The Network Centrality of Influential Bankers: a new Capital Structure Determinant

J. Amaro de Matos (FEUNL) M. Ferreira (FEUNL)
P. Matos (USC Marshall School of Business) J. Mergulhão (FEUNL)*

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Abstract

This paper studies the impact of the presence of bankers in the board of a corporation on its capital structure. We assume that the presence of bankers reduces information asymmetry problems, facilitating information transmission between corporations and financial institutions. Using a large database on Board of Directors, we construct the directors's social network and measure the relative influence (centrality) of bankers on the information transmission mechanism. Our results indicate that the presence of bankers in the board increases the leverage ratio in US. This effect is magnified by the influence of the banker, i.e. the more connected a banker is, the higher the leverage ratio of the firm in which he or she sits. We also show that he effect of banker's social influence on the leverage ratio increases with firm's opacity, which is consistent with our interpretation of the role of bankers on the information transmission mechanism.

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1 Introduction

In this paper we examine whether the presence of influential bankers in the board of a corporation affects or not the capital structure of the firm. First, we measure the influential role of the bankers on the network of directors by using social network analysis to compute their centrality on the network. We then examine whether the banker's centrality impacts on the capital structure of a firm when seating on the board of directors.

Modigliani and Miller's (1958) states that capital structure should be irrelevant under a set of assumptions in the sense that the value of a firm does not depend on the debt-to-equity ratio. Theoretical research and empirical evidence have shown that capital structure is a main determinant of firm value. Relaxing the assumptions characterizing the MM frictionless economy would become a source of research in Corporate Finance.

Bankruptcy costs [Baxter (1967), Stiglitz (1972), Kraus and Litzemberger (1973), Kim (1978)], agency costs [Jensen and Meckling (1976)], and information asymmetry [Ross (1973), Myers and Majluf (1984)], have added to the analysis as an offsetting cost of debt. The trade-off between tax advantages and costs of debt imply that an optimal capital structure may exist. Although Miller (1977) argues that, when adding personal taxes, optimal capital structure exists only at macro level, and not at firm-level, DeAngelo and Masulis (1980) show that corporate tax shield substitutes (such as depreciation, amortization and investment tax credits) imply "a unique interior optimum leverage decision with or without leverage related costs". Myers (1984) suggests that after setting a target leverage ratio, firms gradually adjust their capital structure.

Diamond (1984) shows that if banks act as "delegated monitors" when lending money to corporations, as suggested by Schumpeter (1939), informational asymmetries in the financial markets are reduced, minimizing the monitoring costs. Petersen and Rajan (1994) and Berger and Udell (1995) relate increases in availability of credit with bank-firm relationship. Moreover, banker-directors, i.e. bankers who seat simultaneous on the board of directors of a bank and of a non-financial firm, provide financial expertise to management [Mace

(1971), Lorsh and MacIver (1989)]. The informational advantage of bankers-directors and the ability to discipline management, either by termination or by the changes in the compensation structure is a more effective monitoring mechanism then loan covenants [Williamson (1988), Kroszner and Strahan(2001)].

As a result, the presence of banker-directors may reduce the monitoring costs even further [Fama (1985)], possibly lowering the costs of funds [James (1987), Berger and Udell (1995)], specially in the cases where there is higher information asymmetry between insiders and the public financial markets [Fama (1985), Leland and Pyle (1997), Kracaw and Zenner (1998), Kroszner and Strahan (2001)]. Booth and Deli (1999), Kroszner and Strahan (2001) and Bird and Mizruchi (2005) demonstrate a positive correlation between firms' capital structure and the presence of unaffiliated banker-directors (if they sit on the board of Banks who are not the leading arranger of the loan contracted by the firm). Ciammara (2006) shows that, when taking into account the endogeneity, the presence of an affiliated banker-director has a positive effect on the firm leverage.[1]

However, creditors on the board have an informational advantage over outside creditors [Leland and Pyle (1997) and Krozner and Straham (2001)]. Kracaw and Zenner (1998) show evidence of negative price reaction to announcement of loan renewals involving a bank represented on the firm's board. Using an international sample, Ferreira and Matos (2008) provide evidence that banks extract informational rents from the firms, by charging higher spreads.[2] Güner et al. (2008) also show that the presence of financial experts on the board affect corporate decisions, although not always in the best interest of shareholders. Stecher and Grønnevet (2009) propose a theoretical framework where the creditors' interests protection increases with information asymmetry, board size and proportion of outside directors on the board, providing a more benevolent interpretation of the misconduct of bankers as proposed by Güner et al. (2009). Similarly, Andersen et al. (2004) find that the cost of debt is inversely related to board independence and board size. Raheja (2005) proposes a model where

[1] Endogeneity occurs because firms simultaneous choose board composition and capital structure: firms may invite a banker to the board anticipating future financing needs, or a banker on the board may facilitate access to credit increasing the leverage ratio.

[2] Kracaw and Zenner (1998) show evidence of negative price reaction to annoucement of loan renewals involving a bank represented on the firm's board.

insiders of large boards release more information to outside directors in the periods prior to CEO sucession in order to increase the probability of being nominated CEO. In fact, board size plays a decisive role. On one hand, the probability of having a banker on the board increases with the board size. On the other hand, the number of connections of a director will depend on the board size.

Recent studies show the influence of individuals' connections on financial decisions. Goldman, Rocholl and So (2009) show that politically connected boards can add value to firms. Fracassi (2008) show that the social network of the management team have an impact on corporate investment decisions, where connected firms make similar investments. Cohen et al. (2009) show that portfolio managers invest in firms they are connected through their network. In both cases, profitability is higher the more central the managers are on the network. Both studies argue that the network lower information-gathering costs [Nahapiet and Ghosal (1998)] screening and selecting the important pieces of information [Burt (1997)].

