Internal Capital Markets in Business Groups: Evidence from an Emerging Market*

Esmaeil Aliabadi†

Abstract

This paper examines internal capital markets (ICMs) in Iranian business groups. Using hand-collected data on the ownership structure of Iranian firms, we show that investment-cash flow sensitivity is significantly lower for group members compared to independent firms. Furthermore, a group firm's investment is significantly affected by the cash flow of other firms within the same business group. This finding is consistent with two competing hypotheses on ICMs in business groups; the tunneling hypothesis postulates that business groups try to divert cash flow from firms with low cash flow to voting rights to those with high cash flow to voting rights. On the other hand, the efficient ICM hypothesis argues that business groups direct resources to firms with high growth opportunities, regardless of the deviations between cash flow and voting rights. Consistent with the latter, we find that firms' investment sensitivity is only to the cash flow of other group firms with higher positions, i.e. less deviation between cash flow and voting rights. Furthermore, we explore the potential channels through which, business groups can move funds across affiliated firms. Our results suggest that dividend is an important mechanism for cash flow circulation in business groups.

Keywords: Business Group, Internal Capital Market, Investment-Cash Flow Sensitivity

*I wish to thank Ali Ebrahimnejad (from Sharif University of Technology) and Mahdi Heidari (from Tehran Institute for Advanced Studies (TeIAS) and Khatam university) as my respectable supervisors, and all participants in the presentation meetings at Sharif university and TeIAS for their helpful comments. All errors are my own.

†Tehran Institute for Advanced Studies (TeIAS) and Khatam University

1 Introduction

Business groups – groups of mostly listed firms with interconnected ownership structure controlled by a common ultimate owner – are the dominant organizational structure in many parts of the world (Claessens et al. (2000) and La Porta et al. (1999)). Despite the prevalence of business groups and their prominent role in capital allocation in economies, especially in emerging markets, little is known about the efficiency of their capital allocation. Some studies highlight the role of business groups in alleviating financing constraints, mutual risk sharing and reallocating capital to firms with higher growth opportunities (Masulis et al. (2011), Hoshi et al. (1990), and Almeida et al. (2015)). Other studies, however, provide evidence of tunneling and cross-subsidization of weaker firms among business groups (Bertrand et al. (2002) and Ferris et al. (2003)).

In this paper, we provide new evidence of capital allocation in business groups by examining the internal capital markets (ICMs) of Iranian business groups. Utilizing a hand-collected dataset of business group firms in Iran, we begin by characterizing the organizational structure of these groups and the interlinks between member firms. We then examine the investment behavior of group member firms and its sensitivity to the cash flows of same-group firms. Our evidence indicates that group firms' investments are significantly less sensitive to their own cash flow, as compared to independent firms, but highly sensitive to the cash flows of same-group firms.

The investment sensitivity to cash flows of other firms in the same group can be caused by tunneling resources from firms where the ultimate owner has lower cash flow rights to firms with higher cash flow rights. This would imply investment sensitivity only to the cash flow of firms where the ultimate owner has lower cash flow rights (Bertrand et al. (2002)). Conversely, if ICMs allocate capital efficiently, funds should be directed from firms with

lower growth opportunities to those with higher growth opportunities, regardless of the ultimate owner's varying cash flow rights across firms. This could result in reallocation of capital from firms with higher positions within the business group structure to firms with lower positions in which the ultimate owner has lower cash flow rights. This is precisely what we find; firm investments are only sensitive to the cash flow of firms with above-median positions within the group structure. We do not find any evidence of sensitivity to cash flow of firms where the ultimate owner has lower cash flow rights.

Finally, we examine dividend policy as a key mechanism identified by the previous studies for moving resources across group members (Faccio et al. (2001) and Goyal et al. (2020)). We first document unusually high dividend payout ratios among Iranian firms compared to the payout ratios for other countries. The median dividend-to-sales ratio (dividend-to-cash flow) in our sample is around 7 (31) percent[1], compared to the median 0.98 (11.8) percent reported for other countries (La Porta et al. (1999)). This further motivates us to explore dividend as a potential mechanism of capital reallocation. Consistent with the existing literature, we find that group-affiliated firms pay higher dividends than independent firms (Goyal et al. (2020)). Specifically, group-affiliated firms pay approximately 7 to 10 percentage points higher dividends, as measured by the percentage of EBIT, relative to independent firms. These figures are highly economically significant when compared to the median dividend payout ratio of 31 percent in our sample. More importantly, we find that firms pay lower dividends when firms with higher position in the group earn more cash flow. We do not find a similar effect for firms with lower positions. This finding is consistent with the hypothesis that dividend is an important mechanism used by business groups to circulate cash flows inter-

[1]If we dismiss the zero-dividend cases, the median dividend-to-sales ratio (dividend-to-cash flow) would be 14 (52) percent

nally across affiliated firms.

In addition to dividends, a small number of studies identify other mechanisms used in internal capital markets, such as intragroup loans (Gopalan et al. (2007), Santioni et al. (2020), and Buchuk et al. (2014)) and cross-firm equity investment (Almeida et al. (2015)). The distinguishing feature of dividend is that all shareholders, including minority shareholders, receive dividends in accordance with their share of ownership. As such, while dividend can be considered as a mechanism for circulating capital in the ICMs, it cannot be used as a means of minority shareholder expropriation (Faccio et al. (2001)). To further examine the workings of ICMs in Iranian business groups, we explore cross-firm equity transfers as an alternative mechanism. We do not find any relation between firm investments and cross-firm equity investment and within-group block trades.

Iran provides our setting, which is unique because most business groups in Iran are either state-owned or owned by semi-governmental entities. This is in contrast to the existing literature which has predominantly focused on family business groups. The only notable exceptions are studies of the Chinese business groups, but these studies find evidence of inefficient capital allocation in Chinese state-owned business groups (Asker et al. (2015) and Lin et al. (2011)). In contrast, we find that, despite the lack of proper investor protection and weak law enforcement, Iranian business groups tend to allocate capital to firms with better investment opportunities and we do not find evidence of tunneling and investor expropriation.

The rest of the paper is organized as follows. In Section 2, we provide a survey of related literature. In section 3 we provide an overview of business groups in Iran. Section 4 describes the data we use. Section 5 lays out our empirical model and hypotheses development and in Section 6 we present our estimation results.finally, in section 7 we present concluding remarks.

2 Related Literature

This study is closely related to the literature on Internal Capital Markets (ICMs) in business groups[2]. The ubiquity of these organizational forms in almost all emerging markets (Khanna and Palepu (2000)) has been construed as a rational response to the severe information problems and market imperfections engendered by undeveloped financial markets and weak legal institutions of these economies (Chang and Hong (2000), Khanna and Palepu (2000), Morck et al. (2005), Khanna and Yafeh (2007)). Firms in these countries face serious difficulties in raising external financing (La Porta et al. (1997)) and thus, in the face of this constraint, try to rely more on their internal sources of capital (Gopalan et al. (2014)). Being members of diversified business groups can alleviate financial constraints facing firms operating in these countries by providing within-group capital markets that facilitate the redistribution of resources among group members (Lensink et al. (2003) and George and Kabir (2008)). The common ownership feature of firms affiliated to same business groups is considered as the chief driving force of these interactions.

A large body of research in this area has focused on identifying different channels through which these interactions can take place. Gopalan et al. (2007) examine Indian business groups and show that intragroup loans are extensively used as a tool to support financially weaker members. Buchuk et al. (2014) use intra-group lending data of Chilean business groups and provide evidence in support of groups' financing advantage. In a multi-country study, Gopalan et al. (2014) examine the dividend policies of group members and document that dividends paid by group members are positively affected by the equity-investments of other firms affiliated to the same group. Based on the implications of their theoretical model, they provide evidence in sup-

[2]Groups of firms under common control (Almeida et al. (2011))

port of the hypothesis that group insiders use their share of dividends from cash-rich firms to invest in financially constrained ones.

Some other studies try to shed light on the protective role of business groups upon their members in times of economic hardship. Buchuk et al. (2020) consider the period of the 2008-9 recession and study the transfer of cash among Chilean group members in the form of intra-group loans. Their results cast emphasis upon the significant role of group central firms in facilitating lending and borrowing activities of group members. Santioni et al. (2020) examine the effect of group membership on the survival from global financial crisis by using data on Italian business groups. They show that strong fundamentals of other group members along with the more salubrious fundamentals of firms themselves positively enhances the prospects of firms' survival in times of credit crisis. To investigate the role of diversified business groups in attenuating financial constraints imposed by East Asian financial crisis, Lee et al. (2009) study Korean chaebols[3] and show that they enhanced efficient allocation of capital among group members. In another study, Almeida et al. (2015) also focus on firms in Korean business groups and document a flow of cash from low-growth to high-growth firms and finally conclude that the membership in business groups had been a great boon for Korean firms that significantly helped them mitigate destructive effects of the crisis.

Apart from the advantageous role of business groups in substituting undeveloped financial markets, they have also a dark side that makes literature ambivalent about whether they are net "paragons or parasites" (Khanna and Yafeh (2007)). The prevalent pyramidal structure of business groups and the subsequent discrepancy between cash flow right and control right of the ultimate owner in group members provide group owners with strong incentives to expropriate minority shareholders of group firms (Lemmon and Lins (2003), Almeida and Wolfenzon (2006) ,and Lin et al. (2011)). In other words, the in-

[3]Korean business groups are called chaebols

terconnectedness of group members sometimes is only destined to serve group owners which may has destructive effects on some group members. Such activities are called "Tunneling". Anecdotes of tunneling are abundant and expropriation can take place in many different ways. Intercorporate loans (Jiang et al. (2010)), equity investment, internal trades (Chang and Hong (2000)), equity-linked PSOs' pricing (Baek et al. (2006)), dividends (Faccio et al. (2001)), diversification (Kali and Sarkar (2011)) and merger and acquisition activities (Bae et al. (2002)) are only some of the most familiar ways that previous studies have investigated. Maybe the most famous study that explores the transfer of funds between firms in business groups is Bertrand et al. (2002). They use data on Indian business groups and show that there is significant amount of tunneling from firms that the ultimate owner has lower cash flow right to firms in which it has a relatively higher cash flow right. Their findings suggest that much of tunneling occurs through the channel of non-operating components of profit.

despite the large number of studies in the area of business groups, there is still no incisive and thorough conclusion about their true role in different economies around the world and thus there is still huge room for improvement.

3 Business Groups in Iran

Business groups are a prevalent organizational form across both developed and developing countries (Claessens et al. (2000) and Masulis et al. (2011)). While business groups are not officially recognized by the Iranian Civil or Commercial Code, they appear to be a central feature of corporate ownership in Iran. Most Iranian listed firms tend to have a complex network of interlinked shareholders, controlled by an ultimate owner through many layers of ownership (Farajpour et al. (2019)).

