Connected Stocks: Evidence from Tehran Stock Exchange

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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

2 Measurement of cross-ownership

In table 1 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 et al. 2014; Azar 2011; Freeman 2019; Hansen et al. 1996; He and Huang 2017; He, Huang, and Zhao 2019; Lewellen et al. 2021; Newham et al. 2018)

Table 1: 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, Huang, and Zhao 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 et al. 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 et al. 1996	$\sum_{i \in I^{A,B}} \alpha_{i,A} \times \sum_{i \in I^{A,B}} \alpha_{i,B}$	? ?

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

2.1 Modified Anton's measure

We reformulate mentioned Anton's measure in table 1. 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

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

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 1, 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 2 and 3 where

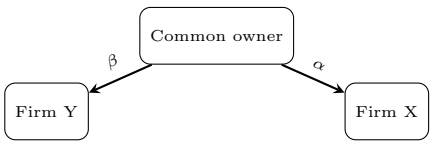
all variables as the same Anton's measure. Both modified measures represent the number of equal percents held block-holder. In other words, If for a pair of stocks with n mutual owners, all owners have even shares of each firm's market cap, then the proposed indexes will be equal to number of holders.[1]

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

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

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 1) 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 1: Numeric example 1



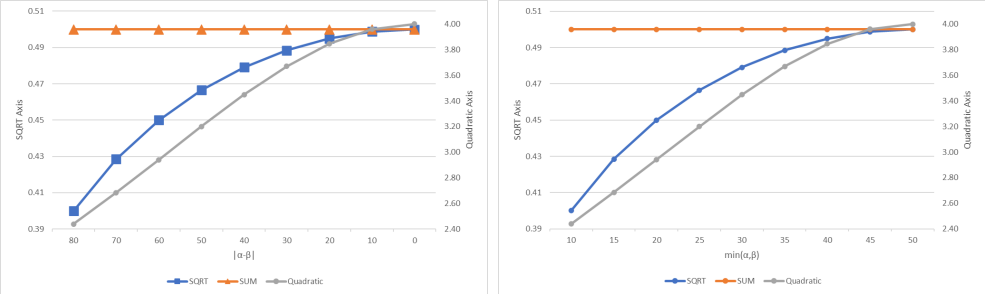
We calculate common ownership measures base on equations 1 (Sum), 2 (SQRT), and 3 (Quadratic) for different ownership distributions. Figure 2 reports calculations results. As we expected, Anton's measure is constant at a fixed level of aggregate common ownership, but SQRT and Quadratic vary from concentrated to dispersed ownership. Concentrated ownership (50-50) has a greater common ownership measure than dispersed (10-90).

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 3). 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 2 reports calculation results. For ownerships that consist of

1

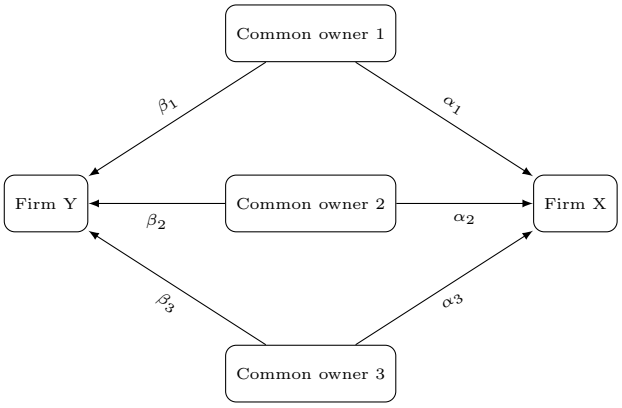
- Each holder owns $1/n$ of each firm ,Firm's market cap is α_1 and α_2, So for each holder of firms we have $S_{i,t}^{f}P_{i,t} = \alpha_i/n$
$[\frac{\sum_{f=1}^{n}\sqrt{\alpha_1/n}+\sum_{f=1}^{n}\sqrt{\alpha_2/n}}{\sqrt{\alpha_1}+\sqrt{\alpha_2}}]^2 = [\frac{\sqrt{n}(\sqrt{\alpha_1}+\sqrt{\alpha_2})}{\sqrt{\alpha_1}+\sqrt{\alpha_2}}]^2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

Figure 2: Comparison of three measure for common ownership



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 3: Numeric example 2



A fundamental assumption in previous examples is equality of firms' market cap. In the last example, we relax this assumption. Table 3 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 4 and 5. In this setting, the SQRT measure has a better variation relative to Anton's measure.

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

Table 2: 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

Figure 4: SQRT measure for fixed aggregate ownership on different relative market cap ratios

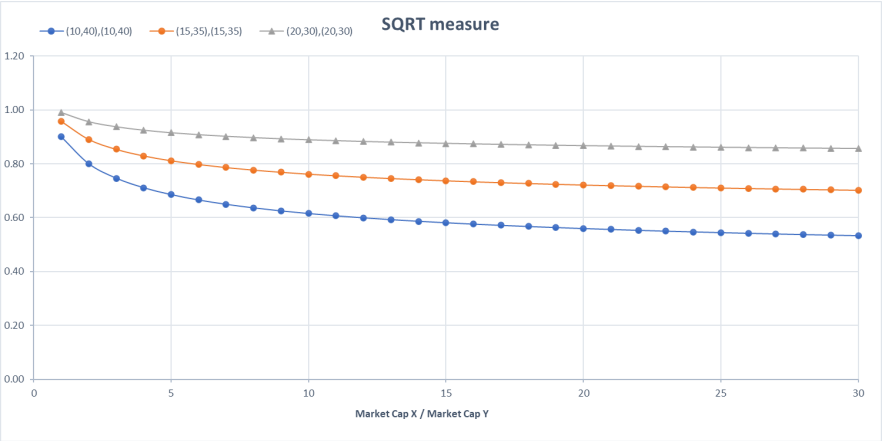


Figure 5: Sum measure for fixed aggregate ownership on different relative market cap ratios

