Connected Stocks: Evidence from Iran

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Abstract

We connect stocks by their common blockholders. We introduce a measure that captures the extent to which distribution of joint holders. A vital feature of the measure is allowing the joint ownership distributions to affect the measure. After that, We show that the degree of shared ownership that crosses a threshold forecasts return correlation, controlling for exposure to systematic return factors and other pair characteristics. We study this effect in business groups and find that being in the same business group significantly affects comovement. Further investigations explain that comovement increases when a bank is a business group's ultimate owner.

Keywords: Asset management; Institutional investors; Return comovement; Common ownership; Indexing

JEL Classifications: G10; G11; G23

1 Introduction

- Table 10 :
  - Common ownership increases co-movement
  - The effect is stronger for pairs that are in the same business groups
- Table 12:
  - For all the pairs, same business groups have an greater effect on co-movement.
  - Common ownership increases co-movement for the pairs in the same business group

2 Data and Methodology

2.1 Data and Sample

We gathered industries index and stock returns, trading volume, and other relevant market and accounting data from the Codal website [1] and the Tehran Securities Exchange Technology Management Co (TSETMC)[2] database. We also use our unique data set, including the daily ownership table that reports all end-of-the-days block-holders of listed firms with their changes in that day. Block-holder is a shareholder who owns at least 1% of the total shares outstanding.

We exclude ETFs from our listed firms because it has a different return and ownership patterns compared to other firms in our study. We restrict

[1] www.codal.ir

[2] www.tsetmc.com

our empirical analysis to 2015/03-2020/03(1394/01-1398/12 Persian calendar) due to the availability of daily ownership data and the special events [3] that happened after 2020/03, which may affect our results.

Business groups - groups of listed firms with interconnected ownership structures controlled by an ultimate common owner - are the principal organizational structure in many parts of the world. Business groups seem to be a central feature of corporate ownership in Iran. Most Iranian listed firms present in a complex interlinked shareholders' network that an ultimate owner governs this group through many layers of ownership.Aliabadi et al. (2021) We do not have pre-specified Iranian business groups despite other countries like South Korea, Japan, and India that their groups are announced formally. For defining business groups, we use data provided by Aliabadi et al. (2021). They use Almeida et al. (2011) algorithm with a 40% threshold for defining groups.

Table 1 reports summary statistics of ownership data and business groups. As shown in the table, 494 firms on average have five block-holders that own 73 percent of them. There are 43 business groups on average, with seven members which own 314 (63%) firms.

2.2 Pair composition

If two firms have at least one common block-holder, We consider them as a pair. By this definition, there are 9336 unique pairs in entire periods, which is 18% of possible pairs (597*596/2 = 177906). As we expected, stocks in pairs have concentrated ownership relative to the total sample, and pairs

[3]The Tehran Stock Exchange's main index (TEPIX) raised exponentially to quadruple value and then fell sharply due to the gigantic entrance of new individual investors that seems to be a bubble period from that period.

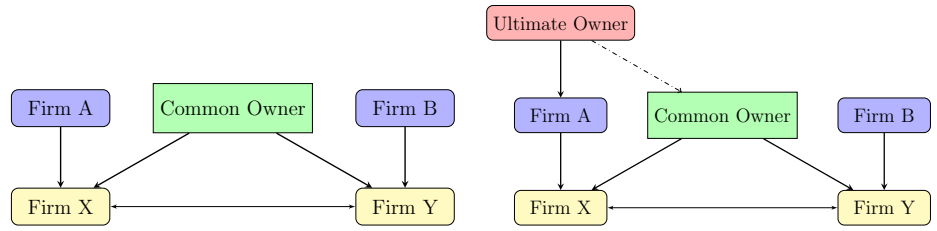
Table 1: This table reports summary statistics of ownership features for all the listed firms. At this table by group, we mean business groups.

Year	1393	1394	1395	1396	1397	1398
No. of Firms	365	376	447	552	587	618
No. of Blockholders	777	803	984	1297	1454	1458
No. of Groups	38	41	43	44	40	43
No. of Firms not in Groups	116	108	147	216	241	243
No. of Firms in Groups	249	268	300	336	346	375
Mean Number of Members	7	7	7	8	9	9
Med. of Number of Members	5	5	5	6	6	5
Mean Of each Blockholder's ownership	21	22	22	21	22	23
Med. of Owners' Percent	7	8	8	8	8	9
Mean Number of Owners	5	5	5	5	5	5
Med. Number of Owners	4	4	4	4	5	4
Mean Block. Ownership	76	77	75	75	75	71
Med. Block. Ownership	82	82	81	80	80	77

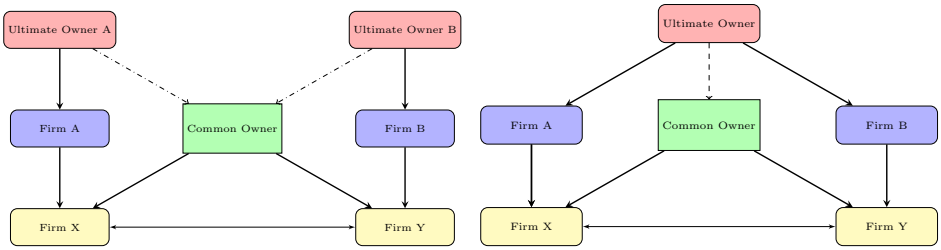
have one common owner.

As one of our empirical studies, we study the impact of being in the same business group relative to being in two distinct groups on pair's correlation. (Further explanations about business groups are in section 2.6) For assigning one pair to a group, both firms should belong to one ultimate owner. Another possibility is that each firm belongs to a different ultimate owner or one of them, or both of them do not belong to any groups, which all of them illustrated in figure 1. By classifying pairs, on average, 15% of them belong to one business group, and 74% of them are not in the same business groups each year. We report summary statistics of ownership features for all pairs in table 2.

Figure 1: Three categories for pairs base on being in business groups



(a) Pair not in the business group



(b) Pair in two distinct business group

(c) Pair in the same business group

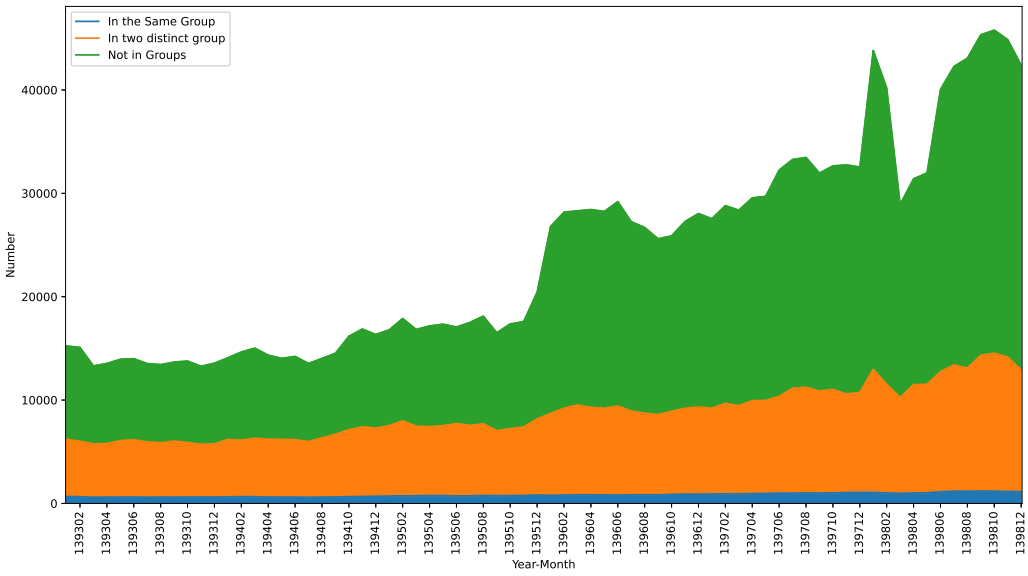
Figure 2 shows the time series of unique pairs' number in each month. The pattern shows that the portion of pairs that are in one business group

Table 2: This table reports summary statistics of ownership features for total pairs. At this table by group, we mean business groups.

year	1393	1394	1395	1396	1397	1398
No. of Pairs	20876	21187	27784	41449	47234	67232
No. of Groups	37	40	42	43	39	43
No. of Pairs not in Groups	11452	11192	15351	26530	29182	43433
Number of Pairs not in the same Group	7962	8731	10971	12916	15366	20745
Number of Pairs in the same Group	923	955	1099	1260	1536	1774
Mean Number of Common owner	1	1	1	1	1	1
Med. Number of Common owner	1	1	1	1	1	1
Mean Percent of each blockholder	19	19	19	19	19	20
Med. Percent of each blockholder	13	12	12	12	12	14
Mean Number of Pairs in one Group	31	30	30	34	39	44
Med. Number of Pairs in one Group	8	10	8	10	9	10
Mean Number of Owners	5	5	5	5	4	5
Med. Number of Owners	5	5	5	5	4	5
Mean Block. Ownership	73	73	72	70	70	70
Med. Block. Ownership	73	73	73	71	71	71

is roughly stable. The number of pairs in each period is between 322 to 5101 pairs which, on average, there are 4325 pairs.