The origins of many of these business groups dates back to the 1979 revolution, although they have gone through massive transformation over the past four decades (Harris (2013)). Following the Islamic revolution in 1979, a wave of nationalization of key sectors of the economy occurred, during which, an estimated 580 domestic enterprises were nationalized (Harris and Kalb (2019)). These firms were predominantly owned by families connected to the Pahlavi Monarchy (1925-1979) and were expropriated or bought from the owners, largely in response to the negative social sentiment against those associated with the Monarchy. Some of these firms were owned directly by the Pahlavi family and were previously managed by the Pahlavi Foundation, which after the revolution, were repossessed and organized under newly-formed foundations, such as "Bonyad Mostazafan" (Dispossessed Foundation) and "Bonyad Shahid" (Martyrs Foundation).

Another group of companies in heavy industries such as steel were owned and managed by the Industrial Development and Renovation Organization (IDRO) during the 1960s and 1970s. IDRO was a large state-owned holding company tasked with developing new firms in capital-intensive industries and upgrading existing firms with new technology and managerial expertise to facilitate the process of industrialization in Iran before the 1979 revolution. The 1980-1988 Iran-Iraq war further established the role of these post-revolutionary organizations as the main tool for mobilizing economic resources to support war and implement state's goals for social development.

The primary phase in the formation of business groups from their above-mentioned ancestors took place during the 1990s and 2000s, as a result of two related forces; A multi-phased privatization by the state, and the development of the domestic stock market. The first phase of privatization occurred between 1989 and 1994, during which, more than 300 companies were fully or partially privatized. The first wave, however, came to a stop, following the public outcry over the favoritism in the privatization process.

The second wave of privatization did not come until 2004 when Article 44 of the Iranian Constitution was amended by the Supreme Leader. In its original form, the Article identified an expansive set of economic sectors as the "state sector", including banking, insurance, power generation, railroads, and aviation, all of which were publicly owned and administered by the state. The 2004 amendment significantly reduced the scope of state ownership and, with a few exceptions such as upstream oil&gas, required the government to divest majority ownership in several industries. The second wave of privatization included ownership transfer of approximately $150 billion of State-Owned Enterprises (SOEs) and assets. According to a 2012 report by Iran's Chamber of Commerce, Industry, and Mines, the main beneficiaries of the second wave of privatization were semi-governmental groups, including pension funds, military institutions, cultural and religious foundations, and revolutionary foundations (Iran Chamber of Commerce, Industries, Mines, and Agriculture; 2012). This wave of privatization led to the formation and expansion of large multi-layered business groups and holding companies such as the Social Security Investment Company (SSIC), which together with other pension fund investment arms, fully or partially owns approximately 550 firms, 130 of which were listed on the Tehran Stock Exchange (TSE) (Institute for Social Security Research, 2017). The SSIC itself was fully owned by the Social Security Organization (SSO) until April 2020, when it got listed on the TSE.

An important part of the second wave of privatization was a program known as "Saham-e Edalat" (Justice Shares), which was advocated and implemented by Mahmoud Ahmadinejad[4] during his presidency (2005-2013). The program involved massive distribution of up to 40 percent ownership in SOEs to tens of millions of eligible citizens through the formation of provincial investment companies owned by citizens through local cooperatives. The shares were

[4]The sixth president of Iran; from 2005 to 2013

offered at significant discounts and through long-term repayment periods. This led to a formation of 30 provincial investment companies, which owned a total of $36 billion of shares as of 2014 (Financial Tribune Daily). The provincial investment companies formed an association - the Provincial Investment Companies Association – to coordinate their voting rights in the SOEs, as each owned a small percentage of each company, while collectively they had ownership of up to 40 percent.

These waves of privatization, transferred control of hundreds of SOEs to semi-governmental groups and was the main driver of the formation of business groups in Iran. This was accompanied by the development of the stock market in Iran, which despite its long history of nearly 50 years, was largely dormant until the early 2000s. The privatization wave and the development of the stock market also reinforced each other, as the government put extensive effort to the develop the legal and institutional infrastructure for the development of the market as an effective tool for privatization, and the development of the market allowed the government to sell off ownership in companies more easily. Another impact of the stock market development was to facilitate listing of a large number of companies owned by business groups. This allowed these groups to list fully owned firms and sell non-controlling ownership to the public, creating a wedge between cash flow rights and voting rights.

To sum up, the multiple waves of privatization, together with the development of the stock market, transformed pre-revolutionary holding companies and post-revolutionary institutions and foundations into large business groups that dominate major industries in Iran today. As a result of these developments, a distinguishing feature of Iranian business groups is that in the majority of cases, the ultimate owner is a semi-governmental or parastatal entity, as opposed to a wealthy family. Such an ownership structure provides a unique and largely unexplored setting to study the features of

business groups including ICMs and reexamining the existing findings in the literature, while simultaneously demanding extra caution in generalizing our findings to other contexts.

4 Data

4.1 Financial and Ownership Data

The data we use in our empirical analysis is culled from several sources. We take accounting data of all Iranian listed firms from the Codal[5] website; a public database that covers all financial and accounting data released by Iranian listed firms. Also, end-of-years ownership tables are extracted from the Tehran Stock Exchange (TSE)[6] database that reports all end-of-the-days block-holders (shareholders who own at least 1% of the total shares outstanding[7]) of listed firms with their ownership percentages. We expunge ETFs and mutual funds out of hand from our data set because they have a totally dissimilar corporate governance pattern to other firms under study. Since TSE only considers ownership structure of listed firms, to be able to identify the ultimate owner of each listed firm and create the whole structure of business groups, we merge TSE ownership data with a unique hand-collected data set that includes all extra ownership links needed to build the network of groups. We restrict our empirical analysis to 2014-2018 because finding extra ownership links was relatively toilsome for years before that.

The high level of chronic inflation in Iran's economy requires some adjustments to the stock items in firms' balance sheets; specifically our main variable of total book value of assets. Iran's economy experienced on average

[5] www.codal.ir

[6] www.tse.ir

[7] In this context, Iran's disclosure rules are tighter than other countries. For example the U.S. Securities and Exchange Commission (SEC) requires public firms to list all their shareholders that have at least 5% of firm's common stocks. This minimum requirement is also 5% in China.

nearly 20% annual inflation in our considered time period and even higher levels in years before that. Since the market values of assets move away from the book values in such an inflationary economy, using raw data will be problematic. Thus, to obviate the possibility of ending up with erroneous and misleading results, we use inflation adjusted book value of assets in the whole of our empirical analysis. In Appendix B we will explain our adjustment method in details.

Table 1 reports the summary statistics of the key variables used in this paper. We report the statistics for all firms, only group affiliated firms, and only stand-alone firms separately to see whether there is any differences between disparate categories or not. As shown in the last two columns of the table, group firms have on average higher *Own Cash Flow/Asset*, greater *Size*, higher profitability indicators (*ROA*, *ROE*, and *ROS*), higher payout measured by *Dividend/EBIT*, lower *Investment/Asset*, and lower *Debt Ratio*. For all firms, the portion of annual investment and cash flow are 1% and 7% of the value of their assets; respectively.

Table 1: This table reports summary statistics for three categories: All firms which includes both group members and stand alone firms, Only group members, and only stand alone firms. The last two columns show the difference of means of variables corresponding with group members and stand-alone firms and the p-vale of the t-test for this difference. The period of the analysis is 2014-2018. For variables definitions see Appendix A.

	All Firms				Group Firms				Stand-Alone Firms				Diff. of Means	
	mean	median	sd	N	mean	median	sd	N	mean	median	sd	N	diff	p-value
Own Cash Flow/Asset	0.092	0.072	0.097	2449	0.104	0.088	0.097	1297	0.079	0.057	0.094	1152	0.025	0.00***
Investment/Asset	0.02	0.009	0.028	2432	0.018	0.009	0.025	1313	0.022	0.009	0.03	1119	-0.004	0.00***
adj Investment/Asset	0.007	-0.00	0.025	2401	0.005	-0.00	0.023	1304	0.009	0.00	0.028	1097	-0.004	0.00***
Own Q	0.96	0.85	0.42	2437	0.96	0.84	0.43	1289	0.97	0.87	0.42	1148	-0.012	0.481
Debt Ratio	0.36	0.33	0.20	2566	0.34	0.32	0.18	1359	0.38	0.35	0.21	1207	-0.036	0.00**
Size (BT)	835	145	2408	2531	1038	179	2882	1320	614	104	1723	1211	424	0.00***
Dividend/EBIT	0.37	0.31	0.35	2460	0.43	0.45	0.34	1309	0.30	0.15	0.34	1151	0.12	0.00***
Dividend/Asset	0.05	0.02	0.06	2527	0.06	0.04	0.07	1350	0.04	0.01	0.05	1177	0.02	0.00***
Dividend/Sale	0.19	0.07	0.27	2374	0.22	0.11	0.28	1271	0.16	0.03	0.26	1103	0.06	0.00***
Sale Growth	0.195	0.107	0.521	2336	0.193	0.104	0.488	1286	0.197	0.11	0.556	1150	-0.004	0.855
ROA	0.067	0.049	0.091	2449	0.076	0.061	0.09	1297	0.057	0.037	0.09	1152	0.019	0.00***
ROE	0.254	0.211	0.313	2449	0.286	0.243	0.317	1297	0.218	0.187	0.304	1152	0.068	0.00***
ROS	0.244	0.151	0.48	2412	0.277	0.167	0.435	1280	0.207	0.128	0.524	1132	0.07	0.00***

The reported means of *Own Cash Flow/Asset* and *Investment/Asset* for Iranian group firms and stand alone firms are comparable with the documented means of these variables for chaebol and non-chaebol firms in the post Asian

crisis period (1999-2005) by Lee et al. (2009). They report that chaebol firms' mean cash flow to asset and investment to asset were 10.1% and 3.9% in that time period. These means for Non-chaebol firms were 7.5% and 2.5%; respectively, based on their study.

4.2 Grouping Algorithms

Contrary to some other countries like South Korea, Japan, and India, In Iran we don't have predetermined business groups and thus, we have to create them with the aid of some proper algorithms. We use two fundamentally different algorithms that were introduced in previous studies to make sure that our main findings are not driven by the grouping method.

4.2.1 Grouping Based on Control Thresholds

Our first method of grouping borrows extensively from Almeida et al. (2011). In the context of this method, we say a specific firm is controlled by an owner if the owner holds more than a predetermined portion of votes in that firm; directly or indirectly.

To identify Iranian business groups based on this approach to control, in the first step, for each firm we consider the voting rights of it's immediate shareholders to find the controlling owner. In this step, the controlling owner is defined as a shareholder whose voting right goes beyond the minimum level required by the method. Some firms may have no controlling owner in this step. In the second step, for each firm we replace those of it's shareholders which have a common controlling owner with that common owner and assign the combined sum of the voting rights of those shareholders to that owner and then back to step one and repeat it. By doing so, some firms which had no controlling owner in the first step, find themselves controlled indirectly by the controlling owner of some of their shareholders (this case occurs when the combined sum of voting rights of those of their shareholders which are

themselves controlled by a common entity exceeds the control threshold). We go on in this way until repeating does not append any new firm to the set of firms which have controlling owners. Once we reach this point, business groups are identified by applying a trivial rule: firms which are governed by the same controlling owner are belonging to the same group. We call that common controlling owner the ultimate owner of the group. Note that the act of repeatedly replacing shareholders with their controlling owners guarantees that the identified ultimate owner itself has not any control owner. The set of firms which remain uncontrolled at the end of the process are considered as stand-alone (independent) firms. We explain the details this algorithm in Appendix C.