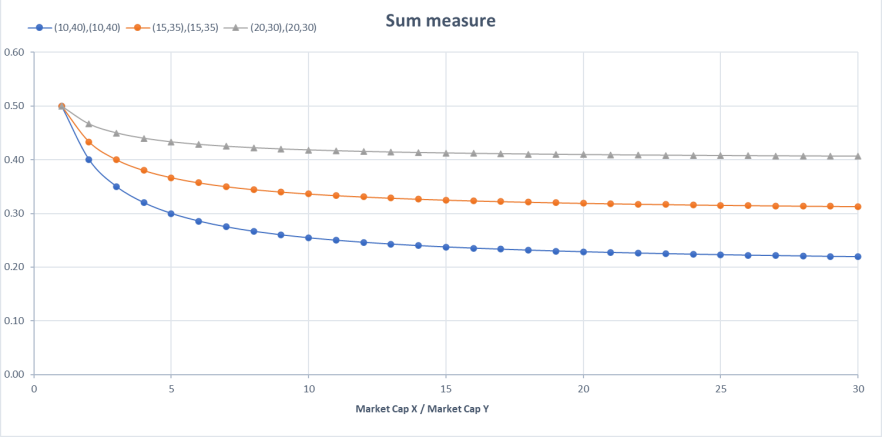


Table 3: text

	$(\alpha_1,\beta_1),(\alpha_2,\beta_2)$					
	(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

4 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 4: text

	variable	$\text{count}_{(\text{month} \times \text{id})}$	mean	std	min	25%	median	75%	max
Total	FCA	258352	0.167	0.268	0.003	0.024	0.056	0.181	3.967
	FCAP	258352	0.141	0.192	0.003	0.023	0.052	0.164	0.985
Same Group	FCA	41191	0.499	0.425	0.005	0.172	0.441	0.703	3.967
	FCAP	41191	0.399	0.262	0.004	0.146	0.410	0.615	0.985
Not Same Group	FCA	192551	0.100	0.154	0.003	0.021	0.043	0.109	2.166
	FCAP	192551	0.089	0.121	0.003	0.020	0.041	0.103	0.970
Same Industry	FCA	40364	0.377	0.416	0.007	0.060	0.242	0.571	3.967
	FCAP	40364	0.291	0.259	0.006	0.055	0.209	0.498	0.970
Not Same Industry	FCA	217988	0.128	0.208	0.003	0.022	0.047	0.132	2.555
	FCAP	217988	0.114	0.162	0.003	0.021	0.044	0.125	0.985

3 Data and Methodology

3.1 Data and Sample

We gathered industries index and stock returns, trading volume, and other relevant market and accounting data from the Codal website [2] and the Tehran Securities Exchange Technology Management Co (TSETMC)[3] database. We

[2] www.codal.ir

[3] www.tsetmc.com

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 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 [4] 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 5 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.

3.1.1 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 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. 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 6. By classifying pairs, on average, 15% of them

[4]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.

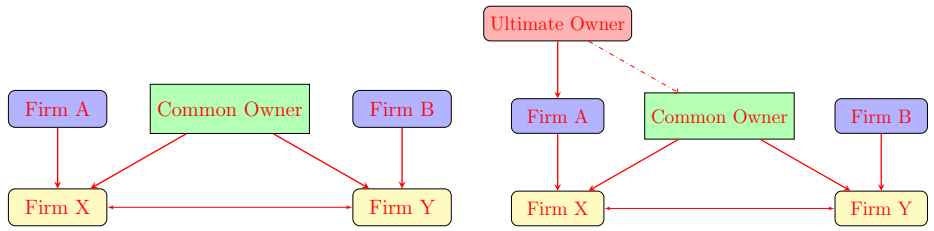
Table 5: This table reports summary statistics of ownership features for all the listed firms. At this table by group, we mean business groups.

Year	2015	2016	2017	2018	2019	2020	mean
No. of Firms	355	383	520	551	579	602	498
No. of Blockholders	724	887	1274	1383	1409	1390	1178
No. of Groups	41	42	46	45	40	40	42
No. of Firms not in Groups	113	128	207	224	247	602	254
No. of Firms in Groups	242	265	332	339	332	332	307
Mea Number of Members	6	6	7	8	8	8	7
Med. of Number of Members	4	4	6	5	6	6	5
Mea Of each Blockholder's ownership	21.30	22.00	20.80	20.50	21.90	23.00	21.58
Med. of Owners' Percent	7.94	7.55	6.95	6.34	8.31	9	8
Mea Number of Blockholders	5	5	5	5	5	4	5
Med. Number of Owners	4	4	4	4	4	3	4
Mea Block. Ownership	71.6	71.2	68	67.7	65.4	62.00	67.65
Med. Block. Ownership	79.9	80.1	77	77.1	72.9	69.70	76.12

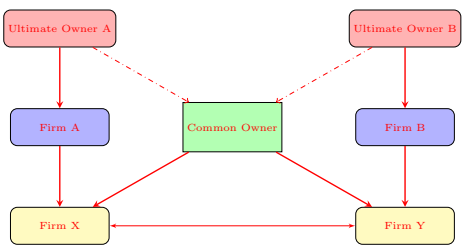
belong to one business group, and 74% of them are not in the same business groups each year. We report summary statistics of ownership features for all pairs in table 6.

Figure 7 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 is roughly stable. The number of pairs in each period is between 322 to 5101 pairs which, on average, there are 4325 pairs.

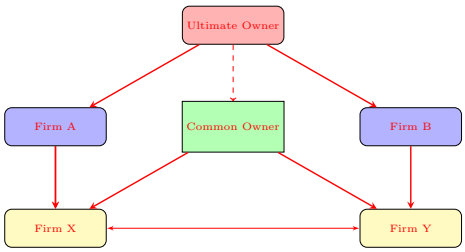
Figure 6: Three categories for pairs base on being in business groups



(a) Pair not in the business group



(b) Pair in two distinct business group

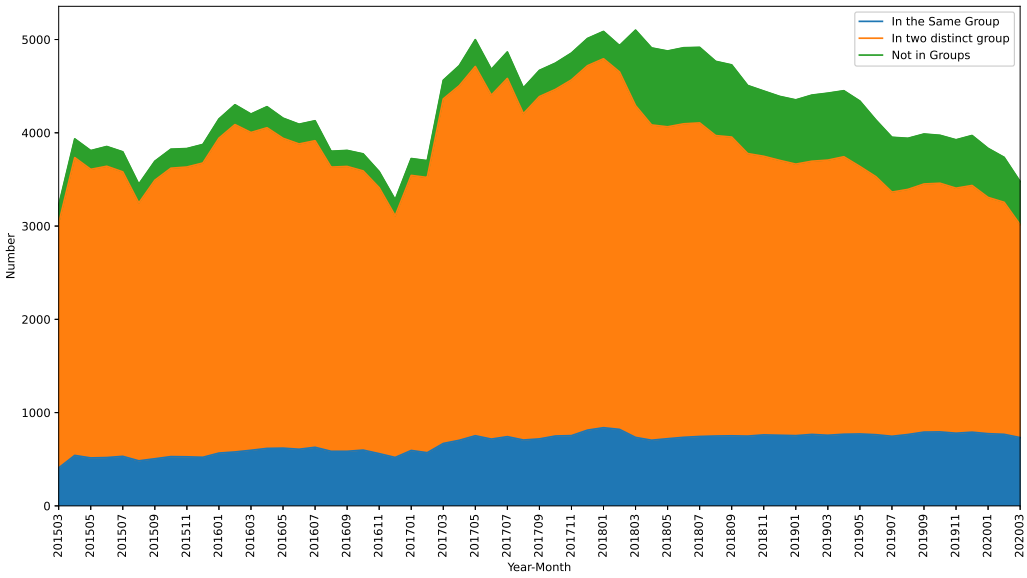


(c) Pair in the same business group

Table 6: This table reports summary statistics of ownership features for total pairs. At this table by group, we mean business groups.