Figure 2: The number of unique pairs in each month



2.3 Stock Return comovement

We calculate the monthly correlation of each pair from stocks' daily abnormal returns. Benchmark for calculating abnormal return is the following equation which is a four-factor model plus industry return due to the importance of industries on stocks' return in the Tehran stock exchange (TSE) :

$$\begin{aligned} R_{i,t} = \alpha_i + \beta_{mkt,i} R_{M,t} + \beta_{Ind,i} R_{Ind,t} + \\ + \beta_{HML,i} HML_t + \beta_{SMB,i} SMB_t + \beta_{UMD,i} UMD_t + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where $R_{i,t}$, $R_{M,t}$ and $R_{Ind,t}$ are excess daily return of respectivly firm, market and firm's industry from bank deposit's daily rate(risk free). Other variabales difinition is base on Carhart four-factor model [Carhart (1997)].

At the end of each month, we estimate our benchmark model base on the past three-month period (from two months before the end of the preceding month) and measure daily residuals. After that, we calculate the monthly correlation of daily residuals during that month for the pair.

We use other benchmarks for calculating a monthly correlation and report its summary in table 3. As we expected, models that include industry returns remove pairs' correlation. According to the results, it seems that our selected benchmark (4 Factor + Industry) almost captures all the pairs' comovement because it is nearly a zero mean variable. We use these correlations for our analysis.

Table 3: This table reports distribution of calculated correlation base on different models.

	mean	std	min	25%	50%	75%	max
CAPM + Industry	0.021	0.200	-1.0	-0.047	0.016	0.084	1.0
4 Factor	0.032	0.202	-1.0	-0.040	0.025	0.096	1.0
4 Factor + Industry	0.016	0.199	-1.0	-0.051	0.010	0.076	1.0
4 Factor + Industry (With Lag)	0.015	0.198	-1.0	-0.051	0.010	0.076	1.0

2.4 Controls

We are interested in the effects of common ownership on pair's comovement. Our prediction of a higher correlation for a higher level of common ownership dominates by stocks' intrinsic similarity, and these similarities motivate block-holders to hold these stocks simultaneously. These related stocks will comove regardless of who owns them.

The first group of controls is pair controls. These controls include a dummy variable for whether two stocks are in the same industry, **SameIndustry**; a dummy variable for whether two stocks are in the same business

group, **SameGroup**. As shown in table 4, 10% and 6% of pairs are in the same industry and business group. Furthermore, we control for cross-ownership between two stocks and define **CrossOwnership** as the maximum percent of cross-ownership between two firms in the following month.

Table 4: This table reports the number of pairs in the same industry and business group.

	Yes	No
SameIndustry	753806	12422942
	(5.7%)	(94.3%)
SameGroup	304444	4508062
	(6.3%)	(93.7%)
SameGroup & SameIndustry	115536	13176748
	(0.9%)	(99.1%)

Another group of controls are firm-specific controls. We define these variables base on Anton and Polk (2014) methodology. One of these is size control based on the normalized rank-transform of the percentile market capitalization of the two stocks, **Size1** and **Size2** (where we label the larger stock in the pair as the first stock). The other one is a book to market ratio based on the normalized rank-transform of the percentile book to market of the two stocks, **BookToMarket1** and **BookToMarket2**. We also control these characteristics on a pair level. Our measures of similarity, **SameSize**, and **SameBookToMarket**, are the negative of the absolute difference in percentile ranking for a particular characteristic across a pair.

We calculate our controls daily and then report the average of these variables for the entire period at the end of each month. Table 5 shows the summary statistics of specified controls in this section.

Table 5: This table shows the summary statistics of specified controls in empirical studies.

	mean	std	min	25%	50%	75%	max
sgroup	0.06	0.23	0.00	0.00	0.00	0.00	1.00
sBgroup	0.06	0.24	0.00	0.00	0.00	0.00	1.00
Monthlysize1	0.58	0.23	0.01	0.40	0.58	0.77	1.00
Monthlysize2	0.30	0.20	0.00	0.13	0.25	0.41	0.99
MonthlySameSize	-0.29	0.20	-0.97	-0.41	-0.24	-0.13	-0.00
MonthlyB/M1	0.54	0.25	0.00	0.36	0.57	0.75	1.00
MonthlyB/M2	0.55	0.24	0.00	0.36	0.56	0.75	1.00
MonthlySameB/M	-0.32	0.20	-0.99	-0.44	-0.27	-0.16	-0.00
MonthlyCrossOwnership	0.14	2.59	0.00	0.00	0.00	0.00	95.77

2.5 Measurement of cross-ownership

In table 6 we summarize common ownership measurements which are used in literature. There are two groups of measurement for common ownership. First of all, model-based measures that capture common ownership base on a proper model. These measures have a better economic interpretation, but most of them are bi-directional or industry-level measures.(e.g, Harford et al. (2011); Azar et al. (2018); Gilje et al. (2020))

In addition to model-based measures, some ad hoc common ownership measures are used in the empirical literature. There is significant doubt on how these measures capture common ownership's impact on the management, and many of them have unappealing properties.(e.g, Anton and Polk (2014); Azar (2011); Freeman (2019); Hansen and Lott Jr (1996); He and Huang (2017); He et al. (2019); Lewellen and Lowry (2021); Newham et al. (2018))

In our primary analysis, we estimate the impact of common ownership on pair's correlation. For this purpose, we need a pair-level measure with a good economic interpretation that is not bi-directional. As a result, we propose

Table 6: This table summarizes common ownership measurements in the literature.

Group	Paper	measurment	Flaws
Model Based	Harford et al. (2011)	$\sum_{i \in I^{A,B}} \frac{\alpha_{i,B}}{\alpha_{i,A}+\alpha_{i,B}}$	Bi-directional
	Azar et al. (2018)	$\sum_j \sum_k s_j s_k \frac{\sum_i \mu_{ij}\nu_{ik}}{\sum_i \mu_{ij}\nu_{ij}}$	Industry level
	Gilje et al. (2020)	$\sum_{i=1}^{I} \alpha_{i,A} g(\beta_{i,A}) \alpha_{i,B}$	Bi-directional
Ad hoc	He and Huang (2017); He et al. (2019)	$\sum_{i \in I^{A,B}} 1$	invariant to the level of common ownership
	Newham et al. (2018)	$\sum_{i \in I^{A,B}} min\{\alpha_{i,A}, \alpha_{i,B}\}$	?
	Anton and Polk (2014)	$\sum_{i \in I^{A,B}} \alpha_{i,A} \frac{\bar{\nu}_A}{\bar{\nu}_A+\bar{\nu}_B} + \alpha_{i,B} \frac{\bar{\nu}_B}{\bar{\nu}_A+\bar{\nu}_B}$	Invariant to the decomposition of ownership
	Freeman (2019); Hansen and Lott Jr (1996)	$\sum_{i \in I^{A,B}} \alpha_{i,A} \times \sum_{i \in I^{A,B}} \alpha_{i,B}$	? ?

a modification for Anton's measure (Anton and Polk (2014)) that captures the extent of common ownership distribution and apply this measure in this study.

2.5.1 Modified Anton's measure

We reformulate mentioned Anton's measure in table 6. This factor measure common ownership as the total value of stock held by the F common-holders of the two stocks, scaled by the total market capitalization of the two stocks

$$\text{Overlap}_{Sum}(i,j) = \frac{\sum_{f=1}^{F}(S_{i,t}^{f} P_{i,t} + S_{j,t}^{f} P_{j,t})}{S_{i,t} Pi, t + S_{j,t} Pj, t} \tag{2}$$

where $S_{i,t}^{f}$ is the number of shares held by owner f at time t trading at price Pi, t with total shares outstanding of $S_{i,t}$, and similarly for stock j. As shown in equation 2, this measure neglects different distribution of common owners and represents the percent of joint-held market capitalization from the total market capitalization of the two stocks.