In this work, we test the role of a banker-director on the information flow that is released to the (credit) market. In the case of a significant role, we also test how the influence of bankers contributes to the reduction of information asymmetry, reducing monitoring costs and, therefore, impacting on the capital structure of the firm. Our results indicate that not only the presence of bankers on the board increases the leverage ratio, as found in Byrd and Mizruchi (2005), but also that this effect is magnified by the influence of the banker. We propose to classify the influence of bankers by measuring their centrality in the social network of boards and directors: the more directors a banker is linked with, the more information may pass through him, helping to reduce information asymmetry, either by disseminating information or by having a certification role.[3] Consistently with this interpretation, our results indicate that the effect of the banker's social influence on the leverage ratio increases with firm opacity, i.e. firms where information asymmetry is higher. In the presence of other factors which might reduce information asymmetry, e.g. credit rating, the role of the banker's

[3]The presence of bankers on the board may also have a certification role (Fama (1985), Bhatacharya and Chiesa (1995), BhataKracaw and Zenner (1998)]. Byrd and Mizruchi (2005) results suggest that non-lenders bankers have a certification role for distressed firms while exercising a monitoring role for non-distressed firms.

influence as information transmission mechanism is reduced.

This paper is organized as follows. In Section 2 we summarize the determinants of capital structure and hypothesize how the presence (and the centrality) of a banker-director may also be considered a capital structure determinant. In Section 3 we describe the data. In Section 4 we explain the methodology, addressing firstly, the directors' network and the centrality measures used to classify the influential role of bankers and secondly, the estimation procedures used to correct for a possible endogeneity bias. In Section 5 we present the results. The main conclusions are summarized in Section 6.

2 Capital Structure Determinants

In this section we start by presenting the known determinants of capital structure, already established in the literature. We will then propose a new determinant, based on the influence of bankers and their role in the information transmission channels.

2.1 Established in the literature

Previous studies show that size, asset tangibility and specificity, growth opportunities, profitability, and median industry leverage are the main determinants of capital structure[4]. We will briefly discussed the theory behind and the variables we used to proxy for each determinant.

Size has a positive impact on leverage. First, larger firms are usually covered by a higher number of analysts, reducing the information asymmetry. Therefore, when lending to smaller firms, lenders face relatively higher monitoring costs. This extra cost is passed to the borrower by increasing the interest rate, and hence reducing the leverage. Secondly, bankruptcy costs are fixed and therefore larger firms have relatively lower bankruptcy costs. This positive relationship is empirically documented in several studies such as Rajan and Zingales (1995), Schenoy and Koch (1996), although there is some mixed evidence in the literature as in Titman and

[4]For a thorough review of the literature, see Frank and Goyal (2007).

Wessels (1988).

The pecking order theory of Myers (1984) and Myers and Majluf (1984) suggests a hierarchy in the financing mechanism, where in order to reduce information asymmetry costs, firms favour internal funds over external funds, and among these, firms favour debt over equity. Therefore, more profitable firms will be less leveraged. This negative relationship is consensual among the empirical literature [Rajan and Zingales (1995), Booth et al. (2001), Fan et al. (2003) and Jong et al. (2006)]

According to Jensen and Meckling (1976), the conflict of interests between debtholders and shareholders may be avoided by allocating collateral debt to specific projects. Therefore, firms with higher levels of tangible assets can have higher leverage, as new debt contracts can use those assets as collateral. Jensen et al. (1992) and Rajan and Zingales (1995) show evidence of a positive relationship between asset tangibility and leverage. However, Shenoy and Koch (1996) find mixed results across industries. This difference in results is due to the asset specificity and its liquidity if used as collateral. If an (tangible) asset is highly specific to the firm, it might be worthless outside the firm even if its book value is high, implying a negative relationship between asset specificity and leverage. Also, some authors find mixed results when differentiating between short-term and long-term debt [see Wijst and Thurik (1993) and Chittenden et al. (1996)]

According to Myers (1977) growth firms should use more equity finance in order to avoid passing up profitable investments. The same author has suggested the use of the market-to-book ratio as a proxy for future growth opportunities. Therefore, we should expect a negative effect of the market-to-book ratio on the leverage ratio. This theory has mixed evidence on the literature. While Rajan and Zingales (1995) and Hirota (1999) have found the expected negative relationship (for an international and a Japanese sample respectively), Chiarella, Pham and Tan (1992) and Lee, Lee and Lee (2000) show the opposite (for Australian and Korean sample, respectively).

2.2 A new capital structure determinant

Podolny (1994) shows that social relationships between market agents may prevent market failure due to uncertainty and information asymmetry. Moreover, Burt (1997) shows that a network of social relationships allows people to gather more information about others whom they don't know personally, playing a crucial role in screening and selecting the relevant pieces of information. Nahapiet and Ghosal (1998) provide evidence that social networks represent information channels that lower information-gathering costs. Nohria (1992) shows that the creation and maintenance of information flows, usually referred to as "networking", increases one's information, allowing the possible inclusion of private information.

In the same way, we should expect the social relationships of the directors of a firm to play a role in information transmission, reducing the information asymmetry between agents in the market. Shane and Cable (2002) show the importance of social ties in obtaining venture capital. The authors survey directly a small sample of entrepreneurs classifying the degree of "acquainteness" of seed-stage investors, i.e. how well does each entrepreneur knows each investor before presenting the project. They conclude that the social network of the entrepreneurs has an important role in facilitating credit. However the survey approach is not feasible when analyzing a large numbers of firms.[5]

Our proposal is to use the network of the boards and directors as a proxy for the real social network of market agents. This means that the network we construct only has partial information of the professional relationships between agents, excluding all others relationships, both professional (all non-board related connections) or private (family/friendship ties or common memberships of Universities, clubs). Also, in contrast with Shane and Cable (2002) approach, where qualitative data on the strength of the social relationship is available, we can only observe that two directors sit in the same board at a particular time and assume that those two must know each other and are, therefore, directly connected.

[5] The survey included 100 hours of interview for 106 individuals and 50 firms.