Year	2015	2016	2017	2018	2019	2020	Mean
No. of Pairs	4689	5868	6554	7430	6371	4094	5834
No. of Groups	40	41	43	43	38	38	41
No. of Pairs not in Groups	231	275	318	969	924	544.00	544
No. of Pairs in the same Group	662	793	1012	1118	1055	803	907
No. of Pairs not in the same Group	3778	4746	5183	5273	4308	2741	4338
Mea. Number of Common owner	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Mea. Number of Pairs in one Group	24	24	26	27	26	20	25
Med. Number of Pairs in one Group	10	11	9	10	11	8	10
Mea. Number of Pairs in one Group	25	26	27	29	28	21	26
Med. Number of Pairs in one Group	10	11	9	6	7	6	8
Med. Number of Owners	5.96	5.83	5.7	5.77	5.78	6	5.82
Medi. Percent of each Blockholder	10.18	10.27	10.46	10.3	10.69	11	10.49
Med. Block. Ownership	78.45	79.01	79.03	79.65	79.49	79.31	79.16

Figure 7: The number of unique pairs in each month



3.1.2 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) :

$$\begin{aligned} R_{i,t} = \alpha_i + \beta_{mkt,i} R_{M,t} + \beta_{Ind,i} R_{Ind,t} + \\ + \beta_{HML,i} HML_t + \beta_{SMB,i} SMB_t + \beta_{UMD,i} UMD_t + \varepsilon_{i,t} \end{aligned} \tag{4}$$

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 7. 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 7: This table reports distribution of calculated correlation base on different models.

$\rho_{ij,t}$	mean	std	min	25%	50%	75%	max
CAPM + Industry	0.007	0.328	-1	-0.194	0.006	0.208	1
4 Factor	0.038	0.338	-1	-0.172	0.035	0.248	1
4 Factor + Industry	0.006	0.326	-1	-0.194	0.005	0.206	1
4 Factor + Industry (With Lag)	0.006	0.325	-1	-0.194	0.006	0.206	1

3.1.3 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 8, 12% and 11% of pairs are in the same industry and business group.

Table 8: This table reports the number of pairs in the same industry and business group.

Type of Pairs	Yes	No
SameIndustry	1110	8631
	(11%)	(88%)
SameGroup	1142	8599
	(12%)	(89%)
SameGroup & SameIndustry	494	9247
	(5%)	(95%)

Another group of controls are firm-specific controls. We define these variables base on Anton et al. 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.

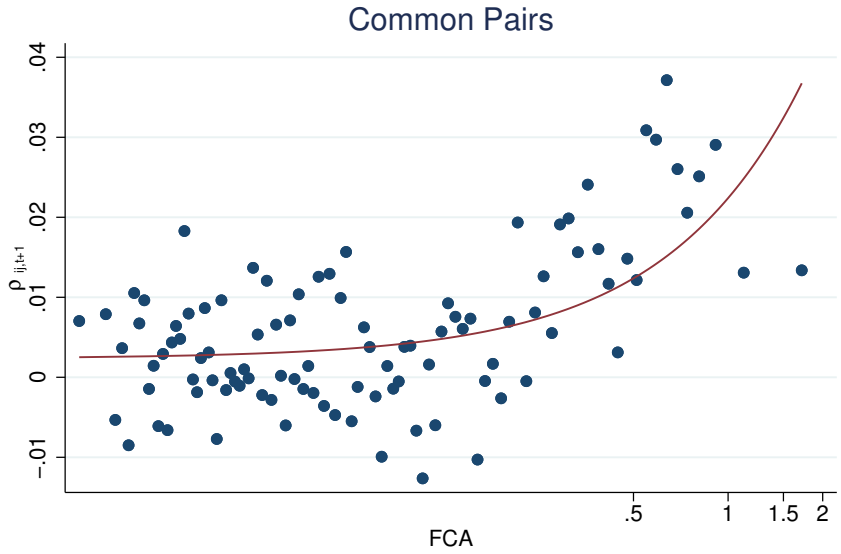
We calculate our controls daily and then report the average of these variables for the entire period at the end of each month. Table 9 shows the

summary statistics of specified controls in this section.

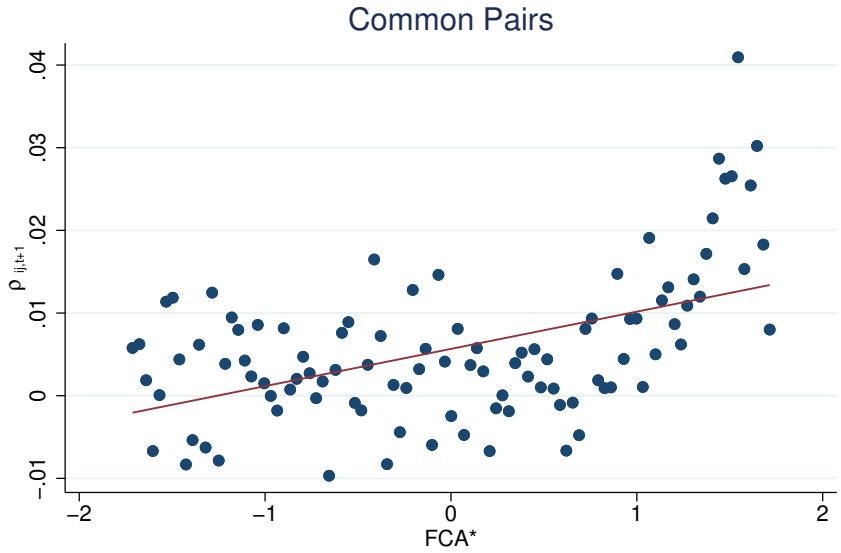
Table 9: This table shows the summary statistics of specified controls in empirical studies.