We reweight this formula to capture the difference between ownership distribution. Our proposed measures are shown in equation 3 and 4 where

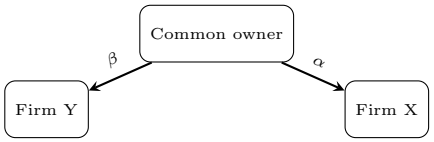
all variables as the same Anton's measure. Both modified measures represent the number of equal percents held block-holder. In other words, If for a pair of stocks with n mutual owners, all owners have even shares of each firm's market cap, then the proposed indexes will be equal to number of holders.[4]

$$\text{Overlap}_{Sqrt}(i,j) = [\frac{\sum_{f=1}^{F}(\sqrt{S_{i,t}^{f}P_{i,t}} + \sqrt{S_{j,t}^{f}P_{j,t}})}{\sqrt{S_{i,t}Pi,t} + \sqrt{S_{j,t}Pj,t}}]^2 \tag{3}$$

$$\text{Overlap}_{Quadratic}(i,j) = [\frac{\sum_{f=1}^{F}[(S_{i,t}^{f}P_{i,t})^2 + (S_{j,t}^{f}P_{j,t})^2]}{(S_{i,t}Pi,t)^2 + (S_{j,t}Pj,t)^2}]^{-1} \tag{4}$$

There are some numeric examples for better comparison. Two firms (X and Y) have one common owner who has α and β from each market capitalization, respectively. (illustrated in figure 3) for better illustration, assume that the sum of holder's ownership equal to 100 percent ($\alpha + \beta = 100$), and two firms' market cap is equal.

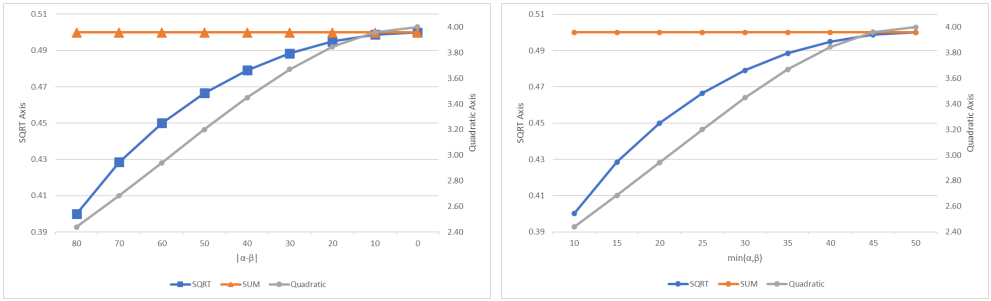
Figure 3: Numeric example 1



We calculate common ownership measures base on equations 2 (Sum), 3 (SQRT), and 4 (Quadratic) for different ownership distributions. Figure 4 reports calculations results. As we expected, Anton's measure is constant at a fixed level of aggregate common ownership, but SQRT and Quadratic vary from concentrated to dispersed ownership. Concentrated ownership (50-50) has a greater common ownership measure than dispersed (10-90).

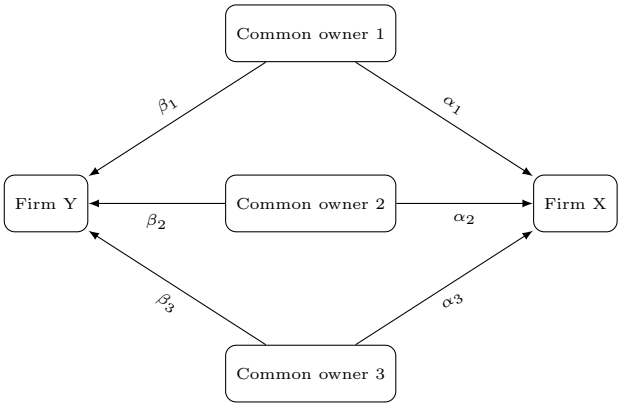
[4] Each holder owns $1/n$ of each firm ,Firm's market cap is α_1 and α_2, So for each holder of firms we have $S_{i,t}^{f}P_{i,t} = \alpha_i/n$
$[\frac{\sum_{f=1}^{n}\sqrt{\alpha_1/n}+\sum_{f=1}^{n}\sqrt{\alpha_2/n}}{\sqrt{\alpha_1}+\sqrt{\alpha_2}}]^2 = [\frac{\sqrt{n}(\sqrt{\alpha_1}+\sqrt{\alpha_2})}{\sqrt{\alpha_1}+\sqrt{\alpha_2}}]^2 = n$
$[\frac{\sum_{f=1}^{n}(\alpha_1/n)^2+\sum_{f=1}^{n}(\alpha_2/n)^2}{\alpha_1^2+\alpha_2{}^2}]^{-1} = [\frac{\alpha_1^2+\alpha_2^2}{n(\alpha_1^2+\alpha_2^2)}]^{-1} = n$

Figure 4: Comparison of three measure for common ownership



Now assume that there are three common owners for the two mentioned firms. First holder's ownership from firm X and Y are respectively α_1 and β_1. It is similar for other holders. (illustrated in figure 5). As before, the firm's market cap is equal. We calculate measures for concentrated or disparate ownership and ownerships that are less than the aggregate of the firm's market cap. Table 7 reports calculation results. For ownerships that consist of total market cap, results are consistent with the first example. Although, when aggregate ownership decreases, the Quadratic measure denotes unrealistic numbers. We conclude that our Quadratic measure is not a good measure for common ownership.

Figure 5: Numeric example 2



A fundamental assumption in previous examples is equality of firms' mar-

Table 7: text

Ownership	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII
α_1	1/3	20	10	20	10	5	1
β_1	1/3	10	10	20	10	5	1
α_2	1/3	10	80	20	10	5	1
β_2	1/3	20	80	20	10	5	1
α_3	1/3	70	10	20	10	5	1
β_3	1/3	70	10	20	10	5	1
SQRT	3	2.56	2.33	1.8	0.9	0.45	0.09
SUM	1	1	1	0.6	0.3	0.15	0.03
Quadratic	3	1.85	1.52	8.33	33.33	133.33	3333.33

ket cap. In the last example, we relax this assumption. Table 8 reports calculated measures for fixed aggregate ownership on different relative market cap ratios. We extend our analysis to higher market cap ratios and report our results in figure 6 and 7. In this setting, the SQRT measure has a better variation relative to Anton's measure.

Figure 6: SQRT measure for fixed aggregate ownership on different relative market cap ratios

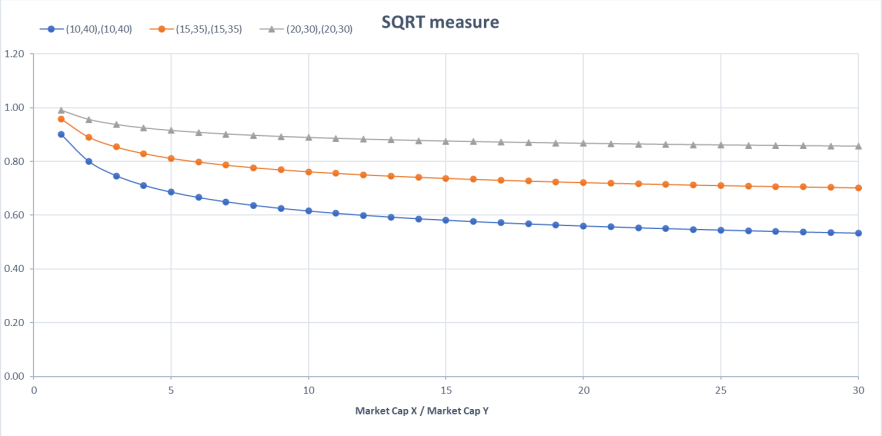


Figure 7: Sum measure for fixed aggregate ownership on different relative market cap ratios