Using social network analysis and suitable centrality measures (to be defined in Section 4.1), we infer the influential role of each director. In particular, we are interested in the role of bankers-directors in the information flow, its impact on the reduction of information asymmetries and, as a consequence, its impact on the firm's capital structure. We focus on the role of bankers because of their privileged access to information during the process of credit concession. If the social network of directors is a good proxy for the real life social network, then we should expect that the presence of banker on the board of firm may reduce the information asymmetry between firm and lenders which in turn allows the firm to increase its leverage. Specifically we test the following hypothesis:

Hypothesis 1 *The presence of a banker on the board increases the leverage of a firm,*

Byrd and Myzruchi (2005) have already tested for hypothesis 1, i.e. they tested for the mere presence of bankers in boards. In fact, although we test the same hypothesis, our banker and bank classification criteria is different from the one used in Byrd and Myzruchi (2005). Firms are categorized as banks if they are listed as "Banks" in Worldscope's Industry Level 3 name. This is a broader definition of bank that the one used by Byrd and Myzruchi (2005), which was restricted to commercial banks. Note that this definition of "banker-directors" will apply to everyone who is a board member of a firm that falls into our "bank" criteria. This means that there will be individuals that will be classified as "banker-directors", even if their original background is not the banking industry.[6]

However, no study has evaluated the role of banker-directors in the information transmission mechanism. If it is true that bankers have an important role in the reduction of the information asymmetry, then the more influential a banker is, the more he will contribute to lessen the information asymmetry between the market and the firm where he is also a director. Note that we do not need to assume that the banker is

[6] Mr. Beattie will be considered a "banker-director" in 2006 because he sits on a bank's Board, in this case the Royal Bank of Canada's Board. Sharing this directorate is Mr. Young, an independent director who sits on the same bank's board since 1991 and was Chairman and CEO of a frozen food company from 1984 to 2001. Nevertheless, if he is central on the network, this is, if he has influence on the network, he may play an important role in the information transmission regardless of his previous background.

sharing insider information or any other form of illegal action. It suffices to interpret the banker role in the information transmission mechanism as in Burt (1997) where the network is used as a filter for the relevant pieces of information: when the market analyses all pieces of available information, it will give more weight to information coming from more influential sources of information. The more central a banker is on the network, the higher is his ability to use the network to screen and select the relevant information, providing a more reliable signal to the market and reducing information asymmetry. Again, as a reduction in the information asymmetry between firm and lenders would allow the firm to increase its leverage, we test for the following hypothesis:

Hypothesis 2 *The more influential a banker-director, the higher the leverage of a firm.*

There are other factors that can contribute to better dissemination of information. Firms which are constituents of a major index are more likely to be followed by a higher number of analysts and will have higher media coverage than a smaller capitalization firm. Firms can also choose to be rated by credit rating agencies. The rating will serve as a certification mechanism, contributing to the reduction of information asymmetry. In these cases, the role of the banker in the information transmission mechanism should be less relevant.

The level of information asymmetry may also be proxied with other financial variables. For example, in an efficient market, prices move with the arrival of new information. If there is no information, prices do not change and one does not observe trades. Therefore, one may use a liquidity measure such as Amihud's (2002) to proxy for the level of information asymmetry. Another example would be the accruals quality proposed by Dechow and Dichev (2002). Being an estimate of future cash flows, accruals are subjected to estimation error. Therefore, low quality of the accruals can contribute to higher levels of information asymmetry.

In other words, the higher the information asymmetry is, the more important is the role of an influential banker for the information transmission mechanism. If the effect of the presence (or the influence) of a banker-director on the firm's leverage is in fact due to a reduction in the information asymmetry, then one should expect this effect to be higher in more opaque firms. We specify this hypothesis as:

Hypothesis 3 *The higher the level of information asymmetry, the bigger the impact of the presence (or influence) of a banker on the leverage of a firm.*

and we will refer to the proxies cited above as proxies for firm opacity.

3 Data

Our final dataset is the result of the merge of two types of data: the financial data and the board composition database.

Our data on boards is based on BoardEx reports, which provide information on the interlocks of the boards, i.e. instead of presenting a directory of names and titles, BoardEx provides historical linkages between boards of different firms. The sample includes data of US firms from 2000 to 2006 although firm coverage increases through time.

When a firm does not appear on BoardEx reports, it does not necessarily mean that there is no banker-director: it may be the case that the firm is not analyzed by BoardEx. This is evident in Table 1, which compares the proportion of firms with banker-directors using the whole WorldScope[7] sample or restricting the sample to firms for which BoardEx also provides information on board size (only available from 2001 onwards).

The sharp decrease in the proportion of bankers after 2003 may be due to regulatory change. Following the Enron financial scandal, the 2002 Sarbanes-Oxley strongly recommended[8] that bankers should not seat on the board of firms with whom they also had a lending relationship through the bank. On the other hand,

[7] The comprehensive coverage available on Worldscope represents more than 95% of the world's market value. Worldscope includes up to 20 years of historical data on more than 50,000 public and private companies, with up to 1,500 data elements on each company record.

[8] The original SOX proposal limited the pool of financial expert to CPAs or other professional with direct accounting experience, but the final proposal would include bankers.

Table 1

	2000	2001	2002	2003	2004	2005	2006
Panel A	10%	10%	10%	11%	13%	14%	15%
Panel B	-	35%	30%	30%	20%	18%	19%

Table 1: Proportion of firms with banker-directors. Panel A includes all firms present in WorldScope sample, while the Panel B restricts the sample to firms for which BoardEX also provides information on board size.

this may be due to the fact that firm coverage is not constant. BoardEX started its activity in 1998, covering 2783 firms in 34 countries, while in 2006 its coverage included 8187 firms in 57 countries. Although BoardEX provides no information on how firms are selected, we deem that initial coverage included bigger and more known firms, with smaller firms being added posteriorly. This hypothesis is supported by the decrease of the average market value of firms in the sample through time.

There is a positive relationship between firm size and board size which is well documented in the literature. Both Linck, Netter and Yang (2008) and Boone et al. (2007) find evidence that the board size of firms increase with size and complexity of operations, where the former study focuses on young firms (<10 years since IPO) and the latter on the different characteristics of boards in small and large firms. This positive relationship between firm and board size is also present in our data.