	mean	std	min	25%	50%	75%	max
SameIndustry	0.16	0.36	0.00	0.00	0.00	0.00	1.00
SameGroup	0.18	0.38	0.00	0.00	0.00	0.00	1.00
Size1	0.75	0.21	0.01	0.61	0.81	0.93	1.00
Size2	0.47	0.25	0.00	0.27	0.44	0.66	1.00
SameSize	-0.28	0.21	-0.99	-0.42	-0.23	-0.10	0.00
BookToMarket1	0.53	0.26	0.00	0.33	0.54	0.75	1.00
BookToMarket2	0.51	0.24	0.00	0.31	0.50	0.70	1.00
SameBookToMarket	-0.29	0.21	-1.00	-0.42	-0.25	-0.12	0.00
MonthlyCrossOwnership	0.01	0.07	0.00	0.00	0.00	0.00	0.96

4 Forecasting Comovement



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 month t+1 against our measure of institutional connectedness.

4.1 Modeling Cross-Sectional Variation in Comovement

4.1.1 Model and estimation

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

- Use Fama macbeth to estimate
- Estimate that model on a monthly frequency
- Adjust standard errors by Newey and West adjustment with 4 lags $(4(60/100)^{\frac{2}{9}} = 3.57 \sim 4)$
- we use current period's correlation as a control variable for controlling omitted variable bias

4.1.2 Results

- Use group fixed effect and no change in our results
-

Table 10: text

	Dependent Variable: Future Monthly Correlation of 4F+Industry Residuals						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FCA*	0.00476***	0.00394***	0.00373***	0.00105	-0.0000511	-0.000238	0.000299
	(4.88)	(5.16)	(5.04)	(1.23)	(-0.06)	(-0.28)	(0.37)
ρ_t		0.124***	0.125***	0.124***	0.124***	0.124***	0.123***
		(4.92)	(4.93)	(4.90)	(4.90)	(4.90)	(4.88)
SameIndustry			0.00187	-0.00386*	-0.00402*	-0.00505*	-0.00476*
			(1.15)	(-2.01)	(-2.06)	(-2.58)	(-2.37)
SameGroup				0.0194***	0.0123***	0.0129***	0.00910*
				(7.86)	(4.30)	(4.54)	(2.26)
(FCA*) × SameGroup					0.00839**	0.00816**	0.00801**
					(3.29)	(3.20)	(3.02)
SameSize						0.0118***	0.0122***
						(4.61)	(4.67)
SameBookToMarket						0.00432	0.00624
						(1.28)	(1.63)
Observations	249030	248118	248118	248118	248118	248118	248118
Group FE	No	No	No	No	No	No	Yes
R^2	0.001	0.034	0.034	0.035	0.035	0.036	0.046

t statistics in parentheses

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

4.1.3 Bearish/Bullish Market

$$\begin{aligned}\rho_{ij,t+1} = \beta_0 &+ \beta_1 * \text{FCA}^*_{ij,t} \\ &+ \beta_2 * \text{Bearish Market} \times \text{SameGroup} \\ &+ \beta_3 * \text{Bullish Market} \times \text{SameGroup} \\ &+ \beta_4 * \text{FCA}^*_{ij,t} \times \text{Bearish Market} \times \text{SameGroup} \\ &+ \beta_5 * \text{FCA}^*_{ij,t} \times \text{Bullish Market} \times \text{SameGroup} \\ &+ \sum_{k=1}^{n} \alpha_k * \text{Control}_{ij,t} + \varepsilon_{ij,t+1}\end{aligned} \tag{6}$$

- Use Fama macbeth to estimate
- Estimate that model on a monthly frequency
- Adjust standard errors by Newey and West adjustment with 4 lags $(4(60/100)^{\frac{2}{9}} = 3.57 \sim 4)$
- we use current period's correlation as a control variable for controlling omitted variable bias

4.1.4 Results

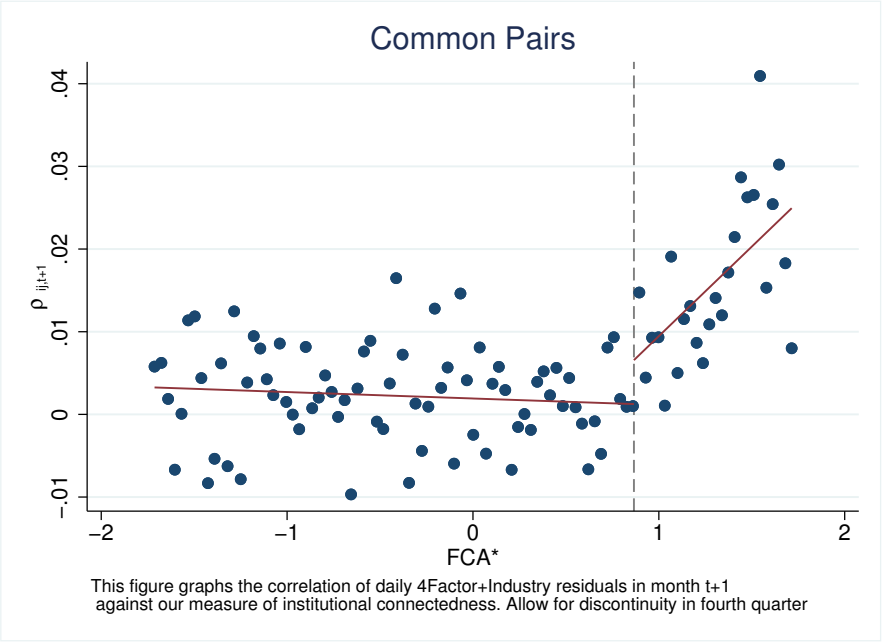
- 37% of observations are in bearish market
- In table 11 we use a time dummy for a bearish market and a bullish market in the next period. We also interact with these dummies with our interested controls. According to results, in a bearish market, only high common ownerships in the business group affect the pair's correlation. However, in a bullish market, all level of common ownership that happens in the same business group has a great effect on the pair's correlation