We apply a 40% cut-off control right. Our motivation to choose such a large threshold is twofold: first, Iranian listed firms have on average about 20% free float (the portion of shares that are in hands of public investors) which most of the time have no significant direct influence on the corporate governance. We apply half of the remaining 80% as the cut-off level to devolve control. Second, since we want to test the interaction of firms belonging to the same business groups, we need to make sure that group members are really governed by the common ultimate owner and thus we want to set a threshold that can rule out loose controlling relations. A relatively large threshold can provide us with reliable assurance about the complete sovereignty of the ultimate owners of groups over their subsidiaries. Bearing these two concerns in mind, we choose a 40% threshold as cut-off level.

4.2.2 Grouping Based on Voting Power Indices

Our second method of grouping uses the algorithm proposed by Aminadav et al. (2011) that fundamentally have roots in Shapley and Shubik (1954). Contrary to the absolute cut-offs used in the control thresholds method, this approach considers *relative voting powers*. *Shapley-Shubik Index (SSI)* is cal-

culated for each of the shareholders of a firm in the context of a *weighted majority game*[8]. Each shareholder is considered as a player in the voting game and its corresponding *SSI* reflects the relative power of that shareholder in changing the outcome of a collaborative decision. Aminadav and Papaioannou (2020) employ this method and study the patterns of corporate control around the world (They study 40,000 listed firms from 127 countries over 2004 to 2012).

The way we should go to identify Iranian business groups based on this approach to control is too similar to the previous one. The sole difference lies in the decision rule to be applied to determine controlling owners. Instead of examining the voting right of a shareholder or a combined sum of voting rights of some shareholders (in the case when they themselves are controlled by a common owner) to see whether the absolute control threshold is passed or not, this method compares the *SSI* of single shareholders or a combined set of shareholders (when these shareholders have common controlling owner) with the minimum required level of *SSI* and if this level is exceeded, the firm is considered as controlled.

This method has two key parameters: the first is the majority quota (q) that shows the minimum number of votes that are needed to pass a vote. We set this parameter to 40%, based on the argument laid down for the first method. The second parameter is *SSI* that shows the minimum voting power a shareholder needs to take control of the company. Following Aminadav et al. (2011), we set this parameter to 75%.

After we identified the whole members of groups employing each approach to control, in addition to determining the cash flow right and the control right (voting right) of the group's ultimate owner in each of the group members

[8] A common form of voting game, "which can be described by specifying non-negative real number weights for the voters and a positive real number quota satisfying a boundedness condition such that a coalition is winning precisely when the sum of the weights of the voters in the coalition meets or exceeds the quota." Barua et al. (2005)

(represented by *cfr* and *cr*, respectively), we also calculate some metrics that are helpful in describing the relative importance and the location of individual members in the structure of the groups. These metrics are *centrality* and *position*. The first one shows the extent to which a firm is used by the ultimate owner to exercise control on other group members and the second one measures the closeness of each member to the group's ultimate owner. To be more precise, we say a firm is more central if when we drop that firm from the group, the average control right of the ultimate owner in other firms in the group diminishes more. We also say a firm is located in lower *position* in the group when it is linked to the ultimate owner through less number of intermediaries[9]. We calculate all four of these variables based on Almeida et al. (2011).

Note that because we use 40% as the control threshold in the first method and as the minimum required majority quota in the second one, it is possible that we come up with a situation in which some firms have two independent controlling owners. Such incidents occur in a handful of cases in our analysis. To rectify this problem we carefully examine the controlling power of both identified controlling owners and choose the one which has more influence on the corporate decisions.

Table 2 presents the initial (raw) and final (corrected) status of firms in terms of group membership. Following Kandel et al. (2019), we keep only identified groups which have at least three listed firms. As we see in panel A, in 4 firm-year cases the raw output of the two methods are not congruent. To correct this incompatibility, we scrutinize the ownership structure of these firms and apply to them the result of one method that seem more precise. After applying this manual correction, we come up with the group membership status reported in panel B. As we see, in each year, about half of our firms are identified as group affiliated.

[9]Note that firms located in the higher positions of the pyramid, have lower *position*s.

A point that is worth explaining further is the high-level of coordination between the raw outputs of the two methods. Because our two methods of grouping take fundamentally different approaches towards the necessary conditions for categorizing a firm as controlled, this level of concordance is somewhat unexpected. The clue to fathom out this result lies in the concentrated ownership structure of Iranian firms. In the considered time period, the median ownership of the largest shareholders of listed firms is about 50%. It means that in most cases, the largest shareholder exerts comprehensive control on the firm and the two methods do not even enter into the area of possible disagreement (because 50% $>$ absolute cut-off level of 40% and also 50% $>$ minimum required majority quota of 40%).

In Table 3 we present a brief overview of the identified groups. In each year, groups have on average about 9 members. The largest group is comprised of 28 member firms. Our identified groups are to some extent diversified and on average firms from 4.5 different industries are affiliated to each group. The average control right and cash flow right of the group's ultimate owner in about 65% and 43%, respectively, which implies average discrepancy of about 22%. Claessens et al. (2000) report that the mean cash flow right and voting right of the largest ultimate owner in East Asian companies are 15.7% and 19.8% (a divergence of about 4.1%), respectively. These averages for Western Europe firms are 34.6% and 38.5% (a divergence of about 3.9%) based on Faccio and Lang (2002). The last column reports that there is on average 2.3 ownership links between group members and the group owner which directly measures the extent of pyramiding.

Figures 1 and 2 depict two identified Iranian business groups. The group which Figure 1 alludes to, has a relatively more intricate structure with numerous ownership links. The other group shown in Figure 2 has a more typical pyramidal structure.

Table 2: This table presents the initial (panel A) and the final (panel B) status of Iranian firms in terms of group membership based on our two different methods of grouping. The initial status is the raw output of the two algorithms. After resolving the differences between the two methods by scrutinizing the ownership environment of disputed companies, we assign each of them the result of one method which seems more accurate, and finally, we reach the final status of firms in terms of group membership reported in panel B. Our first method of grouping (the second column) is based on control thresholds. in our analysis we use the 40% cut-off control. Our second method (third column) is based on weighted voting games literature. when applying this method we use the 40% quota (q) and 0.75 Shapley-Shubick Index (SST). The numbers is parentheses show the portion of firms identified as group affiliated in each year under each method.

	40% cut-off	q=40%, SSI=0.75
Panel A: Initial Status:		
1- Total number of identified control firms		
Year = 2014:	249(51%)	249(51%)
Year = 2015:	265(51%)	265(51%)
Year = 2016:	283(52%)	281(51%)
Year = 2017:	293(53%)	294(53%)
Year = 2018:	299(53%)	300(53%)
2- Identified firm-year observations as controlled in ONLY one method	4	
3- Out of which (2) with different ultimate owner	0	
Panel B: Final Status:		
1- Total number of identified control firms		
Year = 2014:	249(51%)	249(51%)
Year = 2015:	265(51%)	265(51%)
Year = 2016:	283(52%)	283(52%)
Year = 2017:	294(53%)	294(53%)
Year = 2018:	300(53%)	300(53%)
2- Identified firm-year observations as controlled in ONLY one method	0	
3- Out of which (2) with different ultimate owner	0	

5 Hypotheses Development

We aim to examine the implications of ICM hypothesis in Iranian business groups. If group members are truly less financially constrained than standalone firms; allegedly because they have access to the "deep-pocket" (Boutin et al. (2013)) of the groups, we anticipate that their investments be less dependent on their internal sources of capital.

Hypothesis 1. *If ICM exists and alleviates financial constraints of group members, their investment should be less dependent on their internal sources*

Table 3: This table reports a brief description of the identified business groups. The yearly number of groups, average number of members affiliated with each group, number of firms belonging to the group with the largest number of members, average number of unique industries that each group affiliated firm operate in, average cash flow right and control right of the ultimate owner of the groups in group members, and average position of the group firms are reported in this table.

	No. of Groups	Avg. Number of Members	Max. Number of Members	Avg. Number of Industries	Avg. CFR	Avg CR	Avg. Position
year = 2014	29	8.6	28	4.5	0.42	0.64	2.3
year = 2015	32	8.3	27	4.4	0.43	0.65	2.3
year = 2016	33	8.6	28	4.3	0.43	0.65	2.3
year = 2017	33	8.9	27	4.5	0.44	0.65	2.3
year = 2018	31	9.7	28	4.6	0.44	0.64	2.3

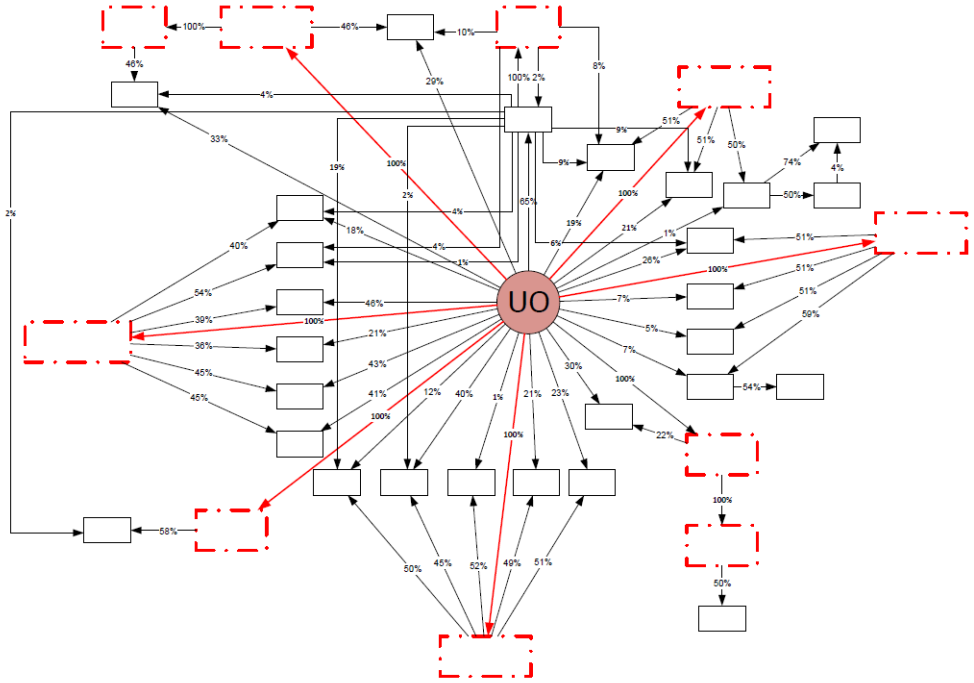

Figure 1: An Iranian Business Group with complex structure

of capital relative to stand alone firms.