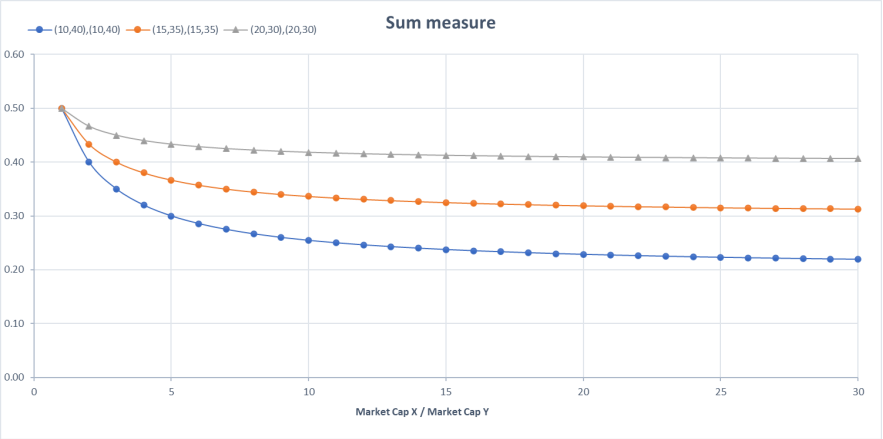


Table 8: text

	$(\alpha_1,\beta_1),(\alpha_2,\beta_2)$					
	(10,40),(10,40)		(15,35),(15,35)		(20,30),(20,30)	
$\frac{\text{MarketCap}_x}{\text{MarketCap}_y}$	SQRT	SUM	SQRT	SUM	SQRT	SUM
1	0.90	0.50	0.96	0.50	0.99	0.50
2	0.80	0.40	0.89	0.43	0.96	0.47
3	0.75	0.35	0.85	0.40	0.94	0.45
4	0.71	0.32	0.83	0.38	0.92	0.44
5	0.69	0.30	0.81	0.37	0.91	0.43
6	0.67	0.29	0.80	0.36	0.91	0.43
7	0.65	0.28	0.79	0.35	0.90	0.43
8	0.64	0.27	0.78	0.34	0.90	0.42
9	0.63	0.26	0.77	0.34	0.89	0.42
10	0.62	0.25	0.76	0.34	0.89	0.42

In conclusion, We use the SQRT measure for our main study. This measure has an acceptable variation within different distributions and relative market caps. Also, it has a fair value at a lower level of aggregate common ownership.

On each day, we measure common ownership by SQRT measure and then report an average of these daily calculations for the entire period at the end of each month. We also calculate Anton's measure in this way. Table 9 report snapshots of the distribution of common ownership measure for both methods. As we expected, the modified measure creates higher values for a high level of common ownership than Anton's measure. The average common ownership measure is five and three times larger, respectively, in business groups and industries.

Table 9: text

index	variable	mean	std	min	25%	50%	75%	max
All	FCA	0.158	0.234	0.002	0.031	0.079	0.191	12.650
	FCAP	0.144	0.166	0.002	0.030	0.077	0.193	1.000
Same Group	FCA	0.474	0.478	0.005	0.096	0.367	0.691	6.174
	FCAP	0.346	0.265	0.004	0.081	0.321	0.561	1.000
Not Same Group	FCA	0.087	0.154	0.003	0.020	0.038	0.087	6.184
	FCAP	0.072	0.102	0.003	0.020	0.037	0.078	0.998
Same Industry	FCA	0.274	0.383	0.003	0.044	0.126	0.351	6.262
	FCAP	0.207	0.215	0.003	0.041	0.120	0.314	0.999
Not Same Industry	FCA	0.150	0.217	0.002	0.030	0.077	0.183	12.650
	FCAP	0.140	0.161	0.002	0.029	0.074	0.187	1.000

2.6 Overview of Business Groups in Tehran Stock Exchange

There is no difference between emerging markets (such as Chile, India, Indonesia, South Korea, Pakistan, and many more) and developed ones (like Italy and Sweden); business groups present everywhere. However, group-affiliated firms are relatively large and economically important in emerging markets. These groups principally consist of legally independent firms grouped by persistent formal (e.g., equity) and informal (e.g., family) links.(Khanna and Yafeh (2007)) There is a complex ownership network in TSE as an emerging market. This complicated ownership creates a vast number of business groups in which an ultimate owner controls them through a multi-layer of ownership. (Farajpour et al. (2019))

The reason for many of these business groups back to the 1979 revolution. After the revolution, due to social sentiment, critical sectors of the economy nationalized, and their ownership transferred to the government or other pseudo-government foundations. Also, some other groups of firms in heavy industries were established and controlled by the Industrial Development and Renovation Organization (IDRO) during the 1960s and 1970s. (IDRO was a state-owned holding company for investing in capital-intensive industries)

The business groups are formed from mentioned ancestors due to two related forces; A multi-phased privatization by the state and the development of the domestic stock market. In the first wave of privatization, more than 300 companies were fully or partially privatized. In the second one, approximately $150 billion ownership of State-Owned Enterprises (SOEs) and assets were transferred. Pension funds, military institutions, cultural and religious foundations, and revolutionary foundations (pseudo-government groups) primary customers in the second wave of privatization. These waves of privati-

zation transferred control of hundreds of SOEs to semi-governmental groups and were the main driver of the formation of business groups in Iran. In addition, the developing stock market from the early 2000s enhances this effect. The government tried to develop the stock market as a tool for better privatization. (Aliabadi et al. (2021))

In conclusion, the multiple waves of privatization with the development of the stock market changed ownership structure in pre-revolutionary holding companies and post-revolutionary foundations. They created large business groups that govern primary industries. As a result, we expect that pairs in the business groups belong to the same sector, and figure 8 confirms that. As you can see, only 8% of our pairs belong to the same industry, but 43% of pairs in the same group are in the same industry. Pairs in the business groups are the same size and book to market as other pairs. However, as said before, the common ownership level in these pairs is much greater, and cross-ownership is higher in business group pairs. Figure 9 reports an average of control variables in these two types of groups.

Figure 8

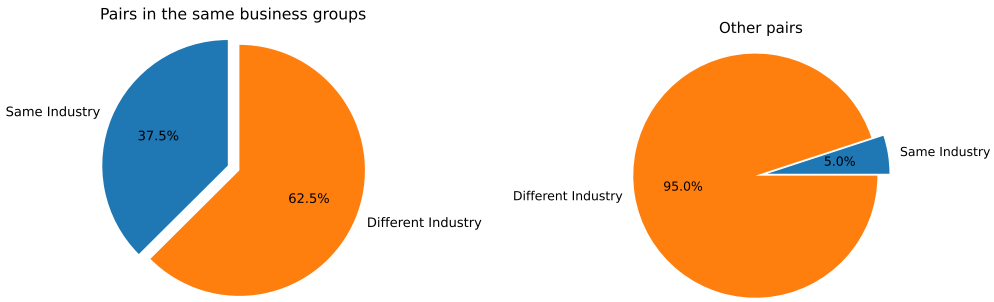
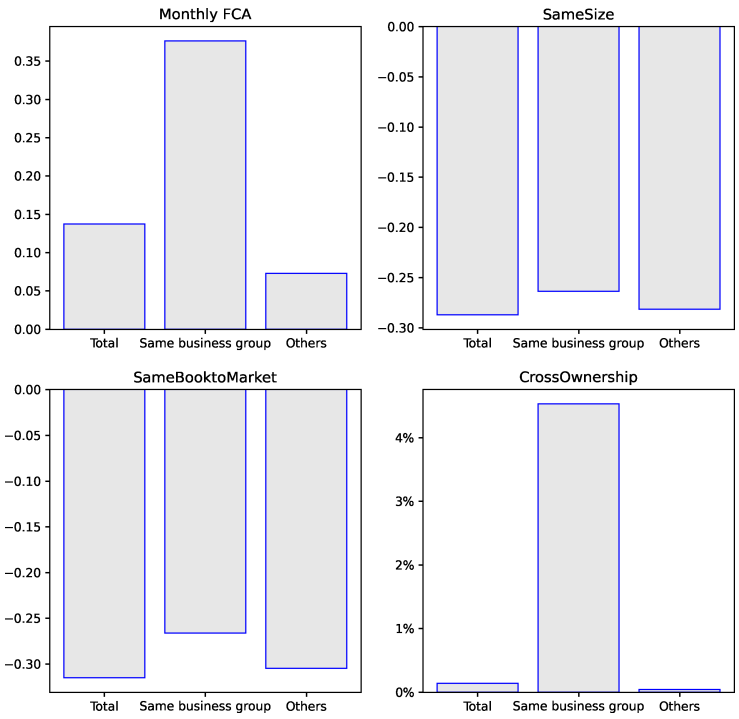


Figure 9


Monthly FCA
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Total
Same business group
Others
SameSize
0.00
−0.05
−0.10
−0.15
−0.20
−0.25
−0.30
Total
Same business group
Others
SameBooktoMarket
0.00
−0.05
−0.10
−0.15
−0.20
−0.25
−0.30
Total
Same business group
Others
CrossOwnership
4%
3%
2%
1%
0%
Total
Same business group
Others

3 Results

3.1 Forecasting Co-movement

Our specific interest is how the common ownership affects a pair of stocks return co-movement. As it has shown in figure 10, a higher level of common ownership in the current period is associated with a higher level of correlation in the following month. We empirically test the impact of current measured common ownership on the next period's co-movement.