Table 11: text

	Fu. Monthly Cor. of 4F+Ind. Residuals		
	(1)	(2)	(3)
FCA*	-0.000238	-0.000238	-0.000238
	(-0.28)	(-0.28)	(-0.28)
(FCA*) × SameGroup	0.00816**	0.00816**	
	(3.20)	(3.20)	
SameGroup	0.0129***		
	(4.54)		
Bearish Market × SameGroup		0.00415	0.00415
		(1.92)	(1.92)
Bullish Market × SameGroup		0.00880***	0.00880***
		(4.60)	(4.60)
(FCA*) × Bullish Market × SameGroup			0.00424*
			(2.64)
(FCA*) × Bearish Market × SameGroup			0.00393*
			(2.62)
Observations	248118	248118	248118
R^2	0.036	0.036	0.036

t statistics in parentheses

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



This figure graphs the correlation of daily 4Factor+Industry residuals in month t+1 against our measure of institutional connectedness. Allow for discontinuity in fourth quarter

4.2 Discontinuity

4.2.1 Model and estimation

$$\begin{aligned}\rho_{ij,t+1} = \beta_0 &+ \beta_1 * \text{FCA}^*_{ij,t} + \beta_2 * (\text{FCA}^*_{ij,t} > Q3[\text{FCA}^*_{ij,t}]) \times \text{FCA}^*_{ij,t} \\ &+ \beta_3 * (\text{FCA}^*_{ij,t} > Q3[\text{FCA}^*_{ij,t}]) \times \text{FCA}^*_{ij,t}\text{SameGroup}_{ij} \\ &+ \sum_{k=1}^{n} \alpha_k * \text{Control}_{ij,t} + \varepsilon_{ij,t+1}\end{aligned} \tag{7}$$

- refer to table 12 high correlation between $(\text{FCA}^* > Q3[\text{FCA}^*]) \times (\text{FCA}^*) \times \text{SameGroup}$ and $(\text{FCA}^*) \times \text{SameGroup}$

4.2.2 Results

Table 12: text

Correlation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) ρ_f	1.00										
(2) ρ	0.11	1.00									
(3) FCA*	0.02	0.01	1.00								
(4) (FCA* > $Q3$[FCA*])	0.02	0.02	0.75	1.00							
(5) (FCA* > $Q3$[FCA*]) × FCA*	0.02	0.02	0.76	0.98	1.00						
(6) (FCA*) × SameGroup	0.03	0.03	0.55	0.60	0.68	1.00					
(7) (FCA* > $Q3$[FCA*]) × (FCA*) × SameGroup	0.03	0.03	0.53	0.63	0.71	0.95	1.00				
(8) SameGroup	0.03	0.03	0.44	0.49	0.54	0.75	0.82	1.00			
(9) SameIndustry	0.01	0.01	0.28	0.30	0.32	0.33	0.36	0.38	1.00		
(10) SameSize	0.01	0.01	0.12	0.12	0.12	0.06	0.07	0.03	0.12	1.00	
(11) SameBookToMarket	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.06	0.11	0.07	1.00

Table 13:

	Dep. Variable: Future Monthly Corr. of 4F+Ind. Residuals				
	(1)	(2)	(3)	(4)	(5)
FCA*	0.00476***	-0.000946	-0.000876	-0.00129	-0.00133
	(4.88)	(-0.93)	(-0.83)	(-1.25)	(-1.32)
(FCA* > $Q3$[FCA*]) × FCA*		0.0129***	0.0109***	0.00581**	0.00584**
		(6.77)	(6.12)	(3.11)	(3.14)
ρ_t			0.124***	0.124***	0.124***
			(4.92)	(4.90)	(4.90)
SameGroup				0.0157***	0.0176***
				(7.09)	(7.21)
SameIndustry					-0.00540**
					(-2.80)
SameSize					0.0115***
					(4.50)
SameBookToMarket					0.00416
					(1.22)
Constant	0.00568***	0.00148	0.00128	0.000297	0.00511***
	(6.30)	(1.39)	(1.34)	(0.33)	(4.19)
Observations	249030	249030	248118	248118	248118
R^2	0.001	0.001	0.034	0.035	0.036

t statistics in parentheses

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

Table 14:

	Dep. Variable: Future Monthly Correlation of 4F+Industry Residuals						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FCA*	-0.00133	-0.000238	-0.000251	-0.00150	-0.000223	-0.00109	-0.00110
	(-1.32)	(-0.28)	(-0.29)	(-1.49)	(-0.27)	(-1.09)	(-1.22)
(FCA* > $Q3$[FCA*]) × FCA*	0.00584**			0.00402		0.00282	0.00283
	(3.14)			(1.88)		(1.23)	(1.27)
(FCA*) × SameGroup		0.00816**		0.00659*	-0.00103		-0.000149
		(3.20)		(2.31)	(-0.20)		(-0.03)
(FCA* > $Q3$[FCA*]) × (FCA*) × SameGroup			0.0120***		0.0132*	0.0102**	0.0103
			(3.85)		(2.14)	(2.75)	(1.66)
Observations	248118	248118	248118	248118	248118	248118	248118
R^2	0.036	0.036	0.036	0.036	0.036	0.036	0.036

t statistics in parentheses

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

Table 15:

	All Firms			Big Firms			Big & Small Firms			Small Firms		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
FCA*	-0.000238	-0.00133	-0.00109	0.00319**	0.000544	0.000480	-0.000936	-0.00212	-0.00209	-0.00199	-0.00138	-0.000247
	(-0.28)	(-1.32)	(-1.09)	(3.15)	(0.34)	(0.30)	(-0.76)	(-1.41)	(-1.41)	(-1.34)	(-0.88)	(-0.16)
$(\text{FCA}^* > Q3[\text{FCA}^*]) \times \text{FCA}^*$		0.00584**	0.00282		0.00861*	0.00771		0.00372	0.00324		0.00674*	-0.00415
		(3.14)	(1.23)		(2.48)	(1.92)		(1.52)	(1.15)		(2.17)	(-1.00)
SameGroup	0.0129***	0.0176***	0.00916**	0.0118*	0.0125**	0.00959	0.0248***	0.0252***	0.0233***	-0.00585	0.0106**	-0.0118
	(4.54)	(7.21)	(2.85)	(2.03)	(2.80)	(1.37)	(5.11)	(6.48)	(4.01)	(-1.42)	(2.89)	(-1.96)
$(\text{FCA}^*) \times \text{SameGroup}$	0.00816**			0.00490			0.00204			0.0224***		
	(3.20)			(1.17)			(0.68)			(6.03)		
$(\text{FCA}^* > Q3[\text{FCA}^*]) \times (\text{FCA}^*) \times \text{SameGroup}$			0.0102**			0.00452			0.00207			0.0290***
			(2.75)			(0.64)			(0.49)			(4.82)
SameIndustry	-0.00505*	-0.00540**	-0.00548**	0.00203	0.00172	0.00126	-0.0131***	-0.0134***	-0.0134***	0.00242	0.00315	0.00189
	(-2.58)	(-2.80)	(-2.81)	(0.39)	(0.33)	(0.24)	(-5.49)	(-5.57)	(-5.62)	(0.84)	(1.12)	(0.67)
Observations	248118	248118	248118	61741	61741	61741	123757	123757	123757	62620	62620	62620
R^2	0.036	0.036	0.036	0.043	0.043	0.046	0.038	0.038	0.039	0.040	0.040	0.041