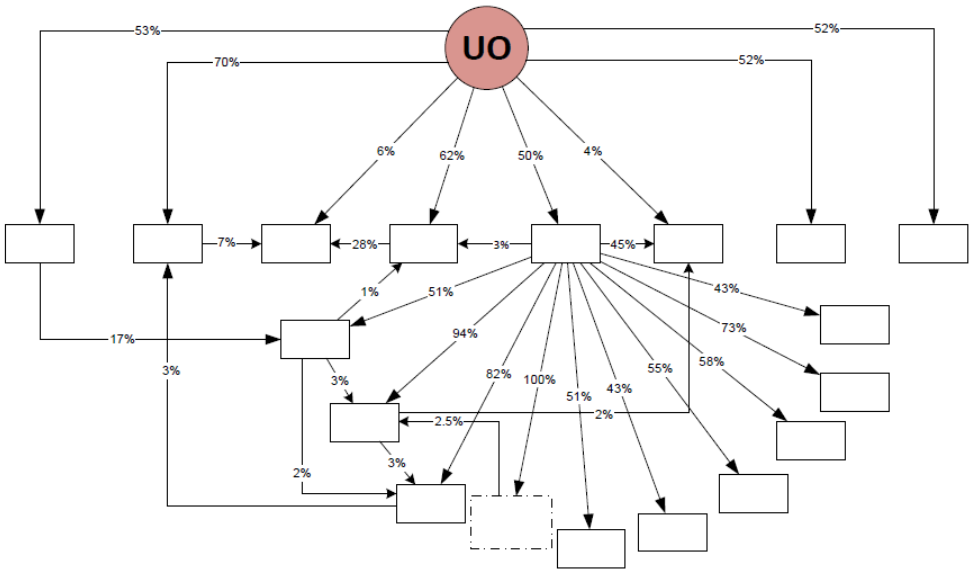

Figure 2: An Iranian business group which has a relatively simpler and more pyramid-like structure

We estimate the following regression model:

$$\begin{aligned} adj\ Investment/Asset_{j,t} = \alpha &+ \beta_1\ Own\ Cash\ Flow/Asset_{j,t} \\ &+ \beta_2\ Group_j \times Own\ Cash\ Flow/Own\ Asset_{j,t} \\ &+ X_{j,t} + Z_j + T_t + \epsilon_{j,t} \end{aligned}$$

where, *Group* is a dummy that takes 1 for firms affiliated to one of our identified business groups and 0 otherwise. We anticipate that $\beta_2 < 0$.
Our second prediction considers only group members. ICM hypothesis implies that group members investments should be sensitive to the cash flow of other firms affiliated to the same group. In other words, group's pocket is an important source of financing for group members.

Hypothesis 2. *the investments of firms affiliated to business groups, are sensitive to the pooled cash flows of other firms belonging to the same group.*

To empirically examine *Hypothesis* 2, we estimate the following regression:

$$\begin{aligned} adj\ Investment/Asset_{j,t} = \alpha &+ \beta_1\ Own\ Cash\ Flow/Asset_{j,t} \\ &+ \beta_2\ Group\ Cash\ Flow/Group\ Asset_{-j,t} \\ &+ X_{j,t} + Z_j + T_t + \epsilon_{j,t}. \end{aligned}$$

If group members financing is partly determined by the cash flow of other firms in the same group, *Hypothesis 2* predicts that $\beta_2 > 0$.

Our first two hypotheses jointly examine the interconnectedness of group members in a way that lightens the burden of financing in Iran's undeveloped economy but have nothing to say about whether these relations will result in tunneling or they are really destined to help members go out of financing quandary.

Tunneling hypothesis requires that the flow of funds should be from firms with low cash flow to voting rights to firms with high cash flow to voting rights (Bertrand et al. (2002)); regardless of members' growth opportunities and financing needs. In other words, it postulates that firms with higher discrepancy between cash flow and voting rights be expropriated to serve firms with narrower wedge between cash flow and voting rights; even when this direction of funds is not efficient for the overall group. In contrary, an ICM that seeks alleviating financial constraints of group members with potentially higher growth opportunities is more likely to result in an exact opposite direction of funds. Since group members with low discrepancy between cash flow and voting rights are most of the time greater is size, more mature, more central (hold substantial equity in other firms (Almeida et al. (2011))), and more well-known, they can absorb external finance more easily and have enough resources to help other group members to mitigate their financing needs. Therefore, we can anticipate that if ICM aims to relieve the drudgery of finding resources to finance the investments of group members which may

have higher growth opportunities, the flow of funds should the opposite of what tunneling implies (The direction of funds should be from firms located in the higher parts of the group structure towards firms in the lower parts).

Hypothesis 3. *If tunneling hypothesis prevails, the investment of group members should be sensitive to the cash flow of firms with higher discrepancy between cash flow and voting rights (firms in the lower parts of the group pyramid). In contrary, if ICM seeks to alleviate financial constraints of firms with higher growth opportunities instead of expropriation, the investment of group members should be sensitive to the cash flow of firms located in higher parts of the group.*

To empirically examine which theory is dominant, we estimate the following regression:

$$\begin{aligned} adj\ Investment/Asset_{j,t} = \alpha &+ \beta_1\ Own\ Cash\ Flow/Asset_{j,t} \\ &+ \beta_2\ Up\ Cash\ Flow/Up\ Asset_{-j,t} \\ &+ \beta_3\ Down\ Cash\ Flow/Down\ Asset_{-j,t} \\ &+ Z_j X_{j,t} + T_t + \epsilon_{j,t} \end{aligned}$$

$\beta_2 > 0$ more confirms the relieving role of ICM and $\beta_3 > 0$ provides evidence in support of tunneling hypothesis.

6 Results

In this section we report the empirical results.

Table 4 presents the results of empirical estimation of *Hypothesis 1.* We use industry adjusted investment to assets ($adj\frac{Investment}{Asset}$) as dependent variable in specifications 1 to 4 to address the time-variant effects of industries. In these columns we include firm and year fixed effects to address the time

invariant characteristics of firms and the specific situations of different years. In the last column, we use investment to assets as dependent variable along with $Industry \times Year$ fixed effects and also dispel firm fixed effects.

Table 4: This table reports the empirical result of testing *Hypothesis 1*. In the first four columns, the dependent variable is the industry-adjusted investment to assets and firm and year fixed effects are included. In the last column we use investment to assets as dependent variable, drop firm fixed effects and include industry×year firm fixed effects along with the year fixed effects. All standard errors are clustered at the firm level. All financial companies are prevented to be used in the firm dimension of the panel. For variables' definitions see Appendix A.

	(1) adj$\frac{Investment}{Asset}$	(2) adj$\frac{Investment}{Asset}$	(3) adj$\frac{Investment}{Asset}$	(4) adj$\frac{Investment}{Asset}$	(5) $\frac{Investment}{Asset}$
Own Cash Flow/Asset	0.0494***	0.0931***	0.0917***	0.0878***	0.108***
	(4.69)	(5.24)	(5.20)	(4.66)	(3.87)
Own Cash Flow/Asset × Group		-0.0718***	-0.0672***	-0.0616***	-0.0701**
		(-3.59)	(-3.37)	(-2.97)	(-2.55)
Own Q				0.00958**	0.0227***
				(2.04)	(4.31)
Lag(Sale Growth)				-0.00305**	0.00497
				(-2.40)	(1.43)
Log(Size)			0.00240	-0.00696	-0.00345
			(0.61)	(-1.13)	(-1.10)
Debt Ratio			-0.00203	-0.00694	0.00400
			(-0.23)	(-0.61)	(0.38)
Constant	0.00362*	0.00388**	-0.000438	0.00910	-0.0176
	(1.93)	(2.19)	(-0.05)	(0.74)	(-1.62)
Firm FE	Yes	Yes	Yes	Yes	No
Year FE	Yes	Yes	Yes	Yes	Yes
Industry × Year FE	No	No	No	No	Yes
Observations	1766	1766	1677	1566	1592
R^2	0.025	0.039	0.041	0.052	0.333

As the first row of Table 4 shows, the extent to which firms invest is too significantly affected by the availability of internal funds. In other words, The higher is the amount of cash flow made by firm (the higher is the amount of internal accessible resources), the higher will be firm's investment. The reported coefficient of 0.108 for β_1 means that one standard deviation increase in *Own Cash flow/Asset* will result in about 0.4 standard deviation increase in firms' *investment/asset* which is highly meaningful. This find-

ing cast emphasis on the fact that when financial markets are undeveloped and the information problems are severe, like Iran's environment, external financing is burdensome if not quietly impossible and firms in the first place rely on their internal sources of capital.

The coefficient of the interaction between firm's cash flow and group dummy, reported in the second row of Table 4, strongly expresses that group members' investments are less dependent on their internal cash flows which provide a supportive evidence on the favor of working ICM in Iranian business groups. The reported positive and highly significant coefficient for firms' Tobin Q shows that in general, firms with more growth opportunities invest more. We include firms' lag of sales growth (following Shin and Park (1999)), log of size, and debt ratio as control variables.

Table 4 provides strong evidence in support of *Hypothesis 1*. In the next step, we present the empirical estimation of *Hypothesis 2* in Table 5. *Hypothesis 2* asserts that if the group pocket is truly a source of financing for group members, any change in the size of this pocket should affect the investment expenditures of group members. To examine this hypothesis, we focus on group members and include group cash flow as independent variable.

As documented in Table 5, group members' investment expenditures are significantly affected by the size of the group pocket. When other firms in the same group make more profit, there are more resources available to group firms to finance their investments. Although group firms' internal cash flows are still important determinants of financing, groups provide their members with an additional source of capital which makes them less financially constrained.

Documented results so far only provide evidence on the existence of internal capital market and are utterly silent about whether these relation between group members are aimed to expropriate or just alleviate financing needs. As we explained in the development of *Hypothesis 3*, we can reach a reli-

Table 5: This table documents the empirical results of testing *Hypothesis 2*. The dependent variable is the industry-adjusted investment to assets. We drop firm j when calculating *Group Cash Flow*. Firm and year fixed effects are included in all specifications and all standard errors are clustered at the firm level. All financial companies are prevented to be used in the firm dimension of the panel. For variables' definitions see Appendix A.