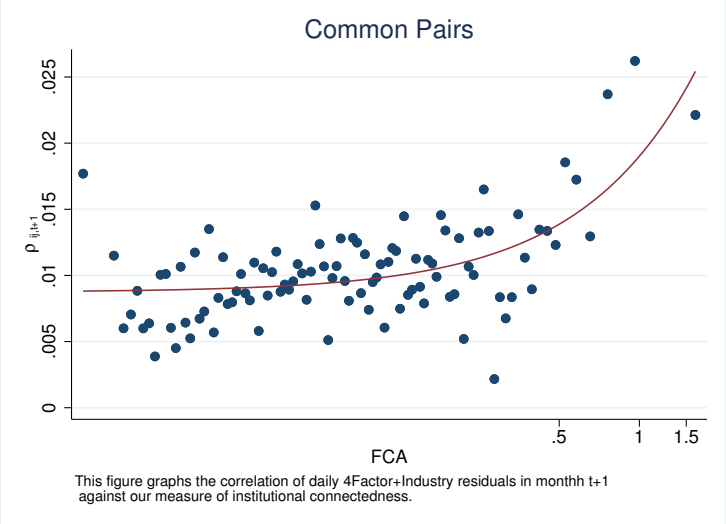


Figure 10: Future monthly correlation for different level of common ownership at this period

For this purpose, we estimate the cross-sectional regressions forecasting within-month realized correlation ($\rho_{i,j,t+1}$) of each pair of stocks abnormal return. By abnormal return, we mean daily four-factor plus industry residuals of estimated model (Specific details and reasons for using this model described in the section 2.3). We use $FCA^{*}_{ij,t}$, $SameGroup_{ij}$, and their inter-

action for our main analysis and other pair characteristics as controls:

$$\begin{aligned}\rho_{ij,t+1} = \beta_0 &+ \beta_1 * \text{FCA}^*_{ij,t} + \beta_2 * \text{SameGroup}_{ij} \\ &+ \beta_3 * \text{FCA}^*_{ij,t} \times \text{SameGroup}_{ij} \\ &+ \sum_{k=1}^{n} \alpha_k * \text{Control}_{ij,t} + \varepsilon_{ij,t+1}\end{aligned} \tag{5}$$

We estimate these regressions for each month and report the time-series average as in Fama and MacBeth (1973) to don't have any problem with cross-correlation in the residuals. We then use Newey and West (1987) to calculate standard errors of the Fama-MacBeth that take into account autocorrelation in the time series of cross-sectional estimates for four lags $(4(71/100)^{\frac{2}{9}} = 3.71 \sim 4)$.

Table 10 shows that results from forecasting cross-sectional variation in pair's co-movement. In the first two columns, we estimate a simplified version of equation 7 with only the *Same Group* as an independent variable. In the first column, we estimate the model without control variables. Recall that our control variables are *Same Industry*, *Same Size*, *Same Book to Market*, and *Cross-Ownership*. The *Same Size* and the *Same Book to Market* are normalized to have a standard deviation of one and are transformed so that higher values indicate greater style similarity. We find that the *Same Group* has a high statically significant effect, with a coefficient of 0.0153 and a t-statistic of 7.90, in the presence of control variables. In columns three and four, we estimate our simplified model with only common ownership, $\text{FCA}^*_{ij,t}$, as a forecasting variable. We find that $\text{FCA}^*_{ij,t}$ significantly improves our forecast, with a coefficient of 0.0011 and a t-statistic of 2.11, which is significant at five percent level, however, the impact of the *Same Group* is eleven times bigger than this.

In the fifth specification of table 10, we use both *Same Group* and $\text{FCA}^*_{ij,t}$

as a forecasting variable. In this specification, only *Same Group* has a significant effect on our estimation. It suggests that pair in the same business group affects more than a higher level of common ownership. Furthermore, in the sixth and seventh columns of table 10, we restrict our investigation to two subsamples. In the first one, we run our model for the pairs in the same business group and others who do not belong to the same one in the second one. It provides evidence that common ownership only matters for the pairs in the same business groups.

Now for the main analysis, we include the interaction of *Same Group* and $\text{FCA}^*_{ij,t}$. We include the business group fixed effects to capture the group's characteristics for the last column. These results aver that $\text{FCA}^*_{ij,t}$ has a larger effect for the pairs in the same business group. It puts forward that the *Same Group* affects co-movement through indirect common ownership, which arises due to the same ultimate owner. On the other hand, as shown in figure 9 and table 9, pairs in the same business group have a higher level of common ownership than others. So, for further analysis, we restrict our analysis to pairs in the fourth quarter of the common ownership.

Table 10: Connected Co-movement

	Dependent Variable: Future Monthly Correlation of 4F+Industry Residuals								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Same Group	0.0166***	0.0153***			0.0147***			0.00624***	0.00549**
	(8.54)	(7.90)			(6.97)			(2.81)	(2.27)
FCA*			0.00150***	0.00112**	0.000736	0.00944***	0.000397	0.000377	-0.0000113
			(2.90)	(2.11)	(1.33)	(7.24)	(0.68)	(0.65)	(-0.02)
(FCA*) × SameGroup								0.00992***	0.0107***
								(6.49)	(6.97)
Observations	1665996	1665996	1665996	1665996	1665996	58337	1607659	1665996	1665996
Sub-sample	All	All	All	All	All	SameGroup	Others	All	All
Group Effect	No	No	No	No	No	No	No	No	Yes
Controls	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.000180	0.000637	0.000170	0.000652	0.000804	0.0112	0.000577	0.000898	0.00575

t statistics in parentheses

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

3.2 High level of common ownership

In line with the previous estimations, figure 11 provides that a higher level of common ownership affects more on the firms' comovement. For detailed analysis, we restrict our sample to the higher level of common ownership, which we define as the pairs with $\text{FCA}_{ij,t}$ in the fourth quarter in each period. Figure 12 shows the relation between future comovement and current measurement of common ownership for that pairs. As you can see in the left panel, in line with the last explanation, common ownership only affects the pairs in the same group, and common ownership without the same group will not affect pairs' comovement although for a high level of common ownership.

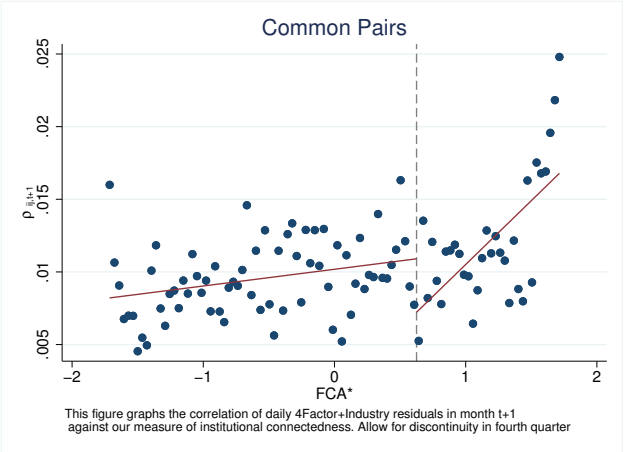


Figure 11: text

For detailed analysis, we estimate the equation 7 with the same methodology in section 3.1 for the subsample of a high level of common ownership. Table 11 reports estimations results. As expected, firms in the same business group have a high statistical and economically significant effect on forecasting future comovements. Columns six and seven prove our prior explanations for the importance of business groups compared to common ownership in pairs

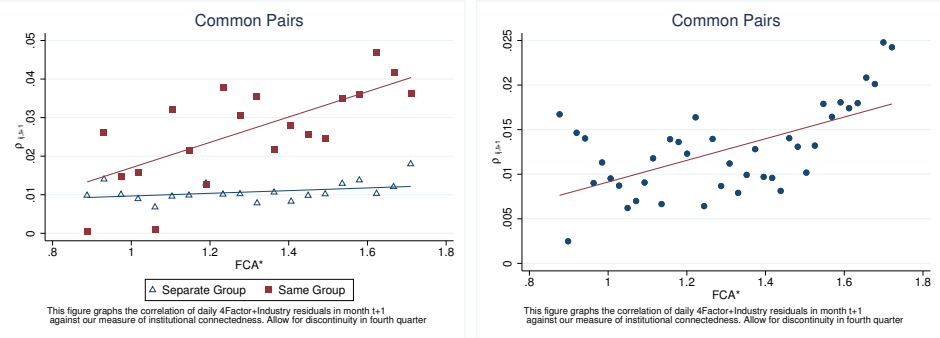


Figure 12: text

with a higher level of common ownership. When we restrict our analysis to the high level of common ownership, our results may be driven by pairs' characteristics. Figure 13 reports an average of control and dependent variable for the subsample and all the pairs. In the fourth quarter, measured common ownership is higher than others, and more than 25% of them belong to the same business group. On the other hand, the difference in size and the book-to-market ratio is not statistically different from other pairs. This similarity shows that pairs in the fourth quarter are not different in their pair characteristics.