t statistics in parentheses

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

5 Forecasting Comovement the Presence of Business Groups

5.1 Overview of Business Groups in Tehran Stock Exchange

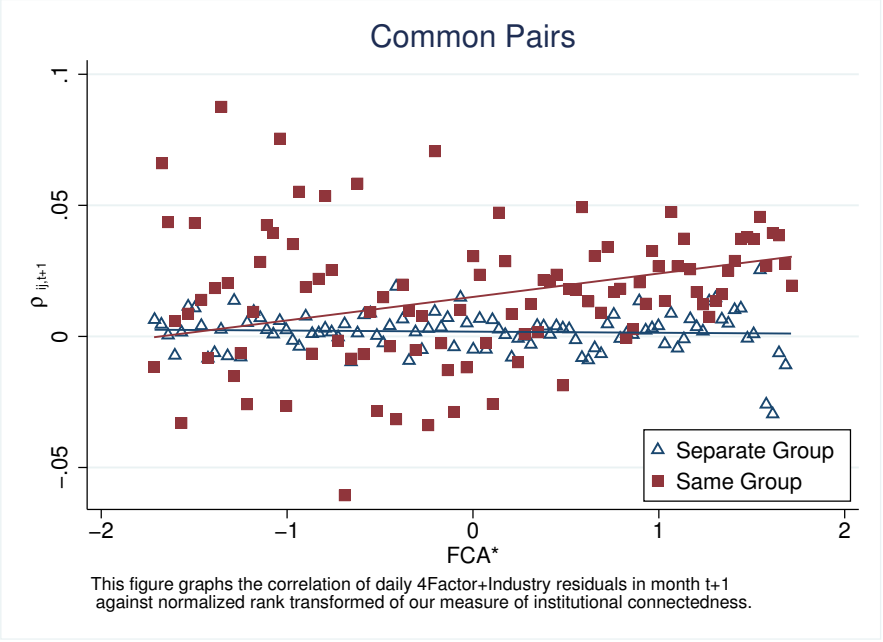
5.2 Modeling Cross-Sectional Variation in Comovement in Business Groups

5.2.1 Effective Business Group

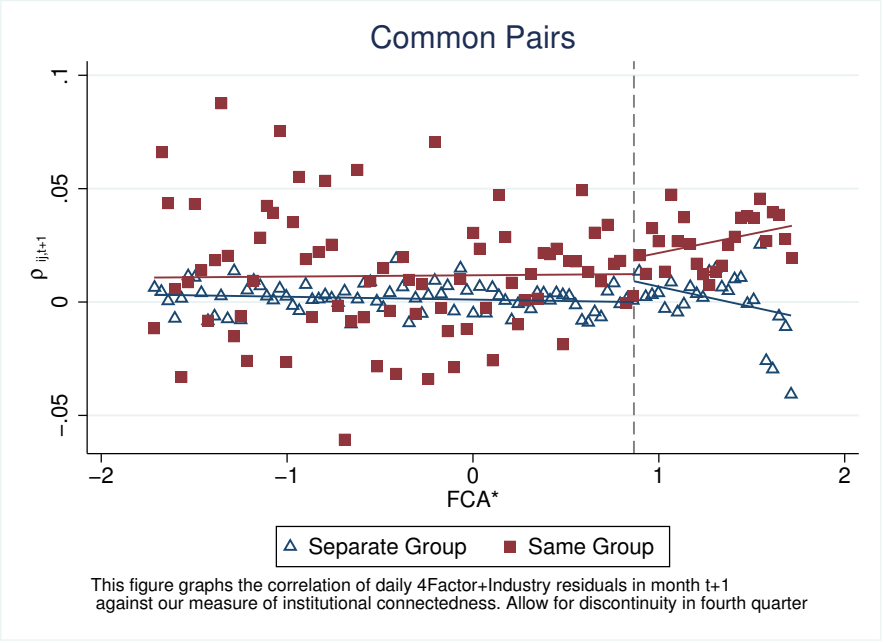
$$\begin{aligned}\rho_{ij,t+1} = \beta_0 + \beta_1 * \mathrm{FCA}^*_{ij,t} + \beta_2 * \mathrm{SameGroup}_{ij} + \sum_1^G \lambda_{1,g} * \gamma_g \\ + \sum_1^G \lambda_{2,g} * \mathrm{SameGroup}_{ij} * \gamma_g + \sum_1^G \lambda_{3,g} * \gamma_g * \mathrm{FCA}^*_{ij,t} \\ + \sum_1^G \lambda_{4,g} \mathrm{SameGroup}_{ij} * \gamma_g * \mathrm{FCA}^*_{ij,t} + \sum_{k=1}^n \alpha_k * \mathrm{Control}_{ij,t} + \varepsilon_{ij,t+1}\end{aligned}$$

5.2.2 Check presence of Banks in Groups

$$\begin{aligned}\rho_{ij,t+1} = \beta_0 + \beta_1 * \mathrm{FCA}^*_{ij,t} + \beta_2 * \mathrm{SameGroup}_{ij} \\ + \beta_3 * \mathrm{FCA}^*_{ij,t} * \ \mathrm{SameGroup}_{ij} + \beta_{10} * \text{Bank is Uo} + \beta_{11} * \text{Bank in group} \\ + \beta_4 * \text{Bank is Uo} * \ \mathrm{SameGroup}_{ij} + \beta_5 * \text{Bank is Uo} * \mathrm{SameGroup}_{ij} * \mathrm{FCA}^*_{ij,t} \\ + \beta_6 * \text{Bank In Group} * \mathrm{SameGroup}_{ij} + \beta_7 * \text{Bank In Group} * \mathrm{SameGroup}_{ij} * \mathrm{FCA}^*_{ij,t} \\ + \sum_{k=1}^n \alpha_k * \mathrm{Control}_{ij,t} + \varepsilon_{ij,t+1}\end{aligned}$$