	(1) adj$\frac{Investment}{Asset}$	(2) adj$\frac{Investment}{Asset}$	(3) adj$\frac{Investment}{Asset}$	(4) adj$\frac{Investment}{Asset}$
Own Cash Flow/Asset	0.0384***		0.0316**	0.0257*
	(2.96)		(2.35)	(1.89)
Group Cash Flow/Group Asset		0.0431***	0.0326**	0.0323**
		(2.76)	(2.03)	(2.08)
Own Q				0.0121*
				(1.97)
Group Q				0.00334
				(0.54)
Lag(Sale Growth)	-0.00475***	-0.00435**	-0.00496***	-0.00512***
	(-2.74)	(-2.58)	(-2.84)	(-2.98)
Log(Size)	0.00277	0.00304	0.00152	-0.0120
	(0.48)	(0.54)	(0.27)	(-1.54)
Debt Ratio	0.0118	0.0107	0.0128	0.00580
	(0.90)	(0.81)	(0.98)	(0.40)
Constant	-0.00635	-0.00692	-0.00756	0.00635
	(-0.45)	(-0.50)	(-0.55)	(0.38)
Firm FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	860	860	860	860
R^2	0.030	0.027	0.037	0.049

able answer to this question by determining the direction of sensitivity. We split group members into two subgroups based on their *position*[10] within the group. We refer to the subgroup comprising firms which have *position*s lower than the median-within-group *position* as *Up* and the other subgroup as *Down*.

[10]This metric first presenten in Almeida et al. (2011) and shows the distance between group members and the group's ultimate owners. Firms in higher positions in the groups structure have lower *position*: are closer to the groups' ultimate owner

Table 6 reports the summary statistics of our main variables of interest for *Up* and *Down* subgroups distinctly. As shown in this table, firms located in the upper half of the group pyramid (firms with lower *position* metric) comparably invest less, have less growth opportunities measured by Tobin's Q, are greater in size, and have greater profitability.

In Table 7 we show the group metrics of firms belonging to the *Up* and *Down* subgroups separately. As we see, the wedge between ultimate owner's voting right and cash flow right in *Up* members is relatively lower by a factor of about $\frac{1}{3}$. This table also reports that *Up* members are more central on average, which means that they own significant shares of other firms belonging to the same group.

Figure 3 depicts a simple and hypothetical groups and shows how we split the group structure into *Up* and *Down* subgroups.

Table 6: This table reports the summary statistics of the main variables for members of *Up* and *Down* subgroups, separately. For variables definitions see Appendix A.

	Up Firms: Position < Median(Within Group Position)				Down Firms: Position ≥ Median(Within Group Position)				Diff. of Means	
	mean	median	sd	N	mean	median	sd	N	diff	p-value
Own Cash Flow/Asset	0.11	0.09	0.09	502	0.1	0.08	0.1	795	0.003	0.54
Investment/Asset	0.01	0.0	0.02	501	0.02	0.01	0.03	812	-0.006	0.00***
Adj Investment/Asset	0.01	0.0	0.02	497	0.01	-0.0	0.02	807	0.0	0.90
Own Q	0.93	0.8	0.43	499	0.98	0.86	0.42	790	-0.05	0.04**
Debt Ratio	0.33	0.31	0.21	530	0.35	0.33	0.17	829	-0.014	0.19
Size	1875	336	4073	510	512	141	1540	810	1363	0.00***
Dividend/EBIT	0.47	0.5	0.35	506	0.4	0.4	0.34	803	0.065	0.00***
Sale Growth	0.22	0.12	0.52	505	0.18	0.09	0.46	781	0.036	0.204
ROA	0.08	0.07	0.09	502	0.07	0.06	0.09	795	0.01	0.00**
ROE	0.29	0.25	0.31	502	0.28	0.24	0.32	795	0.01	0.617
ROS	0.42	0.28	0.46	500	0.18	0.13	0.39	780	0.24	0.0***

Table 7: This table presents group metrics for members of *Up* and *Down* subgroups, separately. For variables definitions see Appendix A.

	All Group Firms	Up Firms: Position < Median(Within Group Position)						Down Firms: Position ≥ Median(Within Group Position)					
	N	n	cfr	cr	cr - cfr	centrality	position	n	cfr	cr	cr - cfr	centrality	position
year=2014	249	94	0.52	0.63	0.11	0.08	1.75	155	0.35	0.64	0.29	0.01	2.68
year=2015	265	102	0.54	0.64	0.10	0.08	1.69	163	0.36	0.66	0.30	0.01	2.68
year=2016	283	110	0.54	0.65	0.11	0.08	1.73	173	0.36	0.65	0.29	0.01	2.70
year=2017	294	119	0.55	0.67	0.12	0.07	1.76	175	0.37	0.65	0.27	0.01	2.74
year=2018	300	116	0.54	0.66	0.12	0.07	1.81	184	0.38	0.63	0.26	0.01	2.67

Table 8 shows the empirical estimation of testing *Hypothesis 3*. As the positive and significant coefficient of *Up Cash Flow/Up Asset* reveals, group

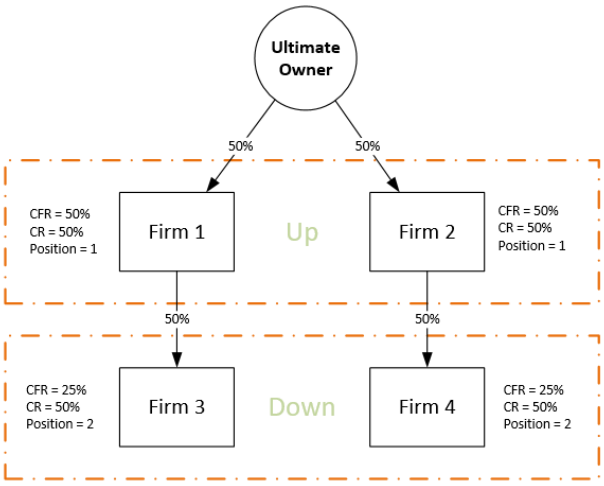

Figure 3: A simple graph that shows how we split each group into two distinct subgroups called *Up* and *Down* based on members' *position*s in the structure of the group.

firms investments are affected by the cash flows of group members in the upper half of the group structure (group firms which have lower than median *position*); i.e, firms which are more central, greater in size, and have lower control wedges.

If we dig deeper in the direction of sensitivity by testing *Hypothesis 3* separately for *Up* and *Down* subgroups (use dependent variables corresponding to *Up* and *Down* subgroups separately), we see that only one out of four possible directions of sensitivity exists: we can observe only the sensitivity of investment of *Down* members to the cash flow of *Up* members. In Table 9 we report the coefficients β_2 and β_3 along with their t-statistics for the four possible directions of sensitivity.

This finding rejects all sorts of tunneling activities which claim that firms in the lower parts of the group structure are expropriated to serve upper firms' financing needs and provides evidence on the existence of an ICM in which firms which are less likely to access to external financing (*Down* firms) and has greater growth opportunities (based on Table 6) benefit from the cash flow of other firms in the same group which are less dependent on

Table 8: This table presents the empirical results of testing *Hypothesis 3*. The dependent variable is the industry-adjusted investment to assets. Firm and year fixed effects are included in all specifications and all standard errors are clustered at the firm level. All financial companies are prevented to be used in the firm dimension of the panel. For variables' definitions see Appendix A.

	(1) adj$\frac{Investment}{Asset}$	(2) adj$\frac{Investment}{Asset}$	(3) adj$\frac{Investment}{Asset}$	(4) adj$\frac{Investment}{Asset}$	(5) adj$\frac{Investment}{Asset}$
Own Cash Flow/Asset				0.0367**	0.0321**
				(2.48)	(2.17)
Up Cash Flow/Up Asset	0.0419**		0.0476**	0.0416**	0.0475**
	(2.60)		(2.39)	(2.09)	(2.42)
Down Cash Flow/Down Asset		0.00647	-0.0182	-0.0267	-0.0293
		(0.38)	(-0.87)	(-1.29)	(-1.47)
Own Q					0.0130**
					(2.09)
Up Q					-0.00652
					(-0.96)
Down Q					0.0107
					(1.45)
Lag(Sale Growth)	-0.00447**	-0.00373**	-0.00397**	-0.00457**	-0.00491***
	(-2.56)	(-2.22)	(-2.28)	(-2.55)	(-2.69)
Log(Size)	0.00301	0.00477	0.00296	0.00105	-0.0148**
	(0.54)	(0.82)	(0.52)	(0.19)	(-1.97)
Debt Ratio	0.00957	0.0104	0.00966	0.0120	0.00470
	(0.70)	(0.76)	(0.68)	(0.87)	(0.32)
Constant	-0.00786	-0.00481	-0.00622	-0.00620	0.0103
	(-0.55)	(-0.34)	(-0.44)	(-0.44)	(0.62)
Firm FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	813	850	803	803	798
R^2	0.035	0.017	0.038	0.050	0.068

Table 9: This table shows the coefficients β_2 and β_3 along with their t-statistics for the four possible directions of sensitivity: investment of *Up* members to the cash flow of *Up* members, investment of *Up* members to the cash flow of *Down* members, investment of *Down* members to the cash flow of *Up* members, and investment of *Down* members to the cash flow of *Down* members.

adj$\frac{Investment}{Asset}$

$\frac{CashFlow}{Asset}$	Up	Down
UP	0.033 (0.8)	0.026 (2.23**)
Down	0.029 (-0.93)	0.025 (-1.36)

the cash flow of others to finance their investments and have weaker growing prospects.

There is a point here that needs further explanation. The sensitivity of group members investments to the cash flow of other firms in the same group (*Hypotheses 2* and *3*) does not necessarily mean that there is a cash transfer between group members. What the results of Tables 5 and 8 indicate is that group members investments are affected by the cash flows of other firms in the same group; directly (via direct cash transfer) or indirectly (through some other interaction that will result in this sensitivity). In the following sections we examine some possible mechanism that directly and indirectly can explain this sensitivity.

6.1 Evidence from Pseudo Groups

The common ownership feature of firms belonging to the same group is assumed to be the driving force of the reported results. Apart from ownership relations, firms affiliated to the same group most of the time have close relationships in terms of management linkage, operation in a specific production chain, business partnership and so on. To make sure that our documented results are truly emanated from the ICMs and are not driven by some other factors, we develop a placebo test. This strategy is common in the literature (for example Santioni et al. (2020)).

For each group we create a pseudo group that mirrors the actual group. To do so, for each member in each group, we find another firm from out of the group (from the population of other groups' members and stand-alone firms) which belongs to the same industry and has the most similarity in terms of the mean size of assets, mean debt ratio, and mean Tobin's Q and replace it with the actual firm. Then, we test *hypotheses 2* and *3* on these pseudo groups instead of the real groups. If the previous documented results are truly driven by ICMs as a characteristic of true business groups-each gov-

erned by a different ultimate owner-we anticipate that there is no sensitivity between investments and cash flows of members of pseudo groups, because they are not truly governed by the same owner.

Table 10: This table presents the empirical results of testing *hypotheses 2* and *3* on the pseudo groups. The dependent variable is the industry-adjusted investment to assets. Firm and year fixed effects are included in all specifications and all standard errors are clustered at the firm level. All financial companies are prevented to be used in the firm dimension of the panel. For variables' definitions see Appendix A.