Our main data source for financial variables is Datastream using all the firms from WorldScope list. Our variable of capital structure is the leverage ratio computed as the ratio of total debt to market capitalization. We use the logarithm of sales as a measure of size, the ratio of tangible to total assets as a measure of asset tangibility, the ratio of R&D expenditure to total assets as a proxy for asset specificity, market-to-book ratio as the usual growth opportunities measure, ROA as the profitability measure. We also use industrial sector dummies (SIC 2-digit level) in order to control for the median industry value.

As for the proxies for firm opacity, we use Compustat to create two variables indicating if the firm is rated by S&P or if the firm belongs to the S&P500 index; we use Joel Hasbrouck's database for the Amihud (2002) illiquidity measure[9] and we compute Dechow and Dichev (2002) measure. With the exception of the last one, these variables decrease with the firm's opacity, this is, higher values of the variables indicate less information asymmetry.

4 Methodology

4.1 Network Construction and Centrality Measures

Our aim is to try to mimic the unobserved information flows by constructing the network formed by the boards and directors. Although a firm is a legal entity, information does not flow between firms, but rather through the individuals placed in different firms. Hence, we analyze the flow of information between firms, by constructing the network of relationship between directors.

We construct a new network constituted only by directors, using the BoardEx reports. Note that the BoardEx database provides historical linkages between boards and directors and not between directors themselves. In this new network, two directors are considered to be connected in a particular year if they sit in the same board during that year. In the social network terminology, we project the original network of boards and directors, a two-mode graph, onto the space of directors. Figures 1 and 2 demonstrate the projection: Figure 1 is a graphical representation of a small part of the boards and directors network for 2006, the original network provided by BoardEx. The top vertex represents the board of Thomson Corporation. The vertices that are connected to the top vertex are Thompson's directors. Each of these individuals may be seated in another firm's board. As an example, Mr. Beattie, who was a Thompson's board member in 2006, was also a board member at the Royal Bank of Canada in the same year. Firms that shared at least one director with Thomson in 2006 are depicted by the vertices in the next layer. The bottom layer represent directors of the latter firms

[9] The authors would like to thank Joel Hasbrouk for providind this data.

that are not Thompson's directors, while individuals who also sit at Thompson's are depicted above. Note that in this figure there are no connections between directors. Directors are linked only to boards. This is a characteristic of affiliation networks, more generally referred to as 2-mode network. These networks have two types of vertices and connections can only occur between vertices of different types.

Figure 2 is the result of projecting the network of Figure 1 onto the space of directors. There are only directors and no firms. The top layer of vertices represent Thomson's directors. In this layer, each vertex is now connected to every other vertex because they were all linked to Thomson's board. Some of these vertices are connected to vertices in the lower layer. This happens when a Thomson's director also sits in another firm's board. Mr. Beattie, the director we selected before as an example, will be connected to every individual who is also a Thompson's director. In addition, he will also be connected to all Royal Bank of Canada's directors, as he is also a board member in this firm.

After constructing the network of directors (only), we are able to measure the role of each individual on the flow of information, by computing a centrality measure for each vertex, i.e. each director, on the network. In this work, we will focus on three basic measures of centrality commonly used in information flows /contagion analysis: degree, closeness and betweenness.

1. The **degree** of a vertex is the number of connections of a vertex with other vertices of the network. Formally, the degree k_i of vertex i is

$$k_i = \sum_{j=1}^{n} A_{ij}$$

where A_{ij} equals 1 if vertex i is connected to vertex j, or 0 otherwise and n is the size of the network, i.e. the number of vertices in the network. It is usual to normalize this measure by the maximum possible degree $(n-1)$. The normalized measure becomes the so-called **degree centrality** and is given by

$$k_i' = \frac{\sum_{j=1}^{n} A_{ij}}{n-1}$$

Within the directors network it represents the number of directors with whom a particular individual is related to. A director with higher degree centrality knows more directors inside the network.

2. **Closeness centrality** (Sabidussi 1965) is the inverse of the average distance from a particular vertex to every other vertex. More formally, the closeness centrality C_i of vertex i is:

$$C_i = \left(\frac{\sum_{j \neq i} d_G(i,j)}{n-1} \right)^{-1}$$

where $d_G(i,j)$ represents the geodesic distance between i and j, i.e. the length of the shortest path between the two vertices. Within the directors network, it represents the average number of contacts that a director would have to make in order to reach any other director on the network. As there are directors which are isolated/separated from part of the network, the classical definition of closeness is not well defined. The solution for these cases, is to use the influential range of each director, i.e. to measure the centrality within the reachable component of the network (Lin 1976) as a ratio of the total number of vertices,

$$C_i^{\prime} = \left(\frac{\sum_{j \neq i} d_G(i,j)}{J_i-1} \right)^{-1} \frac{J_i}{n}$$

where J_i is the size of the network component of vertex i. A director with higher closeness centrality will need on average less intermediaries to reach any other director.

3. **Betweenness centrality** for a given vertex i is defined (Freeman 1977) as follows. Let g_{jk} denote the number of the shortest paths connecting vertices j and k, and $g_{jk}\,(i)$ denote the number of the subset of those shortest paths that also pass through vertex i. The betweenness centrality B_i of vertex i is

$$B_i = \sum_{j<k} \frac{g_{jk}(i)}{g_{jk}}$$

The ratio $\frac{g_{jk}(i)}{g_{jk}}$ can be interpreted as the probability that director i is a vehicle of information transfer between director k and director j, assuming that all shortest paths are equally likely to be used.

After calculating the centrality measures of each individual in the directors' network, we aggregate the centrality measures to the firm level. As we are interested in the information role of bankers-directors, we only use these individuals for aggregation purposes: for each firm, the corresponding centrality measure is the maximum value of the banker-director in the board. If there is no banker-director, the centrality measure is 0[10].

