)	(0.190)	(0.225)	(0.115)	(0.612)	(0.276)	(0.351)	(0.158)
Observations	10,010	10,010	10,010	10,010	887	887	887	887
R-squared	0.852	0.810	0.826	0.534	0.073	0.058	0.055	0.009
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
BG-Year FE	Yes	Yes	Yes	Yes	No	No	No	No
Year FE	No	No	No	No	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* is defined as weighted 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 parentheses. 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 Degree as Centrality Measure**

	(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	1.181***	0.752***	0.429***	0.322**	1.227***	0.820***	0.408*	0.412***
	(0.300)	(0.166)	(0.160)	(0.129)	(0.399)	(0.211)	(0.217)	(0.156)
Recovery × Centrality	0.944**	0.588***	0.356	0.232	1.101*	0.700***	0.401	0.299
	(0.374)	(0.163)	(0.247)	(0.186)	(0.557)	(0.208)	(0.379)	(0.250)
Post × Centrality	0.417	0.337*	0.080	0.258**	0.294	0.321	−0.026	0.347***
	(0.408)	(0.204)	(0.217)	(0.103)	(0.607)	(0.302)	(0.316)	(0.114)
Observations	10,010	10,010	10,010	10,010	887	887	887	887
R-squared	0.853	0.815	0.826	0.539	0.074	0.073	0.048	0.026
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
BG-Year FE	Yes	Yes	Yes	Yes	No	No	No	No
Year FE	No	No	No	No	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. *Centrality* is defined as degree in the undirected graph of ownership in 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 parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.6: **The Role of Central Firms in Lending and Borrowing Relationships: Using a Placebo Rreatment**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All firms				Listed firms			
	L+B	Lending	Borrowing	L−B	L+B	Lending	Borrowing	L−B
Placebo × Centrality	−0.079	−0.091	0.011	−0.102	0.048	0.055	−0.006	0.061
	(0.126)	(0.087)	(0.065)	(0.089)	(0.213)	(0.129)	(0.114)	(0.119)
Observations	5,347	5,347	5,347	5,347	484	484	484	484
R-squared	0.906	0.874	0.886	0.684	0.015	0.011	0.017	0.012
Number of firms	935	935	935	935	74	74	74	74
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BG-Year FE	Yes	Yes	Yes	Yes	No	No	No	No
Year FE	No	No	No	No	Yes	Yes	Yes	Yes

Notes: This table presents a differences-in-differences estimation using for lending and borrowing relationships from 2001 to 2007. 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. *Placebo* is dummy for the years after 2004. Robust standard errors are clustered at the firm level and reported in parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.7: **The Role of Central Firms in Lending and Borrowing: Excluding Holdings**

	(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	1.210***	0.669***	0.540***	0.129	1.349***	0.773**	0.575**	0.198
	(0.352)	(0.217)	(0.168)	(0.162)	(0.467)	(0.289)	(0.236)	(0.247)
Recovery × Centrality	0.957**	0.594***	0.363	0.230	0.958*	0.626***	0.332	0.294
	(0.396)	(0.169)	(0.260)	(0.191)	(0.561)	(0.209)	(0.390)	(0.278)
Post × Centrality	0.412	0.295	0.117	0.178	0.294	0.283	0.012	0.271*
	(0.430)	(0.206)	(0.241)	(0.125)	(0.628)	(0.286)	(0.358)	(0.156)
Observations	9,721	9,721	9,721	9,721	636	636	636	636
R-squared	0.864	0.823	0.842	0.547	0.102	0.086	0.081	0.026
Number of firms	995	995	995	995	53	53	53	53
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BG-Year FE	Yes	Yes	Yes	Yes	No	No	No	No
Year FE	No	No	No	No	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 (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. *Centrality* 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 parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.8: **The Role of Central Firms in Lending and Borrowing Relationships: Using Winsorized Lending and Borrowing Relationships and Ownership Centrality**

	(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	1.063***	0.591***	0.473***	0.118	1.204**	0.665**	0.539**	0.126
	(0.354)	(0.216)	(0.167)	(0.155)	(0.479)	(0.296)	(0.235)	(0.235)
Recovery × Centrality	0.871**	0.507***	0.363	0.144	1.037*	0.613***	0.424	0.189
	(0.369)	(0.165)	(0.245)	(0.196)	(0.522)	(0.205)	(0.366)	(0.282)
Post × Centrality	0.444	0.309	0.135	0.175	0.451	0.336	0.116	0.220
	(0.404)	(0.193)	(0.226)	(0.118)	(0.590)	(0.265)	(0.339)	(0.148)
Observations	10,010	10,010	10,010	10,010	887	887	887	887
R-squared	0.852	0.811	0.826	0.534	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
BG-Year FE	Yes	Yes	Yes	Yes	No	No	No	No
Year FE	No	No	No	No	Yes	Yes	Yes	Yes