	Similar Asset		Similar Debt Ratio		Similar Own Q	
	adj$\frac{Investment}{Asset}$	adj$\frac{Investment}{Asset}$	adj$\frac{Investment}{Asset}$	adj$\frac{Investment}{Asset}$	adj$\frac{Investment}{Asset}$	adj$\frac{Investment}{Asset}$
Own Cash Flow/Asset	0.0358**	0.0323*	0.0395**	0.0335*	0.0362**	0.0380**
	(2.07)	(1.75)	(2.29)	(1.81)	(2.13)	(2.02)
Own Q	0.0160***	0.0166***	0.0178***	0.0175***	0.00319	0.00314
	(2.71)	(2.75)	(3.12)	(2.99)	(0.46)	(0.40)
Group Cash Flow/Group Asset	-0.0207		-0.0183		-0.00674	
	(-1.00)		(-0.91)		(-0.29)	
Group Q	-0.00898		-0.0114*		-0.000696	
	(-1.44)		(-1.79)		(-0.09)	
Up Cash Flow/Up Asset		-0.0293		-0.0305		0.0224
		(-1.42)		(-1.48)		(0.92)
Up Q		-0.00378		-0.00469		-0.00399
		(-0.71)		(-0.90)		(-0.59)
Down Cash Flow/Down Asset		0.0102		0.00949		-0.00691
		(0.64)		(0.60)		(-0.33)
Down Q		-0.00382		-0.000557		0.00210
		(-0.48)		(-0.07)		(0.36)
Lag(Sale Growth)	0.00217	0.00197	0.00229	0.00260	-0.00127	-0.00170
	(1.29)	(1.13)	(1.40)	(1.53)	(-0.64)	(-0.81)
Log(Size)	-0.0170**	-0.0156**	-0.0174**	-0.0162**	-0.00521	-0.00534
	(-2.38)	(-1.99)	(-2.43)	(-2.09)	(-0.54)	(-0.47)
Debt Ratio	-0.0262*	-0.0249	-0.0287*	-0.0256	-0.00750	-0.00265
	(-1.70)	(-1.53)	(-1.86)	(-1.59)	(-0.42)	(-0.14)
	(-1.13)	(-0.78)	(-1.33)	(-0.51)	(0.14)	(0.35)
Constant	0.0450***	0.0403**	0.0469***	0.0375**	0.0141	0.0105
	(2.66)	(2.20)	(2.71)	(2.05)	(0.68)	(0.43)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	869	801	871	805	845	790
R^2	0.064	0.065	0.078	0.072	0.015	0.017

As Table 10 reports, our previous results about the sensitivity of group members' investments to the cash flows of other firms belonging to the same group utterly disappear when we consider pseudo groups instead of real ones. This finding strengthens the idea of existing ICMs in Iranian business groups that

link the investments and cash flows of firms belonging to the same groups.

6.2 Potential Mechanisms

In this section we are going to examine different mechanisms which can (partly) explain our previous reported results. We will investigate dividend policies, stock tradings, capital increase incidents, and block tradings of group members because we have some inchoate hypotheses based on our real world observations that these mechanism potentially can carry some information about the operation of ICMs in Iran's business groups.

6.2.1 Dividend Policy Mechanism

We examine the dividend policy of group members to see whether it can (partly) explain our main finding about the sensitivity of investments of group members to the cash flow of firms in the *Up* subgroups of the same group. Dividend policies of firms affiliated to business groups have been frequently studied both in the context of tunneling (Faccio et al. (2001)) and efficient ICMs (Gopalan et al. (2007)).

In the first step, we investigate the effect of group affiliation on the amount of dividends paid by Iranian listed firms. Previous studies report that group members pay higher amounts of dividend than unaffiliated firms (for example see Faccio et al. (2001) and Gopalan et al. (2014) as international studies and Manos et al. (2012) for the specific case of India). To compare the amount of dividends paid by group firms and stand alone firms, we estimate the variants of the following regression:

$$adj\ Dividend/EBIT_{j,t} = \alpha + \beta_1 Group_j + \gamma X_{i,t} + T_t + \epsilon_{i,t}$$

and report the results in Table 11. Following Faccio et al. (2001) we use industry-adjusted values of payout ratio. In some specifications we use un-

adjusted values and instead of that we include industry×time fixed effects. Since about 25% of firms which have dividend data reported 0 payout, to make sure our results are not driven by these observations, in columns 5, 7, and 9 we drop these firm-years and estimate the regression model only on the remaining observations. The positive and highly significant coefficient of *Group* variable determines that in line with consensus findings of the literature, Iranian group members pay significantly higher amounts of dividend than stand alone firms (about 10% more).

taking a similar approach to Gopalan et al. (2014), who show that higher dividends paid by group members can be explained by the amount of investments taken by other firms in the same group, we examine whether dividends paid by Iranian group affiliated firms are determined (partly) by the cash flows of other firms in the same group. Our hypothesis is that if dividends paid by group members is a tool in the hands of group's ultimate owner to help ICM work, when firms in the *Up* subgroup make more profit and therefore they are less dependent on the dividends gathered from other firms in the group (where they own a significant part of their shares), group firms can pay less dividends and can keep their cash flows inside the company and use them in financing their investment projects. If this hypothesis is true, our main finding of sensitivity of the group members investments to the cash flows of firms located in the *Up* subgroup will become more valid.

Table 12 reports the result of testing this hypothesis. As we see in the first row of the table, when *Up* firms make more profit, group members pay relatively less dividend and thus, can finance more investment projects.

Table 11: This table reports the empirical results of comparing dividend payouts of group members and stand alone firms. The dependent variable is the industry-adjusted payout ratio in most specifications. In columns 5, 7, and 9 we drop zero payout observations to rule out the possibility that these observations carry our main results. Firm and year fixed effects are included when we use industry-adjusted payout ratio as dependent variable. In columns 6 and 7 in which we use payout ratio as dependent variable, we include Industry×fixed effects. All standard errors are clustered at the firm level. All financial companies have been prevented to be used in the firm dimension of the panel. For variables' definitions see Appendix A.

	(1) $\frac{Dividend}{EBIT}$	(2) $\frac{Dividend}{EBIT}$	(3) $\frac{Dividend}{EBIT}$	(4) $\frac{Dividend}{EBIT}$	$dividend > 0$ $\frac{Dividend}{EBIT}$	(6) $\frac{Dividend}{EBIT}$	$dividend > 0$ $\frac{Dividend}{EBIT}$	(8) adj $\frac{Dividend}{EBIT}$	$dividend > 0$ adj $\frac{Dividend}{EBIT}$
Group	0.101***	0.0723***	0.0729***	0.0750***	0.104***	0.0755***	0.0984***	0.0843***	0.115***
	(3.46)	(3.07)	(3.04)	(3.36)	(4.07)	(3.18)	(3.46)	(3.26)	(3.84)
EBIT/Asset		1.624***	1.604***	0.979***	0.281*	1.076***	0.361*	1.112***	0.349*
		(18.02)	(16.25)	(8.55)	(1.77)	(8.63)	(1.95)	(8.45)	(1.86)
Own Q			0.0294	0.0469**	0.0688**	0.0609**	0.0904***	0.0445*	0.0679**
			(1.29)	(2.03)	(2.41)	(2.39)	(2.68)	(1.71)	(2.05)
Lag(Sale Growth)				-0.0151	-0.0167	-0.0144	-0.0263	-0.0296*	-0.0357
				(-1.00)	(-0.72)	(-0.83)	(-0.93)	(-1.68)	(-1.34)
Investment/Asset				-0.0231	-0.265	-0.0630	-0.153	-0.0886	-0.237
				(-0.07)	(-0.77)	(-0.19)	(-0.40)	(-0.23)	(-0.55)
Log(Size)				0.105***	0.0998***	0.101***	0.0965***	0.115***	0.109***
				(6.22)	(4.69)	(5.77)	(4.22)	(5.71)	(4.28)
Debt Ratio				-0.492***	-0.497***	-0.515***	-0.525***	-0.578***	-0.606***
				(-7.82)	(-5.37)	(-7.70)	(-5.15)	(-8.07)	(-5.65)
Constant	0.133**	-0.0458	-0.0805**	0.0516	0.0833	0.216***	0.248***	-0.188*	-0.152
	(2.31)	(-1.55)	(-2.22)	(0.83)	(1.04)	(2.87)	(2.61)	(-1.78)	(-1.18)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Industry×Times FE	No	No	No	No	No	Yes	Yes	No	No
Observations	1883	1847	1754	1636	1183	1636	1183	1610	1161
R^2	0.180	0.352	0.361	0.447	0.327	0.504	0.413	0.363	0.322

Table 12: This table presents the empirical results of testing the dependency of group members payouts on the level of *Up* firms cash flows. The dependent variable is the industry-adjusted payout ratio. Firm and year fixed effects are included in all specifications and all standard errors are clustered at the firm level. All financial companies are prevented to be used in the firm dimension of the panel. For variables' definitions see Appendix A.

	(1) adj$\frac{Dividend}{EBIT}$	(2) adj$\frac{Dividend}{EBIT}$	(3) adj$\frac{Dividend}{EBIT}$	(4) adj$\frac{Dividend}{EBIT}$	(5) adj$\frac{Dividend}{EBIT}$
Up Cash Flow/Up Asset	-0.596**		-0.571*	-0.618**	-0.510*
	(-2.21)		(-1.92)	(-2.10)	(-1.67)
Down Cash Flow/Down Asset		-0.329	-0.0825	-0.126	-0.183
		(-1.18)	(-0.26)	(-0.39)	(-0.56)
EBIT/Asset				0.219	0.249
				(0.83)	(0.95)
Own Q					-0.0331
					(-0.45)
Up Q					-0.0981
					(-1.23)
Down Q					0.0346
					(0.34)
Lag(Sale Growth)	-0.0156	-0.00567	-0.0125	-0.0205	-0.0196
	(-0.54)	(-0.19)	(-0.43)	(-0.68)	(-0.63)
Investment/Asset	0.654	0.659	0.773	0.687	0.744
	(0.72)	(0.74)	(0.84)	(0.74)	(0.80)
Log(Size)	-0.0855	-0.0795	-0.0922	-0.103	-0.0505
	(-1.31)	(-1.20)	(-1.41)	(-1.61)	(-0.44)
Debt Ratio	-0.206	-0.188	-0.208	-0.185	-0.178
	(-1.29)	(-1.17)	(-1.28)	(-1.11)	(-1.03)
Constant	0.544***	0.486***	0.566***	0.559***	0.542**
	(2.98)	(2.78)	(3.12)	(3.09)	(2.38)
Firm FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	595	626	585	585	581
R^2	0.056	0.034	0.058	0.060	0.065

6.2.2 Other Mechanisms

In addition to firms' dividend policies, there may be some other channels through which ICM works in Iranian business groups. Our real world ob-

servations mostly point out to three other channels: transactions of stocks between firms in the same group (mostly stocks of firms outside the group), buying or selling blocks of stocks of another firm in the same group on premium or on discount, and capital increase incidents. Gathering sufficient data to empirically test these channels is not straight forward and thus, we postpone presenting the results of these examinations to the future.