Table 11: Estimation results for high level of common ownership

	Dependent Variable: Future Monthly Correlation of 4F+Ind. Res.						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Same Group	0.0229***		0.0220***	0.0206***	0.0195***	-0.0230*	-0.0201
	(9.86)		(8.34)	(7.28)	(7.24)	(-2.21)	(-1.94)
FCA*		0.0122**	0.00516	0.00494	0.00485	0.00270	0.00194
		(3.11)	(1.23)	(1.18)	(1.17)	(0.60)	(0.46)
(FCA*) × SameGroup						0.0287***	0.0269**
						(3.55)	(3.42)
SameIndustry				0.00367	0.00277	0.00232	0.00404
				(1.67)	(1.20)	(0.97)	(1.62)
SameSize					0.00282	0.00233	0.00385
					(0.78)	(0.66)	(1.03)
SameBookToMarket					0.0104***	0.0103***	0.0113***
					(3.55)	(3.54)	(4.04)
CrossOwnership					0.0360	0.0402	0.0487
					(1.46)	(1.62)	(1.99)
Observations	416514	416514	416514	416514	416514	416514	416514
Group FE	No	No	No	No	No	No	Yes
R^2	0.000923	0.000353	0.00124	0.00151	0.00232	0.00253	0.0150

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

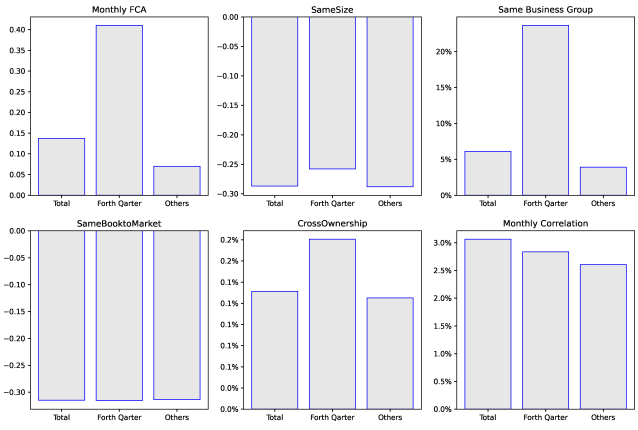


Figure 13: Pairs' characteristics for the pairs with high level of common ownership

3.3 All Pairs

In the former analyses, we restrict our investigation to firms with at least one common owner. By this analysis, we cannot separate the effect of the business group and common ownership; both of them can affect comovement. Furthermore, this restriction limits our result to commonly held firms, but if belonging to the same business group can increase stocks' comovement, it would affect all the firms in the same business group. So, we extend our investigation by constructing all the pairs in the market to separate the effect of direct common ownership and business group and solve the mentioned problem.

For this purpose, we include stocks in one pair if they have at least two months in common. By this definition, we do not restrict our investigation to commonly held stocks and set $\text{FCA}_{ij,t}$ to zero for a pair without any common owner. For analysis of the high level of common ownership, we define a dummy variable that equals one if pairs' common ownership, $\text{FCA}_{ij,t}$, is in the fourth quarter of that period (without considering zeros) and use it as our variable of interest. Other controls are defined as before, and we use the same methodology as used for estimating equation 7. We estimate equation 7 and this new model:

$$\begin{aligned}\rho_{ij,t+1} = \beta_0 &+ \beta_1 * (\text{FCA}_{ij,t} > Q3[\text{FCA}_{ij,t}]) + \beta_2 * \text{SameGroup}_{ij} \\ &+ \beta_3 * (\text{FCA}^*_{ij,t} > Q3[\text{FCA}_{ij,t}]) \times \text{SameGroup}_{ij} \\ &+ \sum_{k=1}^{n} \alpha_k * \text{Control}_{ij,t} + \varepsilon_{ij,t+1}\end{aligned} \tag{6}$$

Table 12 reports results of estimations for two models. These results suggest that pairs in the same group co-move more than stocks that are not in the same group. In addition, as we expected, pairs with common ownership and the high level of common ownership co-move greater than others

(columns 2 and 8). In columns 3 and 9, we use variables of common ownership and the same business group together. Results supported our previous explanation of table 10 that the *Same Group* is critical for forecasting future co-movement, and common ownership does not matter for pairs.

In columns four, five, ten, and eleven of the table 12, we estimate our variable of interest for the subsample of pairs in the same business group and others that are not in the same group. These specifications help us to separate common ownership and the same group effect. The results establish that only a high level of common ownership will increase the co-movement of the stocks' abnormal return for the pairs in the same group. Furthermore, we estimate model 7 and 6 for the full sample. Columns seventh and fourteenth of table 12 reports the result of this estimation and confirm the results of table 10.

In conclusion , these results show that same business group is more important than common ownership. In fact, when we talk about the presence of two stocks in the same business group, we talk about a high level of invisible common ownership between two stocks that we cannot measure that by mutual stockholders.

Table 12: Non-connected Co-movement

	Dependent Variable: Future Monthly Correlation of 4F+Industry Residuals													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
SameGroup	0.0153***		0.0150***			0.0134***	0.0124***		0.0151***				0.0104***	0.00926***
	(9.38)		(9.26)			(7.81)	(7.10)		(9.03)				(6.09)	(5.34)
FCA*		0.000676***	0.000496*	0.00212	0.000427*	0.000408*	0.000116							
		(3.50)	(2.56)	(1.79)	(2.20)	(2.11)	(0.67)							
(FCA*) × SameGroup						0.00247*	0.00321**							
						(2.15)	(2.90)							
(FCA > $Q3$[FCA])								0.00226*	0.000744	0.00226*	0.0122***	-0.0000291	-0.0000725	-0.00110
								(2.63)	(0.97)	(2.63)	(4.40)	(-0.03)	(-0.07)	(-1.32)
(FCA > $Q3$[FCA]) × SameGroup													0.0141***	0.0161***
													(4.65)	(5.54)
Observations	6018646	6018646	6018646	114526	5904120	6018646	6018646	6018646	5851137	6018646	114526	5904120	6018646	6018646
Sub Sample	Total	Total	Total	SameGroups	Others	Total	Total	Total	Total	Total	SameGroups	Others	Total	Total
Group Effect	No	No	No	No	No	No	Yes	No	No	No	No	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.000445	0.000392	0.000491	0.00699	0.000338	0.000515	0.00330	0.000372	0.00127	0.000372	0.00721	0.000323	0.000508	0.00330

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3.4 Size effect

	Dependent Variable: Future Monthly Correlation of 4F+Ind. Res.							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FCA*	0.000377	0.000698	-0.000175	0.00199***	0.00177**	-0.00151	-0.00177	-0.0000771
	(0.65)	(1.25)	(-0.31)	(3.56)	(3.00)	(-1.58)	(-1.84)	(-0.14)
Same Group	0.00624**	0.0102***	-0.00153	0.0117***	0.00661*	0.0366***	0.0268***	0.00750***
	(2.81)	(3.95)	(-0.53)	(3.76)	(2.15)	(10.31)	(6.57)	(3.53)
(FCA*) × SameGroup	0.00992***		0.0134***		0.00599*		0.0123***	0.0105***
	(6.49)		(4.80)		(2.34)		(4.17)	(6.72)
Observations	1665996	346170	346170	693728	693728	626098	626098	1665996
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sub-sample	All Firms	Large Firms	Large Firms	Hybrid Firms	Hybrid Firms	Small Firms	Small Firms	All Firms
Pair Size FE	No	No	No	No	No	No	No	Yes
R^2	0.000898	0.00193	0.00232	0.00135	0.00149	0.00180	0.00198	0.00130