4.2 Estimation

We will test our hypothesis 1 and 2 by running the following regression equation

$$\begin{aligned} LR_{t+1,i} &= \beta_0 + \beta_1 \text{Size}_{t,i} + \beta_2 \text{Profitability}_{t,i} + \beta_3 \text{Asset\_Tangibility}_{t,i} \\ &+ \beta_4 \text{Asset\_Specificity}_{t,i} + \beta_5 \text{Growth\_Opportunities}_{t,i} + \delta \text{Banker}_{t,i} \\ &+ \gamma_1 \text{Industry\_Dummies}_{t,i} + \gamma_2 \text{Year\_Dummies}_t \end{aligned}$$

where the dependent variable, LR_{t+1} is the leverage ratio, measured as the ratio total debt to market capitalization, Size is measured by the logarithm of sales, Profitability is measured by return on assets, Asset Tangibility is measured as the ratio of tangible to total assets, Asset Specificity is measured as the ratio of R&D expenditure to total assets, Growth_Opportunities are measured with market-to-book ratios. Banker may denote either the presence of banker on the board (hypothesis 1)or one of the three banker-director centrality measures (hypothesis 2). We also control for median industry level (using 2 digit SIC codes) and year effects. All variables are winsorized at 1% level. To test hypothesis 3, we will add an extra term, interacting

[10] We repeat the whole analysis using the sum instead of the maximum and the results are robust. We proxy the informational role of the board through the maximum for two reasons. First, we assume that the determinant individual in the information distribution is the one who is more connected/influential. Second, the sum of centrality measures can be ambiguously interpreted.

the centrality measure variable with one of the firm's opacity proxies.

We need to correct for possible endogeneity bias when testing for our hypothesis that bankers-directors (and their centrality on the network) affect the capital structure of a firm. The choice of board composition, and hence the presence and influence of the banker, may not be independent of the choice of the (target) capital structure. The most common way to deal with endogenous regressors is to use Instrumental Variables (IV). However, the IV approach is not valid when the endogenous regressor is a binary variable: let d_i denote a binary variable with $d_i = 1$ if the treatment is received, and $d_i = 0$ otherwise and y_i^1 and y_i^0 denote outcome with treatment and without treatment, respectively,

$$\begin{aligned} y_i^1 &= \beta X_i + \alpha_i + \varepsilon_i \text{ if } d_i = 1 \\ y_i^0 &= \beta X_i + \varepsilon_i \qquad \text{if } d_i = 0 \end{aligned}$$

where X_i is a set of (observable) variables known to influence the outcome and $\varepsilon_i \sim N(0, \sigma_\varepsilon)$. The observable outcome y_i is

$$\begin{aligned} y_i &= (1 - d_i)\, y_i^0 + d_i y_i^1 \\ y_i &= \beta X_i + \alpha_i d_i + \varepsilon_i \end{aligned}$$

If selection into treatment does not depend on the outcome y_i, we can estimate the average treatment effect by OLS, provided that, apart from regressors exogeneity, the usual OLS assumptions hold.

$$E\left[\hat{\alpha}_{OLS}\right] = \frac{1}{n} \sum_{i=1}^{N} \alpha_i = \bar{\alpha}$$

In our case, y_i is the leverage ratio defined as $\frac{\text{Total debt}}{\text{Market Value}}$, d_i indicates the presence of a Banker on the firm's Board and X_i are firm control variables which are empirically known to affect the capital structure.

However, firms simultaneously choose the capital structure and Board composition, which implies that d_i is correlated with ε_i and

$$E\left[\hat{\alpha}_{OLS}\right] = \bar{\alpha} + E\left[\varepsilon_i | d_i = 1\right] - E\left[\varepsilon_i | d_i = 0\right]$$

leading for the inconsistency of the OLS estimator.[11]

This means that, in spite the IV approach being correct for measuring the impact of bankers centrality on the capital structure, the same is not true when measuring the impact of the mere presence of a banker-director. The latter is methodologically equivalent to evaluating the impact of a treatment on a variable of interest, where selection into treatment is endogenous. We will use Rosenbaum and Rubin's (1984) Average Treatment Effects (ATE) approach where selection into treatment is model as an index function dependent on a set of instruments.

The main instrument will be the size of the board, this is, the total number of directors on each board. The larger the number of directors on the board, the higher the probability that one of the directors also sits at a bank. However we do not expect the board size itself to impact on the leverage ratio of the firm. When using the centrality measures under the IV approach, board size will also be an obvious instrument as the centrality measures of the directors are, by construction, dependent of the original board size. Remember that we constructed the network of directors, by projecting the original (2-mode) network, with boards and directors, onto a network of only directors, where directors are connected if they share the same board. Therefore, larger boards will automatically increase the number of connections between the directors seating on those boards. In addition, we also use the three-year averages[12] of the leverage ratio, its determinants (excluding the new proposed one) and volatility as instruments. All instruments are lagged one period. This means that for leverage ratio at $t+1$, the regressors are at time t, number of directors in board is at time $t-1$, and the three/year averages are calculated using times $t-1$, $t-2$ and $t-3$.

[11] See also Imbens and Angrist (1994) and Angrist, Imbens and Rubens (1996).

[12] The three year average is used because of staggered boards.

5 Results

Table 3 reports the regression results. Column 1-6 are the OLS regressions. When restricting the specification to the capital structure determinants already established in the literature (column 1), all coefficients have the expected sign and are highly significant. However both the presence (column 2) and the different influence measure of bankers (columns 3-6) are statistically insignificant. When correcting for endogeneity, the results are the opposite. Using the average treatment effects approach (column7), we conclude that the presence of bankers in the board of the firms affects the leverage ratio (hypothesis 1): on average, the mere presence of a banker on the board of a firm increases the leverage ratio by 0.2.

The magnitude of this effect increases with the banker's influence on the network (hypothesis 2), independent of which centrality measure we use (columns 7-11): on average, the higher the banker's influence, the stronger is his/her impact on the leverage ratio of the firm. Note that, apart from the size coefficient, the coefficients of the previously documented capital structure determinants continue to have the expected sign. The size coefficient becomes negative although not always statistically significant (columns 7-11). This suggests that there must be some firm characteristic that is related to both size and the centrality measure that is not captured by the other control variables.

In Table 4, we include interactions variables between degree centrality and each of the firm's opacity proxy presented before. The results are consistent with our interpretation that the presence of a banker in the firm reduces the information asymmetry. The impact of the banker's influence on the leverage ratio increases with firm opacity, i.e. the effect is weaker when other information asymmetry reduction mechanism is present.