7 Conclusion

In this paper we study the internal capital markets (ICMs) within Iran's business groups. We use a unique hand-collected ownership data and two different algorithms to identify Iranian business groups and in the first step show that investment-cash flow sensitivity is significantly lower for group members compared to independent firms. This finding can be construed as the substituting role of business groups in alleviating members' financial constraints. In the next step, we investigate whether the cash flow of other firms in the same group affect group members investments or not. Our results provide strong evidence in support of the working of an efficient ICM: the investment of group members with higher growth prospects (firm in the lower half of the group structure) are affected by the cash flow of other firms in the same group which are greater in size, more mature, more central, have lower growth opportunities, and possibly have easier access to external financing. The direction of sensitivity we report is the exact opposite of what tunneling hypothesis implies and supports the efficient ICM hypothesis. When we examine different channels through which these interconnectedness can be explained, we find that dividend policy is an important mechanism.

It worth pointing out that our results can not rule out all kinds of tunneling. We only claim that in the context of sensitivity of group members' investments to the cash flow of other firms in the same group, there is no

significant trace of tunneling and what we find supports only the (efficient) ICM hypothesis.

References

Almeida, H., Kim, C.-S., and Kim, H. B. (2015). Internal capital markets in business groups: Evidence from the asian financial crisis. *The Journal of Finance*, 70(6):2539–2586.

Almeida, H., Park, S. Y., Subrahmanyam, M. G., and Wolfenzon, D. (2011). The structure and formation of business groups: Evidence from korean chaebols. *Journal of Financial Economics*, 99(2):447–475.

Almeida, H. V. and Wolfenzon, D. (2006). A theory of pyramidal ownership and family business groups. *The journal of finance*, 61(6):2637–2680.

Aminadav, G., Bachrach, Y., Kosenko, K., Rosenschein, J. S., and Wilf, Y. (2011). Rebuilding the great pyramids: A method for identifying control relations in complex ownership structures. *Available at SSRN 1903941*.

Aminadav, G. and Papaioannou, E. (2020). Corporate control around the world. *The Journal of Finance*.

Asker, J., Farre-Mensa, J., and Ljungqvist, A. (2015). Corporate investment and stock market listing: A puzzle? *The Review of Financial Studies*, 28(2):342–390.

Bae, K.-H., Kang, J.-K., and Kim, J.-M. (2002). Tunneling or value added? evidence from mergers by korean business groups. *The journal of finance*, 57(6):2695–2740.

Baek, J.-S., Kang, J.-K., and Lee, I. (2006). Business groups and tunneling: Evidence from private securities offerings by korean chaebols. *The Journal of Finance*, 61(5):2415–2449.

Barua, R., Chakravarty, S. R., and Roy, S. (2005). Measuring power in weighted majority games.

Bertrand, M., Mehta, P., and Mullainathan, S. (2002). Ferreting out tunneling: An application to indian business groups. *The Quarterly Journal of Economics*, 117(1):121–148.

Boutin, X., Cestone, G., Fumagalli, C., Pica, G., and Serrano-Velarde, N. (2013). The deep-pocket effect of internal capital markets. *Journal of Financial Economics*, 109(1):122–145.

Buchuk, D., Larrain, B., Muñoz, F., and Urzúa, F. (2014). The internal capital markets of business groups: Evidence from intra-group loans. *Journal of Financial Economics*, 112(2):190–212.

Buchuk, D., Larrain, B., Prem, M., and Urzúa Infante, F. (2020). How do internal capital markets work? evidence from the great recession. *Review of Finance*, 24(4):847–889.

Chang, S. J. and Hong, J. (2000). Economic performance of group-affiliated companies in korea: Intragroup resource sharing and internal business transactions. *Academy of Management journal*, 43(3):429–448.

Claessens, S., Djankov, S., and Lang, L. H. (2000). The separation of ownership and control in east asian corporations. *Journal of financial Economics*, 58(1-2):81–112.

England, D. and Mikaelsson, E. (2018). Effects of inflation adjustments on ifrs financial reporting in brazil:-a comparative study of nine companies for the accounting years of 2015 and 2016.

Faccio, M. and Lang, L. H. (2002). The ultimate ownership of western european corporations. *Journal of financial economics*, 65(3):365–395.

Faccio, M., Lang, L. H., and Young, L. (2001). Dividends and expropriation. *American economic review*, 91(1):54–78.

Farajpour, M., Fatemi, S. F., and Ebrahimnejad, A. (2019). Firm interlock and stock price synchronicity: Evidence from the tehran stock exchange. *Financial Research Journal*, 21(1):35–58.

Ferris, S. P., Kim, K. A., and Kitsabunnarat, P. (2003). The costs (and benefits?) of diversified business groups: The case of korean chaebols. *Journal of Banking & Finance*, 27(2):251–273.

George, R. and Kabir, R. (2008). Business groups and profit redistribution: a boon or bane for firms? *Journal of Business Research*, 61(9):1004–1014.

Gopalan, R., Nanda, V., and Seru, A. (2007). Affiliated firms and financial support: Evidence from indian business groups. *Journal of Financial Economics*, 86(3):759–795.

Gopalan, R., Nanda, V., and Seru, A. (2014). Internal capital market and dividend policies: Evidence from business groups. *The Review of Financial Studies*, 27(4):1102–1142.

Goyal, A., Jategaonkar, S. P., and Muckley, C. B. (2020). Why do privatized firms pay higher dividends? *Journal of Corporate Finance*, 60:101493.

Harris, K. (2013). The rise of the subcontractor state: politics of pseudo-privatization in the islamic republic of iran. *International Journal of Middle East Studies*, pages 45–70.

Harris, K. and Kalb, Z. (2019). Pen to the tiller: Land reform and social mobility across the 1979 iranian revolution. *Journal of Agrarian Change*, 19(3):465–486.

Hoshi, T., Kashyap, A., and Scharfstein, D. (1990). The role of banks in reducing the costs of financial distress in japan. *Journal of financial economics*, 27(1):67–88.

Jiang, G., Lee, C. M., and Yue, H. (2010). Tunneling through intercorporate loans: The china experience. *Journal of financial economics*, 98(1):1–20.

Kali, R. and Sarkar, J. (2011). Diversification and tunneling: Evidence from indian business groups. *Journal of Comparative Economics*, 39(3):349–367.

Kandel, E., Kosenko, K., Morck, R., and Yafeh, Y. (2019). The great pyramids of america: A revised history of us business groups, corporate ownership, and regulation, 1926–1950. *Strategic Management Journal*, 40(5):781–808.

Khanna, T. and Palepu, K. (2000). Is group affiliation profitable in emerging markets? an analysis of diversified indian business groups. *The journal of finance*, 55(2):867–891.

Khanna, T. and Yafeh, Y. (2007). Business groups in emerging markets: Paragons or. *Statistics*, 78:214–220.

La Porta, R., Lopez-de Silanes, F., and Shleifer, A. (1999). Corporate ownership around the world. *The journal of finance*, 54(2):471–517.

La Porta, R., Lopez-de Silanes, F., Shleifer, A., and Vishny, R. W. (1997). Legal determinants of external finance. *The journal of finance*, 52(3):1131–1150.

Lee, S., Park, K., and Shin, H.-H. (2009). Disappearing internal capital markets: Evidence from diversified business groups in korea. *Journal of Banking & Finance*, 33(2):326–334.

Lemmon, M. L. and Lins, K. V. (2003). Ownership structure, corporate governance, and firm value: Evidence from the east asian financial crisis. *The journal of finance*, 58(4):1445–1468.

Lensink, R., Van der Molen, R., and Gangopadhyay, S. (2003). Business groups, financing constraints and investment: The case of india. *The Journal of Development Studies*, 40(2):93–119.

Lin, C., Ma, Y., Malatesta, P., and Xuan, Y. (2011). Ownership structure and the cost of corporate borrowing. *Journal of Financial Economics*, 100(1):1–23.

Manos, R., Murinde, V., and Green, C. J. (2012). Dividend policy and business groups: Evidence from indian firms. *International Review of Economics & Finance*, 21(1):42–56.

Masulis, R. W., Pham, P. K., and Zein, J. (2011). Family business groups around the world: Financing advantages, control motivations, and organizational choices. *The Review of Financial Studies*, 24(11):3556–3600.

Morck, R., Wolfenzon, D., and Yeung, B. (2005). Corporate governance, economic entrenchment, and growth. *Journal of economic literature*, 43(3):655–720.

Parker, J. E. (1977). Impact of price-level accounting. *Accounting Review*, pages 69–96.

Santioni, R., Schiantarelli, F., and Strahan, P. E. (2020). Internal capital markets in times of crisis: The benefit of group affiliation. *Review of Finance*, 24(4):773–811.

Shapley, L. S. and Shubik, M. (1954). A method for evaluating the distribution of power in a committee system. *The American Political Science Review*, 48(3):787–792.

Shin, H.-H. and Park, Y. S. (1999). Financing constraints and internal capital markets: Evidence from koreanchaebols'. *Journal of corporate finance*, 5(2):169–191.

Appendix A: Variables Definitions

The variables we use in empirical analysis are defined as follows: *Asset*: Inflation adjusted book value of total assets at the beginning of the year

Investment: Purchase of fixed assets

Own Cash Flow: Earnings before interest and taxe (EBIT)

Own Q: (Firm's market value of outstanding shares + Book value of total debt) / (*Asset*) at the beginning of the year

Log(Size): The logarithm of the firm's market value of outstanding shares at the beginning of the year

Sale Growth: change in sales from the year t-2 to year t-1 divided by sales of year t-2

Debt Ratio: Ratio of the firm's book value of total debt over book value of total assets

Group: A dummy that takes 1 for group firms and 0 for stand-alone firms

Group Cash Flow: The sum of *Own Cash Flow* for all other firms affiliated with the same group

Group Asset: The sum of *Asset* for all other firms affiliated with the same group

Group Q: (Other group firms' market value of outstanding shares + other group firms' book value of total debt)/ (*Group Asset*) at the beginning of the year

Up Cash Flow: The sum of *Own Cash Flow* for all other firms affiliated with the same group and positioned in the upper half of the group (based on *position* metric)

Up Asset: The sum of *Asset* for all other firms affiliated with the same group and positioned in the upper half of the group (based on position metric)

Up Q: (Other *Up* firms' market value of outstanding shares + other *Up* firms' book value of total debt)/ (*Up Asset*) at the beginning of the year

Down Cash Flow: The sum of *Own Cash Flow* for all other firms affiliated with the same group and positioned in the lower half of the group (based on *position* metric)

Down Asset: The sum of *Asset* for all other firms affiliated with the same group and positioned in the lower half of the group (based on *position* metric)

Down Q: (Other *Down* firms' market value of outstanding shares + other *Down* firms' book value of total debt)/ (*Down Asset*) at the beginning of the year

cfr: Cash flow right of the group's ultimate owner; calculated based on Almeida et al. (2011)

cr: Control (voting) right of the group's ultimate owner; calculated based on Almeida et al. (2011)

position: The distance between group's ultimate owner and a firm in the group; calculated based on Almeida et al. (2011)

centrality: "The average drop in voting rights when a firm's votes are not taken into account to compute control right for the other group firms"; calculated based on Almeida et al. (2011)

Appendix B: Inflation Adjustment of Book Value of Assets

Iran's chronic high inflation seriously affects stock values in firm's balance sheets and makes the book values move away from true market values. Since Data on firms' assets plays an important role throughout all our empirical analysis, if we use raw (un-adjusted) data, it will severely vitiate our analysis. To avoid these harms, we try to adjust book values of assets with general-price changes.