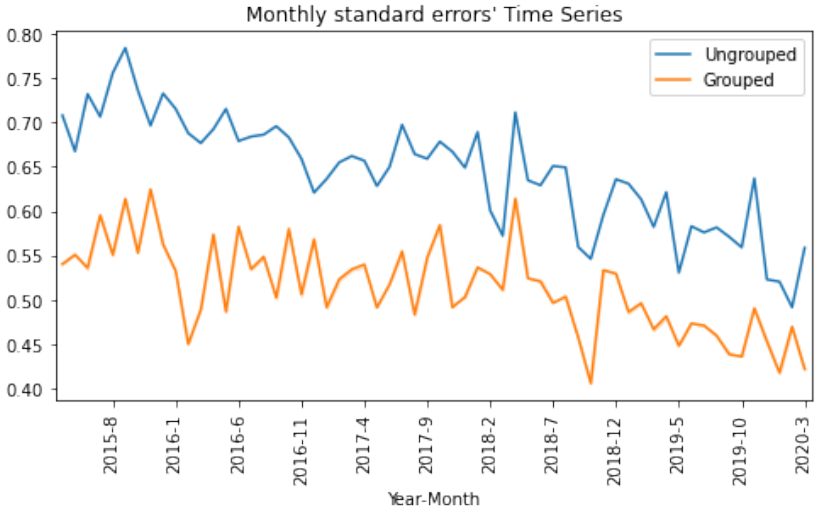
t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3.5 Evidence for correlated trading

For each firm, we calculate daily institutional imbalances, which is the net buying value of institutional investors relative to total traded value on that day ($\text{InsImb} = \frac{\text{Buy}_{\text{value}} - \text{Sell}_{\text{value}}}{\text{Buy}_{\text{value}} + \text{Sell}_{\text{value}}}$). We expect that institutional imbalances have a lower variation in groups due to the correlated tradings that the ultimate owner ordered to do. So, we calculate the monthly standard deviation of the group's imbalances and compare them to unaffiliated ones. As we expected grouped standard error is 13.1% and significantly (with t-stat of 12.57) lower than ungrouped firms.

	count	mean	std	min	median	max
Ungrouped	60	0.645	0.063	0.492	0.653	0.784
Grouped	60	0.514	0.050	0.406	0.514	0.625



According to the main hypothesis, we need to compare pairs in groups with low standard error and other pairs. For this purpose, we define **Low Imbalance std** dummy for groups whose average standard errors are lower than half of the sample. So, this dummy is equal to one if at least one pair's firms belong to the low imbalance std business group. We use the previous methodology for estimating that model this model:

$$\begin{aligned}\rho_{ij,t+1} = \beta_0 + \beta_1 * \text{FCA}^*_{ij,t} + \beta_2 * \text{SameGroup}_{ij} + \beta_3 * \text{Low Imbalance std} \\ + \beta_4 * \text{Low Imbalance std} \times \text{SameGroup}_{ij} \times \text{FCA}^*_{ij,t} \\ + \sum_{k=1}^{n} \alpha_k * \text{Control}_{ij,t} + \varepsilon_{ij,t+1}\end{aligned} \tag{7}$$

We expected pairs in the same business groups with a low standard error of buy-sell imbalance comove more than other pairs. Table 13 reports estimation results. In columns three and four, we use our defined dummy variable and the same group. These results show that pairs in the same group of low imbalance std will comove more than other pairs. Moreover, in the subsample of same business groups, pairs in the low imbalance std comove

greater than others.

Table 13: text

	Future Monthly Corr. of 4F+Ind. Residuals							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FCA*	0.000308	0.000384	0.000320		0.00945***	0.0000347	0.000123	0.0000843
	(0.60)	(0.81)	(0.68)		(6.07)	(0.07)	(0.17)	(0.11)
Same Group	0.0164***	0.0164***	0.00765***	0.00786***		0.00974***	0.00241	0.00154
	(8.68)	(8.68)	(3.64)	(3.90)		(5.36)	(0.79)	(0.48)
Low Imbalance std		0.00119	0.000325	0.000192	0.0241***	0.000469	0.0000788	0.000481
		(1.29)	(0.35)	(0.19)	(6.15)	(0.52)	(0.08)	(0.31)
Low Imbalance std × SameGroup			0.0238***	0.0240***			0.0142**	0.0142**
			(6.85)	(6.90)			(2.95)	(3.14)
(FCA*) × SameGroup							0.00580**	0.00645**
							(2.77)	(2.94)
Low Imbalance std × (FCAP*)							-0.000584	-0.000483
							(-0.77)	(-0.57)
Low Imbalance std × SameGroup × FCA*						0.0209***	0.0126***	0.0120***
						(9.69)	(4.44)	(3.91)
Observations	1665996	1665996	1665996	1665996	58337	1665996	1665996	1665996
Group Effect	No	No	No	No	No	No	No	Yes
Pair Size FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sub-sample	Total	Total	Total	Total	Same Groups	Total	Total	Total
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.00120	0.00132	0.00144	0.00129	0.0210	0.00149	0.00166	0.00643

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Furthermore, we should show that stocks in groups have a similar daily trading behavior. Accordingly, for each firm we run time-series regressions of the firm's daily change in trading measure, $\Delta\text{Measure}_{i,t}$, on changes in market measure,$\Delta\text{Measure}_{Market,t}$, changes in the industry and business group portfolio's measure,$\Delta\text{Measure}_{Ind,t}$ and $\Delta\text{Measure}_{Group,t}$ and ,as well as control variables.

We compute the daily change of measure by this definition $\Delta\text{Measure}_{i,t} = \ln(\frac{\text{Measure}_{i,t}}{\text{Measure}_{i,t-1}})$. We estimate the following regression for each stock across trading days in given year separately and cross-sectional averages of the estimated coefficients are reported, with t-statistics in parentheses :

$$\Delta\text{Measure}_{i,t} = \alpha + \beta_{Market,t}\Delta\text{Measure}_{Market,t} + \beta_{Ind,t}\Delta\text{Measure}_{Ind,t}$$
$$+ \beta_{Group,t}\Delta\text{Measure}_{Group,t} + \delta\text{Controls} + \varepsilon_{i,t}$$

We use the turnover measure as a daily trading measures. We control for lead and lag changes in the two portfolio and market's measures. In addition, we use size of the firm. [Table 14]

Table 14: cross-sectional average of the time-series coefficients for daily changes in turnover

	Dependent Variable: $\Delta\text{TurnOver}_i$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\text{TurnOver}_{\text{Market}}$	0.405***	0.396***	0.360***	0.425***	0.388***	0.448***
	(12.25)	(10.74)	(7.62)	(12.08)	(8.23)	(12.20)
$\Delta\text{TurnOver}_{\text{Group}}$			0.222***	0.229***	0.253**	0.268***
			(3.46)	(4.09)	(3.28)	(3.82)
$\Delta\text{TurnOver}_{\text{Industry}}$	0.120**	0.0205	-0.0156	-0.0237	-0.0833	-0.0999
	(3.25)	(0.24)	(-0.23)	(-0.42)	(-1.04)	(-1.46)
Observations	293264	292179	184699	183442	184699	183442
Weight	-	-	MC × CR	MC × CR	MC	MC
Control	No	Yes	No	Yes	No	Yes
R^2	0.129	0.168	0.246	0.286	0.247	0.286

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 15: Pairwise correlation in turnover

	Dependent Variable: Future Monthly Correlation of Delta turnover						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Same Group	0.0349***	0.0217***			0.0227***	0.0182***	0.0176***
	(11.20)	(7.38)			(7.73)	(6.22)	(6.19)
FCA*			0.000871	-0.000438	-0.00110	-0.00134	-0.00171
			(0.63)	(-0.37)	(-0.93)	(-1.08)	(-1.51)
(FCA*) × SameGroup						0.00619*	0.00631*
						(2.45)	(2.42)
Observations	1447955	1341445	1447955	1341445	1341445	1341445	1341445
Group Effect	No	No	No	No	No	No	Yes
Pair Size FE	No	Yes	No	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	Yes	Yes	Yes
R^2	0.000465	0.00431	0.000461	0.00448	0.00471	0.00481	0.0157

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4 Conclusion

Appendix A Further group analysis

Stock returns of group affiliated firms exhibit robustly positive comovement even after controlling for both market and industry effects. Group betas ($\beta_{Businussgroup}$) are highly significant across all models.