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



This figure graphs the correlation of daily 4Factor+Industry residuals in month t+1 against our measure of institutional connectedness. Allow for discontinuity in fourth quarter

5.3 Results

5.3.1 Effective Business GRoup

Table 16: text

$\text{SameGroup}_{ij} * \gamma_g$		
Coef.	t	uo
1.77	2.22	Sanat Bank
-0.10	-2.48	Government

$\text{FCA}^*_{ij,t} * \gamma_g$		
0.02	2.23	Saman bank
0.01	2.12	Mirabi
0.01	2.34	Alipour&Keshavarz
0.01	2.15	Tipico
0.01	2.51	Imidro

$\text{SameGroup}_{ij} * \gamma_g * \text{FCA}^*_{ij,t}$		
Coef.	t	uo
0.07	3.60	C.S Pension fund
0.06	2.61	Maskan bank
0.05	2.51	Taira
0.02	3.64	vKosar
0.02	3.16	vSakht
0.02	2.68	Tapico
0.02	2.86	Melli bank
-0.04	-2.19	Imidro
-1.02	-2.17	Sanat Bank

γ_g		
Coef.	t	uo
0.05	3.85	Farhangian
-0.01	-3.36	Bonyad
-0.01	-2.67	Sepah bank
-0.01	-2.11	Basij
-0.01	-2.55	Government
-0.01	-2.18	Tejarat bank

5.3.2 Check presence of Banks in Groups

- **Bank is Uo** Groups that their ultimate owner is bank
- **Bank In Group:** Groups that ,at least, consist of one bank

	De. Variable:Future Monthly Correlation of 4F+Industry Residuals									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FCA*	-0.000307	-0.000294	-0.000303	-0.000299	-0.000189	-0.000199	-0.000204	-0.000161	-0.000183	-0.000180
	(-0.36)	(-0.35)	(-0.36)	(-0.35)	(-0.22)	(-0.24)	(-0.24)	(-0.19)	(-0.22)	(-0.21)
(FCA*) × SameGroup	0.00820**	0.00830**	0.00888***	0.00750*	0.00810**	0.00818**	0.00790**	0.00825**	0.00884***	0.00698*
	(3.22)	(3.28)	(3.53)	(2.64)	(3.19)	(3.20)	(3.01)	(3.27)	(3.52)	(2.49)
SameGroup	0.0130***	0.0131***	0.0106**	0.0121**	0.0125***	0.0130***	0.0132***	0.0127***	0.0110**	0.0131**
	(4.55)	(4.53)	(3.08)	(3.30)	(4.38)	(3.96)	(4.00)	(4.41)	(2.85)	(3.20)
Bank is Uo		0.00140	0.000550	0.000550				0.00214*	0.00132	0.00133
		(1.49)	(0.55)	(0.55)				(2.13)	(1.27)	(1.27)
Bank is Uo × SameGroup			0.00804	0.00381					0.00711	0.00181
			(1.51)	(0.70)					(1.37)	(0.34)
(FCA*) × Bank is Uo × SameGroup				0.00458						0.00570
				(1.33)						(1.68)
Bank in group					-0.00392**	-0.00378**	-0.00378**	-0.00431**	-0.00403**	-0.00404**
					(-2.97)	(-3.30)	(-3.30)	(-3.12)	(-3.35)	(-3.35)
Bank in group × SameGroup						-0.00244	-0.00760		-0.00269	-0.00734
						(-0.42)	(-0.80)		(-0.46)	(-0.76)
(FCA*) × Bank in group × SameGroup							0.00435			0.00313
							(0.64)			(0.48)
Observations	248118	248118	248118	248118	248118	248118	248118	248118	248118	248118
R^2	0.035	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.037	0.037