As the first step of the process, we gathered data on firms' revaluation incidents. We assume that firms' reported asset values are equal to the market values at the year in which revaluation occurs. For each year of our empirical analysis, we calculate the market value of assets by adjusting book values by general-price index. Parker (1977) make adjustments using general purchasing power of the dollar (GNP deflator index) and England and Mikaelsson (2018) employs Consumer Price Index (CPI). Concerning more accuracy of Iran's reported CPI, Like England and Mikaelsson (2018) we use that to calculate inflation.

We illustrate our adjustment process using a simple example. Assume firm i's last revaluation before our period of study (2014 to 2018) was in 2013 and it reported the value of it's assets equal to 100 in it's annual financial report. Thus, we assume that the market value of firm i's assets at the end of year 2013 has been equal to 100. Assume Firm i reports it's asset values in years 2014 to 2018 equal to 200, 300, 400, 500, and 600, respectively. Indeed assume that annual inflation was 16%, 12%, 10%, 10%, and 26% on years 2014 to 2018. To calculate the estimated market value of assets at the end of year 2014, we multiply the market value of assets at 2013 to 1 plus year 2013's inflation and then add the value of assets that were acquired during the year; $100 \times (1 + 0.16) + (200 - 100) = 216$. If we continue in this way, the estimated market value of assets at the end of 2015 is $100 \times (1 + 0.16) \times (1 + 0.12) + (200 - 100) \times (1 + 0.12) + (300 - 200) = 341$. In a similar way we can compute the estimated market values of assets in the following years. Note that if firm i has experienced a revaluation in intermediary years, we set the market value of assets for that year equal to the reported book value and for the following years we act as before.

Tables 13 reports the yearly number of revaluation incidents of Iranian listed firms since 2011 to 2018 and Figure 4 depicts the distribution of adjusted assets to un-adjusted assets. As we see in the figure, because of high levels

of inflation, adjusting has a significant effect on the firms' value of assets.

Table 13: This tables shows the yearly number of revaluation incidents of Iranian listed firms since 2011 t0 2017.

year	2011	2012	2013	2014	2015	2016	2017	2018
no. of revaluation incidents	0	4	23	17	24	17	0	25

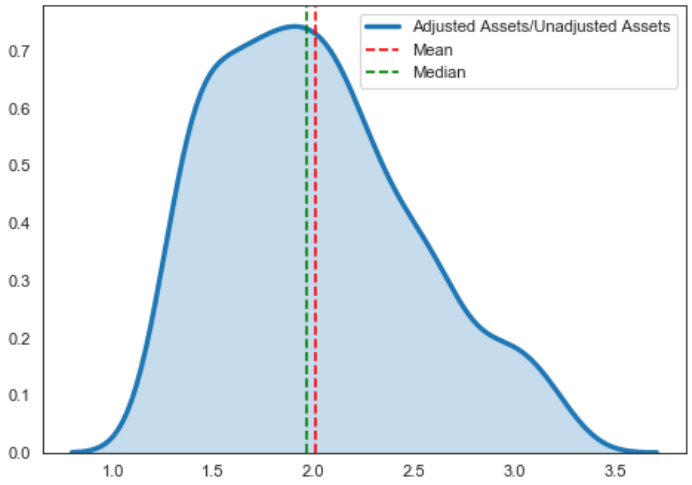

Figure 4: The distribution of adjusted to un-adjusted assets

Appendix C: Details of Grouping Methods

We go into the details of the two grouping methods in the framework of a simple example. Suppose Figure 5 shows the whole structure of Iranian firms; there are only 7 firms (listed and unlisted) with the depicted ownership relations (note that A can be a firm or a person or a family). We are going to find groups in this structure. Based on Almeida et al. (2011) (the control thresholds method), a firm is controlled by an ultimate owner, if the sum of ultimate owners' direct control right in that firm and the direct control rights

of the ultimate owners' subsidiaries in that firm exceeds a predetermined threshold; here 40%. Bearing this definition in mind, we proceed step by step to identify groups within this hypothetical ownership structure.

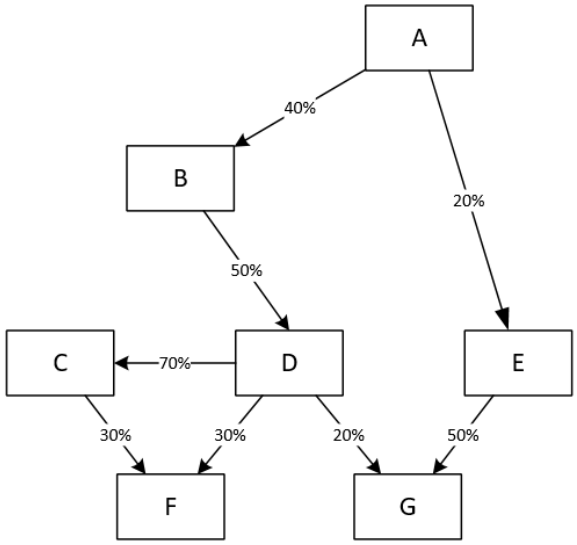

Figure 5: The hypothetical structure of Iranian firms

step 1: For each firm we investigate whether each of it's direct shareholders' stake in that firm exceeds the threshold of 40% or not. If that firm has such a shareholder, we pass the control of that firm to that shareholder and call that shareholder the controller of that firm. The status of controlling pattern at the end of the first step will be like the following table:

firm:	A	B	C	D	E	F	G
controller:	-	A	D	B	-	-	E

step 2: In this step, we repeatedly update the shareholders of firms (replace them with their controlling owners) until reaching a stable structure. In the above example, since A is the controller of B and B is the controller of D, we conclude that D is controlled by A. Furthermore, because D is the controller

of C, we conclude that C is controlled by A. We also characterize E as the controller of G. Furthermore, since both C and D are controlled by A, if we replace them with A and sum up their voting rights in F, we see that A has voting right of 60% (30% + 30%) in F and thus, A is the controller of F, indeed. If we repeat the process one more step, there will be no change in the controlling pattern of firms in this structure. The following table shows the final status of this structure in terms of distinct identified groups:

firm:	A	B	C	D	E	F	G
controller:	-	A	A	A	-	A	E

As depicted in Figure 5, this hypothetical structure can be splited into two different groups. If we apply the Kandel et al. (2019)'s condition of having at least three listed firms, we will have only one group consisting of firms A (the ultimate owner), B, C, D, and F and two stand alone firms (firms E and G); As shown in Figure 6.

The second method of grouping follows the same logic; more or less. The only difference lies in the decision rule: to assign the control of a firm to one of it's predecessors (if such a controlling predecessor exists at all), instead of checking whether the sum of direct and indirect voting rights of the predecessor exceeds the threshold of 40%, we should check that whether the *SSI* of that predecessor can meet the minimum level of 0.75 or not. All other things are similar to the explained procedure.

Just to show the process of calculating *SSI* for each firm's shareholders, consider the firm A which has 4 shareholders; S1, S2, and S3 with the voting rights shown in figure 7.

To calculate the *SSI* for each shareholders S1 to S3, in the first step we should consider all sequential coalitions; where all players all listed in an order determined by the order they have joined the coalition. For example the coalition <S1, S2, S3> means that S1 joins the coalition first, then S2,

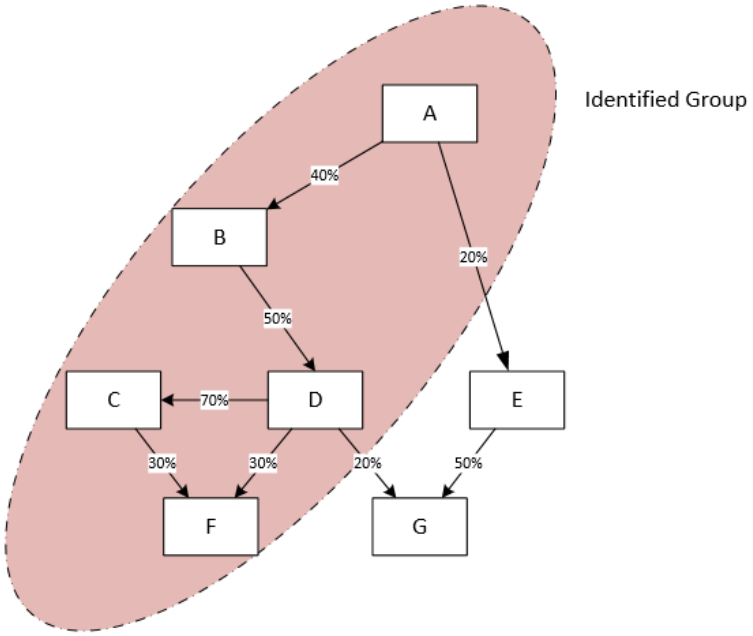

Figure 6: This figure depicts the identified group of the hypothetical structure

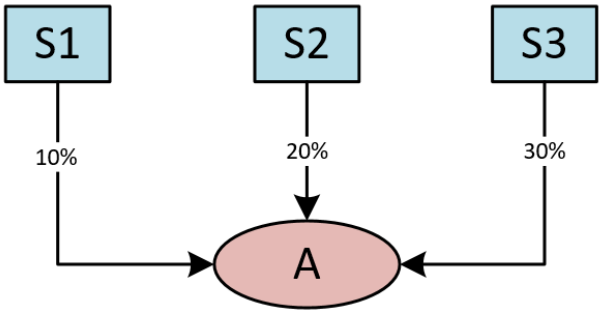

Figure 7: A hypothetical firm with it's shareholders

and the final joiner is S3. The next step is identifying the pivotal player in each sequential coalition (the pivotal player is a player whose vote makes a coalition win). Then, we should count how many of times each player is identified as pivotal. In the final step, the *SSI* is calculated by dividing these counts by the total number of possible sequential coalitions.

considering the weighted voting system represented in figure 7, the list of all possible sequential coalitions and pivotal player in each coalition (bold

player) would be:

<S1, S2, **S3**> <S1, **S3**, S2> <S2, S1, **S3**>

<S2, **S3**, S1> <S3, **S1**, S2> <S3, **S2**, S1>

Note that when we have 3 players, the number of all possible sequential coalitions are $3! = 6$.

As we see, out of all 6 possible sequential coalitions, each of S1 and S2 is pivotal one time and S3 is pivotal four times. Thus, the *SSI* is $\frac{1}{6}$ for shareholders S1 and S2 and $\frac{4}{6}$ for shareholder S3. Since the power index of shareholder S3 is less than the minimum requirement of 75%, Thus, we say that firm A has no controlling owner.