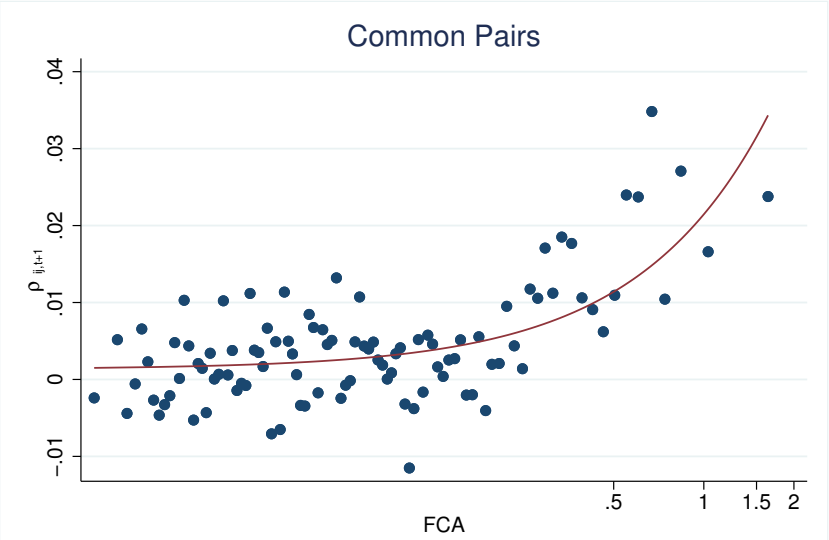
Table 16: Cross-sectional average of the time-series coefficients

	$\text{Return}_i - r_f = R_i$				
	(1)	(2)	(3)	(4)	(5)
R_M	0.801***	0.643***	0.701***	0.257***	0.280***
	(29.99)	(10.68)	(11.05)	(8.84)	(9.02)
$R_{Industry}$		-2.085	-1.878	-0.150	-0.148
		(-0.92)	(-0.93)	(-0.48)	(-0.50)
$R_{Businessgroup}$				0.493***	0.493***
				(11.36)	(11.34)
SMB			0.104***		0.0770***
			(3.52)		(5.24)
UMD			0.0282		0.0218
			(1.23)		(1.94)
HML			0.102***		0.0395***
			(6.05)		(6.39)
Constant	0.0442	0.0145	-0.0297	0.0499***	0.0198
	(1.92)	(0.53)	(-0.83)	(3.87)	(1.25)
Observations	207552	207552	207552	207552	207552
R^2	0.123	0.196	0.213	0.672	0.679

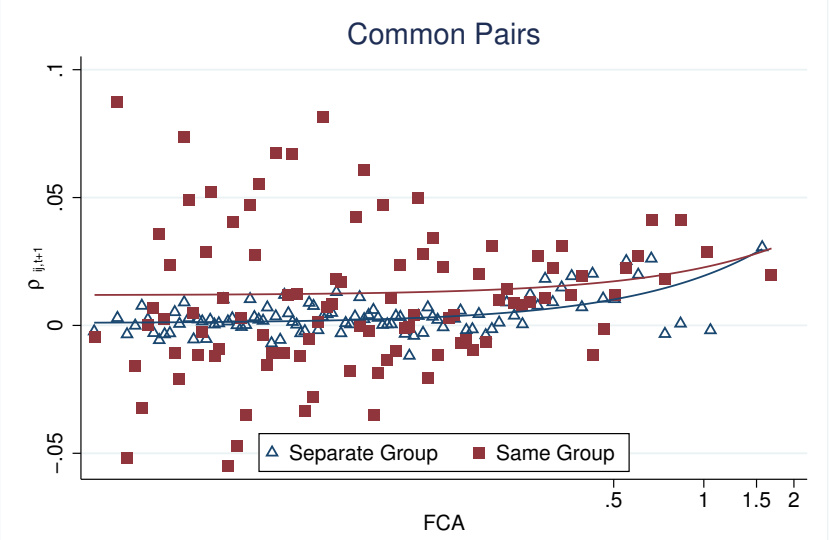
t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix B Logaritmic Transformation



This figure graphs the correlation of daily 4Factor+Industry residuals in monthh t+1 against our measure of institutional connectedness.



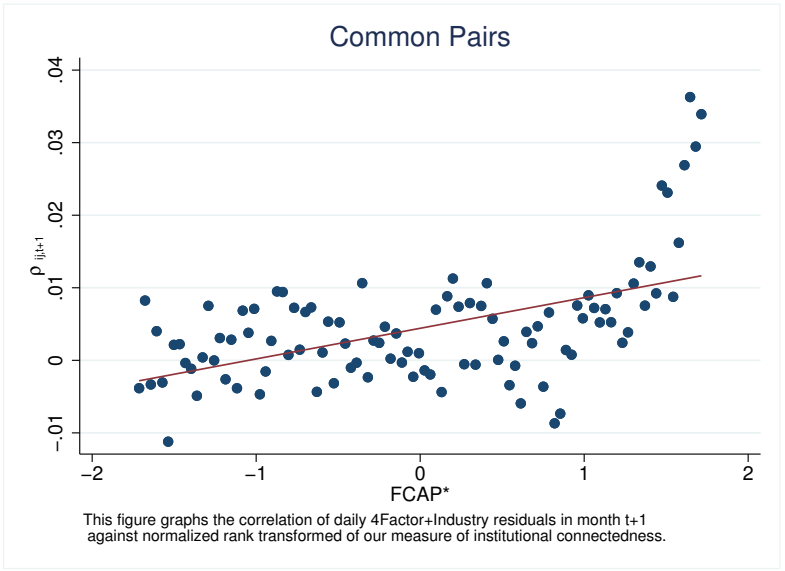
This figure graphs the correlation of daily 4Factor+Industry residuals in monthh t+1 against our measure of institutional connectedness.

	Dependent Variable: Future Monthly Correlation of 4F+Industry Residuals					
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(FCA)$	0.00316***	0.00252***	0.00108	0.000550	0.000748	0.000574
	(4.76)	(4.80)	(1.68)	(0.80)	(1.19)	(0.91)
$(\ln(FCA)) \times$ SameGroup				0.00446*	0.00451*	0.00528**
				(2.44)	(2.45)	(3.33)
ρ_t		0.129***	0.129***	0.129***	0.129***	0.129***
		(4.94)	(4.93)	(4.92)	(4.92)	(4.92)
SameGroup			0.0152***	0.0217***	0.0235***	0.0237***
			(6.06)	(5.14)	(4.90)	(5.03)
SameIndustry					-0.00497*	-0.00602**
					(-2.30)	(-3.00)
SameSize						0.00903***
						(4.31)
SameBookToMarket						0.00132
						(0.59)
CrossOwnership						0.0202
						(1.79)
Constant	0.0137***	0.0111***	0.00586**	0.00433	0.00532**	0.00785***
	(6.02)	(6.45)	(2.77)	(1.86)	(2.68)	(4.14)
Observations	436735	434850	434850	434850	434850	434850
Group FE	No	No	No	No	No	Yes
R^2	0.000344	0.0355	0.0358	0.0360	0.0362	0.0366

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix C Anton Polk's measure



This figure graphs the correlation of daily 4Factor+Industry residuals in month t+1 against normalized rank transformed of our measure of institutional connectedness.

	Dependent Variable: Future Monthly Correlation of 4F+Industry Residuals						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FCAP*	0.00349***	0.00275***	0.00129	0.000761	0.000928	0.000671	0.00108
	(4.69)	(4.75)	(1.98)	(1.09)	(1.46)	(1.05)	(1.70)
(FCAP*) × SameGroup				0.00662*	0.00670*	0.00808**	0.00795**
				(2.20)	(2.21)	(3.12)	(3.15)
SameGroup			0.0154***	0.00919**	0.0110***	0.00871**	0.00753*
			(6.66)	(3.13)	(3.74)	(2.76)	(2.27)
ρ_t		0.129***	0.129***	0.129***	0.129***	0.129***	0.129***
		(4.94)	(4.93)	(4.92)	(4.92)	(4.92)	(4.91)
SameIndustry					-0.00480*	-0.00587**	-0.00568**
					(-2.16)	(-2.82)	(-2.67)
SameSize						0.00892***	0.00894***
						(4.18)	(4.01)
SameBookToMarket						0.00137	0.00220
						(0.61)	(0.94)
CrossOwnership						0.0223*	0.0215*
						(2.22)	(2.02)
Observations	436735	434850	434850	434850	434850	434850	434850
Group FE	No	No	No	No	No	No	Yes
R^2	0.000316	0.0355	0.0358	0.0360	0.0362	0.0366	0.0432

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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