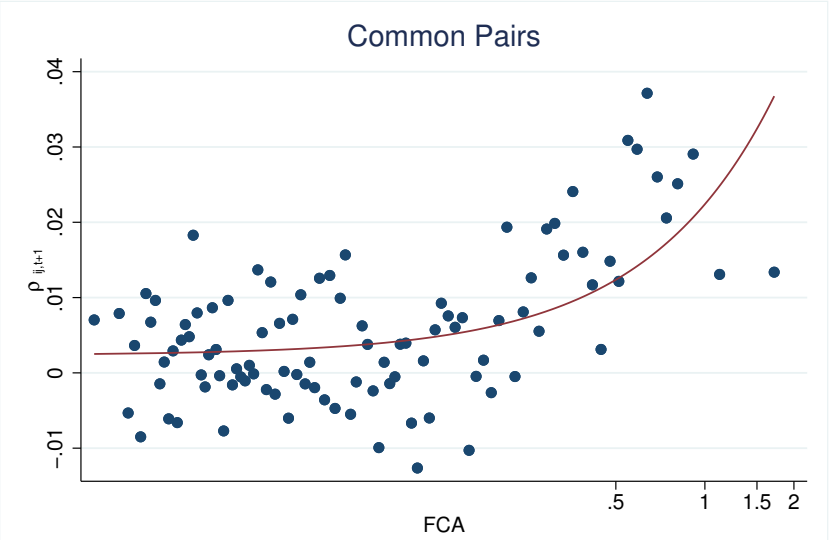
t statistics in parentheses

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

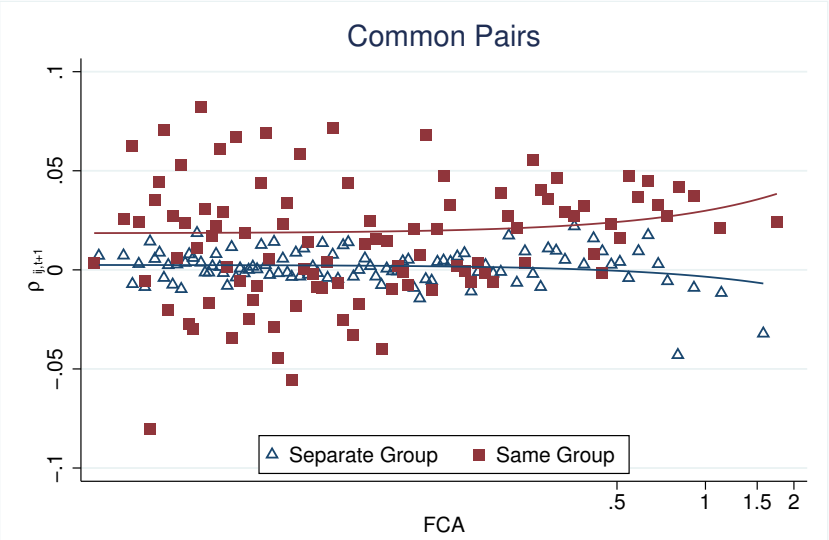
6 Robustness Check

7 Conclusion

Appendix A Logaritmic Transformation



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



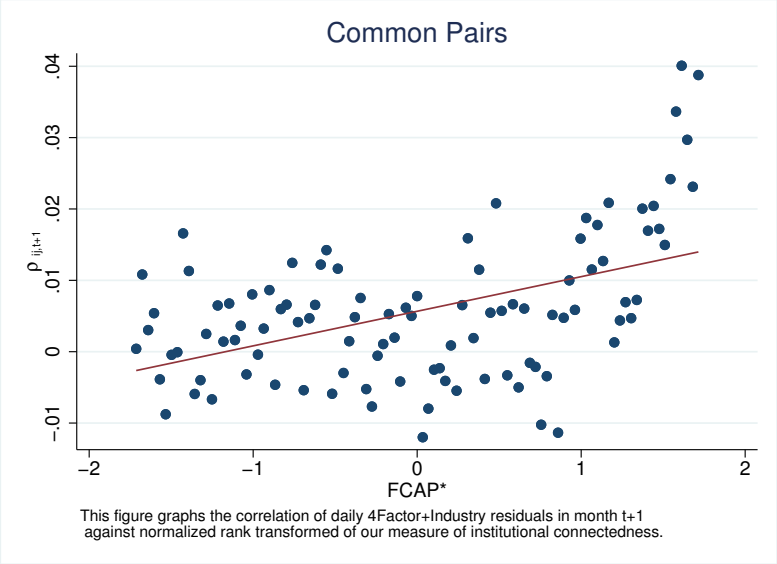
This figure graphs the correlation of daily 4Factor+Industry residuals in monthh t+1 against our measure of institutional connectedness.

	Dependent Variable: Future Monthly Correlation of 4F+Industry Residuals					
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(FCA)$	0.00420***	0.00351***	0.000907	-0.000249	-0.0000972	-0.000260
	(5.55)	(5.88)	(1.24)	(-0.32)	(-0.13)	(-0.36)
ρ_t		0.124***	0.124***	0.124***	0.124***	0.124***
		(4.92)	(4.90)	(4.90)	(4.90)	(4.90)
SameGroup			0.0176***	0.0269***	0.0284***	0.0286***
			(7.84)	(7.11)	(6.76)	(6.92)
$(\ln(FCA)) \times$ SameGroup				0.00582**	0.00589**	0.00574**
				(3.43)	(3.41)	(3.34)
SameIndustry					-0.00417*	-0.00518*
					(-2.13)	(-2.64)
SameSize						0.0116***
						(4.58)
SameBookToMarket						0.00428
						(1.27)
Constant	0.0167***	0.0141***	0.00420	0.000755	0.00159	0.00563*
	(7.38)	(7.77)	(1.92)	(0.32)	(0.74)	(2.61)
Observations	249030	248118	248118	248118	248118	248118
R^2	0.001	0.034	0.034	0.035	0.035	0.036

t statistics in parentheses

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

Appendix B 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)
FCAP*	0.00513***	0.00424***	0.00127	0.0000453	0.000188	-0.000110
	(5.33)	(5.73)	(1.46)	(0.05)	(0.22)	(-0.13)
ρ_t		0.124***	0.124***	0.124***	0.124***	0.124***
		(4.92)	(4.90)	(4.89)	(4.89)	(4.90)
SameGroup			0.0176***	0.0100**	0.0114***	0.0120***
			(8.16)	(3.43)	(3.94)	(4.16)
(FCAP*) × SameGroup				0.00904**	0.00912**	0.00900**
				(3.13)	(3.12)	(3.08)
SameIndustry					-0.00414*	-0.00513*
					(-2.12)	(-2.62)
SameSize						0.0116***
						(4.59)
SameBookToMarket						0.00443
						(1.31)
Constant	0.00568***	0.00482***	0.00187*	0.00166*	0.00206**	0.00654***
	(6.30)	(6.07)	(2.56)	(2.20)	(2.85)	(6.33)
Observations	249030	248118	248118	248118	248118	248118
R^2	0.001	0.034	0.034	0.035	0.035	0.036

t statistics in parentheses

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

Appendix C Fortnightly Frequency

References

[1] Esmaeil Aliabadi et al. "Internal Capital Markets in Business Groups: Evidence from an Emerging Market". 2021.

[2] Heitor Almeida et al. "The structure and formation of business groups: Evidence from Korean chaebols". In: *Journal of Financial Economics* 99.2 (2011), pp. 447–475.

[3] Miguel Anton et al. "Connected Stocks". In: *The Journal of Finance* 69.3 (2014), pp. 1099–1127.

[4] José Azar. "A new look at oligopoly: Implicit collusion through portfolio diversification". 2011.

[5] José Azar et al. "Anticompetitive effects of common ownership". In: *The Journal of Finance* 73.4 (2018), pp. 1513–1565.

[6] Mark M. Carhart. "On Persistence in Mutual Fund Performance". In: *The Journal of Finance* 52.1 (1997), pp. 57–82.

[7] Kayla Freeman. "The effects of common ownership on customer-supplier relationships". In: *Kelley School of Business Research Paper* 16-84 (2019).

[8] Erik P Gilje et al. "Who's paying attention? Measuring common ownership and its impact on managerial incentives". In: *Journal of Financial Economics* 137.1 (2020), pp. 152–178.

[9] Robert G Hansen et al. "Externalities and corporate objectives in a world with diversified shareholder/consumers". In: *Journal of Financial and Quantitative Analysis* (1996), pp. 43–68.

[10] Jarrad Harford et al. "Institutional cross-holdings and their effect on acquisition decisions". In: *Journal of Financial Economics* 99.1 (2011), pp. 27–39.

[11] JieJack He and Jiekun Huang. "Product market competition in a world of cross-ownership: Evidence from institutional blockholdings". In: *The Review of Financial Studies* 30.8 (2017), pp. 2674–2718.

[12] JieJack He, Jiekun Huang, and Shan Zhao. "Internalizing governance externalities: The role of institutional cross-ownership". In: *Journal of Financial Economics* 134.2 (2019), pp. 400–418.

[13] Katharina Lewellen et al. "Does common ownership really increase firm coordination?" In: *Journal of Financial Economics* (2021).

[14] Melissa Newham et al. "Common Ownership and Market Entry: Evidence from Pharmaceutical Industry". 2018.