Bigger firms, being strongly scrutinized by analysts and media, are less subjected to information asymmetry problems, which reduces the impact of banker's influence (column3). So do firms with higher levels of tangible assets. By being able to pledge more assets as collateral, these firms can provide better signals to the market. Our results confirm this hypothesis, as the impact of the banker's social influence on leverage decreases with higher levels tangible to total assets ratio (collumn4). When using Amihud's illiquidity measure as a proxy for firm opacity (column 7), we reach the same conclusion. Accruals quality increase with firm's opacity as they represent better estimates of future earnings, but again the results go in the same direction: the effect of the banker's social influence on leverage increases with accruals quality (column8). Lastly, the same effect is lower for firms which are rated or belong to the S&P500 index (column 5 and 6, respectively). By providing certification, credit rating firms reduce the uncertainty of the signal and therefore the role of the banker on the information transmission mechanism is reduced. Regarding firms belonging to an index, the interpretation is the same as when using firm size interaction to proxy information asymmetry. In both cases where we classify firm's opacity with a binary variable, the effect of the interaction term practically cancels the effect of the bankers influence, yielding a total effect close to zero.

Table 5 presents the evolution of the estimated impact of the presence and influence of the banker on the leverage ratio when using just one year of data or dividing the sample in pre and post SOX years. Although the effect of the presence of a banker is significant and positive throughout the sample years, the impact of the centrality measure is not always significant nor with the same sign as when using the whole sample. We must remember the different timings of the variables: when looking at 2005 results, the centrality measure used was computed based on the 2004 network. This is one and half years after SOX was enacted. Taking into account that most boards are staggered, one might suspect that the effect of SOX recommendations on Board composition was transitory, specially because the estimation results for 2006 are all positive and significant.

These results are robust for changes in the aggregation criteria (sum of individual bankers centrality measure), the dependent variable (book value leverage ratio) and banker definition (using SIC financial sector classification (2-digit SIC $\in [60, 70)$).

6 Conclusion

Our results show the impact of bankers-directors on the capital structure of firms. After correcting for endogeneity, the presence of a banker-director significantly increases the leverage ratio of US firms. Moreover, this impact is stronger the higher the centrality of the banker on the directorship network. This suggests that bankers-directors have an essential role in the dissemination of information in the US market. The more central a banker is on the network, e.g. the more connected the banker is to other directors, the more influence he has on the information transmission, reducing information asymmetries between the firm and the credit market, consequently allowing for higher levels of leverage. This impact on the leverage ratio is reduced for less opaque firms, sustaining our interpretation of the role of bankers-directors as an information asymmetry reduction mechanism.

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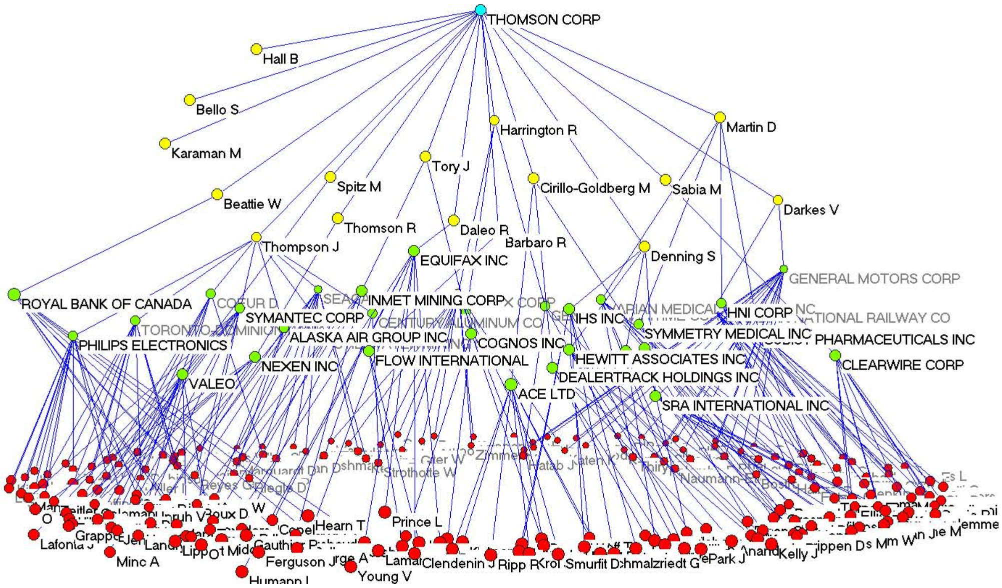

Figure 1: Boards and Directors Network: Graphical representation of the 3-neighboorhood of Thomson Corporation Board in 2006. Yellow vertices (second tier from top) represent Thomson Directors. Green vertices (Third tier from top, capital letters) represent firms which have a Thomson Director on its board. Red vertices represent the directors of firms which have a Thomson Director on its board.

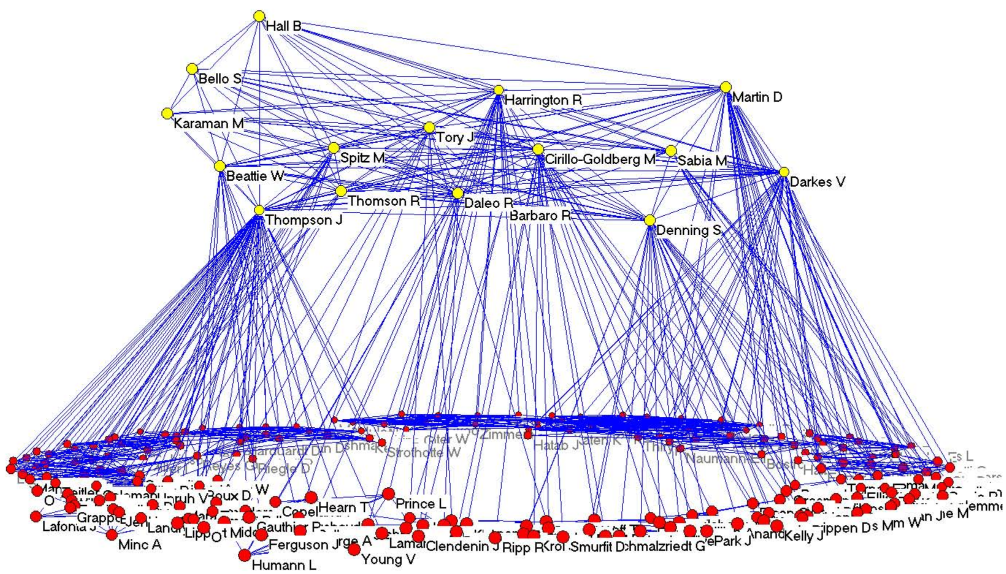

Figure 2: Directors Network: Graphical representation of the projection of the network represented in figure 2 onto the space of Directors. Yellow vertices represent Thomson Directors. Red vertices represent the directors of firms which have a Thomson Director on its board.