Notes: This table presents a differences-in-differences estimation 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 (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. *Centrality* 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 parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.9: **The Role of Central Firms in Lending and Borrowing Relationships: Increasing Overlap of Firm Characteristics**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Optimal trimming (10.6%)				Trimming at 5%			
	L+B	Lending	Borrowing	L−B	L+B	Lending	Borrowing	L−B
Crisis × Centrality	1.328**	0.715**	0.614**	0.101	1.324**	0.739**	0.585**	0.154
	(0.524)	(0.331)	(0.259)	(0.279)	(0.509)	(0.317)	(0.251)	(0.261)
Recovery × Centrality	1.271**	0.704***	0.567	0.137	1.214**	0.704***	0.510	0.194
	(0.590)	(0.222)	(0.425)	(0.334)	(0.567)	(0.218)	(0.405)	(0.318)
Post × Centrality	0.625	0.400	0.225	0.175	0.654	0.415	0.239	0.175
	(0.689)	(0.303)	(0.401)	(0.175)	(0.666)	(0.293)	(0.388)	(0.170)
Observations	514	514	514	514	609	609	609	609
R-squared	0.091	0.078	0.065	0.015	0.078	0.064	0.058	0.014
Number of rut	44	44	44	44	52	52	52	52
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 using the optimal trimming of the propensity score suggested by Crump et al. (2009), while columns (5) to (8) 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. $L + B$ is defined as the number of borrowing relationships plus lending relationships. *Centrality* 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 parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.10: **The Role of Central Firms in Lending and Borrowing Relationships: Clustering SE at Business Group Level**

	(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	1.062**	0.590**	0.472**	0.118	1.203**	0.664***	0.538*	0.126
	(0.406)	(0.227)	(0.198)	(0.127)	(0.473)	(0.232)	(0.263)	(0.149)
	[0.040]	*[0.048]*	*[0.016]*	*[0.608]*	*[0.145]*	*[0.064]*	*[0.283]*	*[0.455]*
Recovery × Centrality	0.870*	0.507**	0.363	0.144	1.036*	0.612***	0.423	0.189
	(0.480)	(0.207)	(0.304)	(0.201)	(0.564)	(0.205)	(0.392)	(0.270)
	[0.040]	*[0.054]*	*[0.296]*	*[0.696]*	*[0.120]*	*[0.051]*	*[0.289]*	*[0.354]*
Post × Centrality	0.444	0.309	0.135	0.174*	0.451	0.335	0.115	0.220
	(0.536)	(0.268)	(0.276)	(0.100)	(0.606)	(0.274)	(0.342)	(0.132)
	[0.780]	*[0.584]*	*[0.880]*	*[0.104]*	*[0.258]*	*[0.103]*	*[0.516]*	*[0.486]*
Observations	10,010	10,010	10,010	10,010	887	887	887	887
R-squared	0.852	0.811	0.826	0.534	0.071	0.059	0.052	0.012
Number of firms	1,034	1,034	1,034	1,034	74	74	74	74
BG-Year FE	Yes	Yes	Yes	Yes	No	No	No	No
Year FE	No	No	No	No	Yes	Yes	Yes	Yes

Notes: This table presents a differences-in-differences estimation for 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 (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. *Centrality* 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 are clustered at the business group level and reported in parentheses. We also present the p-values from clustered standard errors in square brackets using wild bootstrap to take into account the small number of clusters. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.11: **Impact on Providers**

	(1) ROA	(2) ROE	(3) Δ PPE	(4) Δ Sales	(5) External leverage
			Panel A: All Firms		
Crisis × Provider	−0.028	−0.142**	−0.091	0.086	0.042
	(0.020)	(0.064)	(0.162)	(0.310)	(0.038)
Recovery × Provider	−0.009	−0.067**	−0.174	−0.407**	−0.002
	(0.014)	(0.031)	(0.223)	(0.158)	(0.044)
Post × Provider	−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 × Provider	−0.025	−0.146**	−0.040	0.152	0.020
	(0.020)	(0.063)	(0.219)	(0.373)	(0.050)
Recovery × Provider	−0.011	−0.067**	−0.279	−0.589***	−0.039
	(0.016)	(0.030)	(0.322)	(0.217)	(0.059)
Post × Provider	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 and other characteristics. We define *Provider* as non-central firms that increase their net lending position in 2009. Net lending is defined as as lending minus borrowing relationships. 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. Robust standard errors clustered at the firm level are reported in parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.