Table 2: Summary Statistics

	Initial sample		Final sample			
			All firms		Firms with Bankers	
	mean	**sd**	**mean**	**sd**	**mean**	**sd**
Leverage ratio	0.11824	0.14597	0.10909	0.12515	0.14659	0.12372
% firms with bankers	15.2%	0.35857	19.2%	0.39366		
Degree					5.28	10.52
Closeness					0.01825	0.025013
Betweeness					0.0000545	0.000183
log(sales)	12.37	2.45	13.18	2.24	14.80	1.89
ROA	-0.054	0.455	0.014	0.410	0.047	0.112
Market-to-book	54.63	4410.13	6.28	111.81	3.95	10.01
Tangibility ratio	0.217	0.190	0.220	0.180	0.275	0.190
R&D ratio	0.0839	0.1672	0.0658	0.0929	0.0335	0.0438
Board size			13.4	4.7	16.4	4.0
Observations	9359		5024		963	

Table 2: Summary statistics. Columns represent the initial US sample and the final sample (after the merge with BoardEX data) with all firms and restriting the sample only to firms with a banker on the board, respectively.

Table 3

We will test our hypothesis 1 and 2 by running the following regression

$$LR_{t+1,i} = \beta_0 + \beta_1 \text{SIZE}_{t,i} + \beta_2 \text{ROA}_{t,i} + \beta_3 \text{TANG}_{t,i} + \beta_4 \text{ R\&D RATIO }_{t,i} + \beta_5 \text{ log MARKET-TO-BOOK}_{t,i} + \delta \text{BANKER}_{t,i}$$

where the dependent variable, LR_{t+1} is the leverage ratio, measured as the ratio total debt to market capitalization, SIZE is measured by the logarithm of sales, ROA denotes Profitability and is measured by return on assets, TANG denotes Asset Tangibility and is measured as the ratio of tangible to total assets, R&D RATIO denotes Asset Specificity is measured as the ratio of R&D expenditure to total assets, log MARKET-TO-BOOK denotes Growth Opportunities and is measured as the logarithm of market-to-book ratios. BANKER may denote either the presence of banker on the board (hypothesis 1) or one of the banker-director's influence (centrality) measures (hypothesis 2).
We also control for median industry level (using 2 digit SIC codes) and year effects. All variables are winsorized at 1% level.
Columns 1-6, column 7 and columns 8-11 present OLS, average treatment effects results and IV results, respectively. Clustered Standard errors (firm level).

Table 3 (continued)

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) TREATREG	(8) IV	(9) IV	(10) IV	(11) IV
main											
SIZE	0.0130***	0.0123***	0.0129***	0.0129***	0.0132***	0.0128***	-0.000361	-0.0282*	-0.0269*	-0.00945	-0.0657**
	(8.45)	(7.93)	(8.46)	(8.46)	(8.53)	(8.43)	(-0.23)	(-1.91)	(-1.88)	(-1.29)	(-2.14)
ROA	-0.145***	-0.143***	-0.145***	-0.145***	-0.146***	-0.145***	-0.117***	-0.0710	-0.0721*	-0.0941***	-0.0825
	(-9.03)	(-8.90)	(-9.01)	(-9.01)	(-9.02)	(-9.03)	(-9.89)	(-1.59)	(-1.66)	(-3.81)	(-0.88)
TANG	0.0671***	0.0670***	0.0672***	0.0672***	0.0669***	0.0679***	0.0685***	0.0960	0.0926	0.0941***	0.312**
	(3.02)	(3.01)	(3.03)	(3.03)	(3.02)	(3.06)	(5.14)	(1.50)	(1.46)	(2.67)	(2.07)
R&D RATIO	-0.189***	-0.186***	-0.189***	-0.189***	-0.189***	-0.190***	-0.167***	-0.223**	-0.225**	-0.179***	-0.433
	(-5.31)	(-5.25)	(-5.32)	(-5.32)	(-5.31)	(-5.34)	(-5.89)	(-1.99)	(-2.05)	(-3.44)	(-1.22)
log MARKET-TO-BOOK	-0.0297***	-0.0298***	-0.0297***	-0.0297***	-0.0297***	-0.0297***	-0.0294***	-0.0357***	-0.0357***	-0.0349***	-0.0299
	(-8.27)	(-8.29)	(-8.27)	(-8.28)	(-8.26)	(-8.28)	(-12.33)	(-2.98)	(-3.01)	(-5.91)	(-1.04)
DUMMY_BANKER		0.0104					0.202***				
		(1.49)					(10.82)				
DEGREE			0.000197					0.105***			
			(0.33)					(3.01)			
NORM_DEGREE				3.862					1474.4***		
				(0.44)					(3.04)		
CLOSENESS					-0.0921					11.93***	
					(-0.64)					(3.13)	
BETWEENESS						59.83					18865.6**
						(1.27)					(2.55)
Constant	-0.0289	-0.0196	-0.0278	-0.0274	-0.0317	-0.0251	0.145*	0.591***	0.562**	0.329***	1.233**
	(-1.38)	(-0.92)	(-1.33)	(-1.31)	(-1.50)	(-1.21)	(1.64)	(2.64)	(2.55)	(2.72)	(2.42)
[1em] Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5024	5024	5024	5024	5024	5024	5076	5024	5024	5024	5024

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4

	(1) OLS	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV	(7) IV	(8) IV
SIZE	0.0130***	-0.0282*	0.0529***	-0.0289*	-0.0261**	0.00293	-0.00999	0.0243***
	(8.45)	(-1.91)	(3.20)	(-1.89)	(-2.32)	(0.45)	(-0.95)	(4.77)
ROA	-0.145***	-0.0710	-0.226***	-0.109	-0.158**	-0.152***	-0.127***	-0.186***
	(-9.03)	(-1.59)	(-2.80)	(-1.41)	(-2.02)	(-4.89)	(-3.92)	(-6.62)
TANG	0.0671***	0.0960	0.0997*	0.798***	0.0613	0.0434	0.0553	0.0640
	(3.02)	(1.50)	(1.70)	(4.11)	(0.61)	(0.89)	(1.01)	(1.61)
R&D RATIO	-0.189***	-0.223**	0.00251	-0.110	-0.114	-0.185**	-0.256**	-0.234***
	(-5.31)	(-1.99)	(0.02)	(-0.51)	(-0.51)	(-2.27)	(-2.52)	(-3.84)
log MARKET-TO-BOOK	-0.0297***	-0.0357***	-0.0195	-0.0176	-0.0382***	-0.0304***	-0.0328***	-0.0257***
	(-8.27)	(-2.98)	(-1.51)	(-0.86)	(-2.70)	(-4.64)	(-3.96)	(-4.08)
DEGREE		0.105***	0.788**	0.330***	0.253**	0.0811**	0.0811**	-0.0895***
		(3.01)	(2.50)	(3.48)	(2.07)	(2.36)	(2.49)	(-2.70)
DEGREE × SIZE			-0.0525**					
			(-2.48)					
DEGREE × TANG				-0.955***				
				(-3.42)				
RATING					0.255***			
					(4.40)			
DEGREE × RATING					-0.252**			
					(-2.06)			
SP500						0.0522		
						(1.64)		
DEGREE × SP500						-0.0795**		
						(-2.33)		
ILLIQUIDITY							0.000000736	
							(1.45)	
DEGREE × ILLIQUIDITY							-0.000000676**	
							(-2.43)	
AQ								-0.435**
								(-2.43)
DEGREE × AQ								1.167**
								(2.45)
Constant	-0.0207	0.596***	-0.598***	0.520**	0.351**	0.0259	0.320**	-0.215***
	(-0.99)	(2.59)	(-2.58)	(2.35)	(2.55)	(0.31)	(2.03)	(-3.76)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5024	5024	5024	5024	4059	4059	4010	3727

Table 4 - We test hypothesis 3 with the following equation

$$LR_{t+1,i} = \beta_0 + \beta_1 \text{SIZE}_{t,i} + \beta_2 \text{ROA}_{t,i} + \beta_3 \text{TANG}_{t,i} + \beta_4 \text{ R\&D RATIO }_{t,i} + \beta_5 \text{ log MARKET-TO-BOOK}_{t,i}$$
$$+\delta_1 \text{DEGREE}_{t,i} + \delta_2 \text{DEGREE}_{t,i} \times \text{OPACITY}_{t,i}$$

where the dependent variable, LR_{t+1}, is the leverage ratio, measured as the ratio total debt to market capitalization, SIZE is measured by the logarithm of sales, ROA denotes Profitability and is measured by return on assets, TANG denotes Asset Tangibility and is measured as the ratio of tangible to total assets, R&D RATIO denotes Asset Specificity is measured as the ratio of R&D expenditure to total assets, log MARKET-TO-BOOK denotes Growth Opportunities and is measured as the logarithm of market-to-book ratios. DEGREE is the degree centrality measure. We add an interaction term between degree centrality and a proxy for the firm's opacity, denoted by OPPACITY. RATING and SP500 denote indicator variables for the rated firms and SP500 consitituents, respectively. ILLIQUIDITY denotes Amihud's (2002) illiquidity measure. AQ denotes Dechow and Dichev (2002) accruals quality measure. Controls include sector (2 digit SIC) and year dummies. All variables are winsorized at 1% level. Clustered Standard errors (firm level). t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5

	2001	2002	2003	2004	2005	2006	pre SOX	post SOX
DUMMY_BANKER	0.145***	0.152***	0.171***	0.147***	0.183***	0.137***	0.177***	0.179***
	(2.75)	(2.76)	(4.04)	(3.60)	(4.83)	(3.69)	(5.91)	(7.74)
DEGREE	0.0809***	0.0106	0.0819***	0.0719**	-0.00258	0.0735**	0.0778***	0.118**
	(3.31)	(0.70)	(3.20)	(2.13)	(-0.20)	(2.45)	(4.01)	(2.02)
NORM_DEGREE	954.9***	146.4	1133.1***	1053.6**	-75.31	1038.2**	998.6***	1726.3**
	(3.30)	(0.73)	(3.22)	(2.12)	(-0.39)	(2.45)	(3.96)	(2.01)
CLOSENESS	31.27***	1.878	12.69**	-11.43*	-0.221	21.10**	17.08***	5.047*
	(3.31)	(0.39)	(2.25)	(-1.82)	(-0.11)	(2.28)	(3.20)	(1.84)
BETWEENESS	4140.7**	17438.5***	8753.0***	9765.8**	10795.7**	8441.4**	16744.6*	19776.8**
	(2.42)	(2.93)	(3.15)	(2.50)	(2.11)	(2.08)	(1.77)	(2.09)
Observations	433	540	595	1012	1227	1269	1568	3456

Table 4: Evolution of δ coefficient in the following equation:

$$LR_{t+1,i} = \beta_0 + \beta_1 \text{SIZE}_{t,i} + \beta_2 \text{ROA}_{t,i} + \beta_3 \text{TANG}_{t,i} + \beta_4 \text{ R\&D RATIO }_{t,i} + \beta_5 \text{ log MARKET-TO-BOOK}_{t,i} + \delta \text{BANKER}_{t,i}$$

Columns represent samples of specific years or the pre and post Sarbannes-Oxley Act (SOX) periods available on data.