The Economic Effects of Institutional Investor Networks: Evidence from Europe and the United States

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Abstract

As the assets under management of the largest institutional fund managers have increased over the past several decades, changes to firm and investor incentives resulting from the evolving ownership structure of the equity market could lead to undesirable economic consequences. This paper analyzes the potential for common and cross-ownership among institutional investors to affect market concentration, firm salary and benefits expenditures, and firm market performance. Utilizing network centrality measurements to capture the extent of common and cross-ownership establishes significant intertemporal correlations between investor centrality and industry concentration. Additionally, it finds that an increased investor centrality leads to lower firm salary and benefit spending as a proportion of total assets. Finally, it finds positive correlations between centrality and Tobin's Q and determines an interaction effect between investor centrality and whether the industry concentration is higher than average.

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1. Motivation

Over the past fifty years, the assets under management of large financial institutions have substantially increased to best manage the funds of their customers. These institutional investors include but are not limited to commercial banks, hedge funds, mutual funds, pension funds, and insurance companies that frequently buy and sell large equity positions of firms to invest on behalf of their clients. According to the Thinking Ahead Institute report on the world's largest fund managers (2018), the total discretionary assets under management of the top 500 largest fund managers reached 91.5 trillion U.S. dollars in 2018, over a 90% growth since 2008. The rapid growth of institutionally controlled assets results from several trends arising throughout the evolution of investment markets in the past few decades.

Foremost, there has been a decrease in the direct ownership of individual stocks as investors have shifted to fund units in order to take advantage of broader diversification and the services of professional portfolio managers. Rydqvist et al. (2012), report that households directly owned 90% of the stock market within the United States. This fell to just 30% by 2010, which they attribute to changes in tax policy. Additionally, according to Fichtner et al. (2017), the increase in popularity of passive index funds is particularly notable, as the assets under management for both index mutual funds and exchange-traded funds doubled from 2011 to 2014. They illustrate that the passive index fund industry is predominantly concentrated, where the top three institutional asset managers controlled 71% of the market share by 2016. For these three institutions, over 80% of their total equity assets under management constituted passive index funds.

While the activities of these institutions can enable the provision of diverse banking products, the economic implications of the rapid holdings growth of large fund managers can potentially lead to consequences for the markets of the firms in which they choose to invest. Recent literature on institutional investors highlights the effect of common and cross-ownership within equity markets. The former results when a given investor acquires minority shareholdings of multiple competing firms within a single industry. The latter refers to a situation in which a given firm's direct ownership position is held by its competitor. These two effects lead to the creation of dense investor relationship networks and can cause substantial changes to the incentives of companies and equity holders. Of particular concern is the potential for unilateral changes to product prices, quantities, or innovation stemming from the incentivization of anticompetitive behavior. Some have even proposed that antitrust authorities should intervene to prevent such unilateral effects (Rock, 2017). Deviations from the market equilibrium are unprofitable within a perfectly competitive market; however, in the case of

imperfect competition, common and cross-ownership can produce profitable incentives to raise prices at the expense of market share. As illustrated by Salop and O'Brien (2000), a theoretical example incorporating cross-ownership explains that firms will weigh the benefits of a product price increase with the cost of losing market share to competitors. A firm holding a proportion of ownership in any of its competitors partially recoups a decrease in market share by the increased profits from the equity position. Therefore, the increase in prices could be considered profitable under this theoretical framework. The incentives explained within this example also apply to a situation involving common ownership of an institutional investor. The decreased investment returns from a firm's loss in market share would also be recouped through portfolio holdings of the firm's competitors. This motivation to institute these unilateral price changes assumes that institutional investors have enough power to influence managerial decisions within these firms.

1.1 Means of Institutional Investor Influence

Because many blockholders often hold only minor financial stakes in their investment targets, it is worth questioning how and to what extent an investor can influence these companies' managerial decisions. Azar et al. (2017) propose three primary direct mechanisms with which blockholders can influence the corporate governance of companies in which they invest. The first method, voice, is characterized by large asset managers holding private engagement meetings with firm leaders, where they can directly try to influence managerial decisions. The second mechanism involves incentivizing actions by threatening the sale of shares. If a particular investor holds a significant enough equity position in a firm, the threat of short-term price changes from a rapid sell-off could potentially influence managerial decisions. The last proposed mechanism utilizes the investors' ability to vote at shareholder meetings. Even when an investor holds a minority interest in a given firm, they can still exercise significant control through shareholder voting rights due to two factors: the attendance and engagement level of non-institutional investors could be low in comparison to that of large asset managers and multiple institutional investors with aligned incentives could form a voting coalition and amplify the influence of their votes.

1.2 Plan of the Paper

This paper examines the potential economic effects of investment networks created by institutional blockholders, most particularly, changes to market concentration, labor costs, and firm market performance. The remainder of the paper's organizational structure is as follows:

Section 2 outlines the related empirical literature and introduces the hypotheses. The research methodology, details about the data variables, and descriptive statistics are provided in Section 3, while Section 4 explains the main findings and robustness checks. Finally, Section 5 provides some conclusory remarks.

2. Related Literature and Hypothesis Development

Although much theoretical research has been conducted on the effect of investor portfolio diversification on product competition[1], the majority of empirical work focusing on common ownership is fairly recent. Most of this literature specifically analyzes firms within the banking and finance industries. For example, Azar et al. (2016) attribute changes in certified deposit account interest rates and fees of branch-level banks to the extent of common and cross-ownership, captured by a generalized Herfindahl-Hirschman Index (GHHI). Similarly, Gramlich and Grundl (2017) analyze the effects of common ownership within the banking industry, utilizing a modified HHI (MHHI). Their findings were generally consistent with Azar et al. (2016), with significance being sensitive to model specification. The effects of common ownership within the United States airline industry are explored in Azar et al. (2018). They also utilize MHHI to measure the extent of common ownership concentration and find a causal link between it and route level prices. Antón et al. (2018) explore how the magnitude of common ownership influences executive financial incentives across multiple industries. They theorize that a diversified investor wishing to reduce competition would advocate for more modest managerial compensation in order to discourage higher effort. Empirically, they demonstrate a link between common ownership and a reduction in managerial incentives to compete. This paper's methodology is most closely related to Bajo et al. (2020). They construct three centrality measures for investors within common ownership networks and find a positive effect from investor connectedness on firm performance.

As described in the related literature, the incentives created due to common ownership by institutional investors could lead to the encouragement of anticompetitive behavior and introduce inefficient unilateral effects within the markets of firms in which they invest. This paper attempts to quantify the influence of the largest institutional investors, beginning with consequences to market concentration. Because diversified investors have a theoretical incentive to encourage anticompetitive behavior, one would expect to see increasing market concentrations resulting from the escalation of common ownership. This introduces the first testable hypothesis:

[1] See, for example, Rotemberg (1984), Hansen and Lott (1996), Gordon (2003), Rubin (2006), and Azar (2017).

H1: *A high extent of common ownership and investor influence, captured by network centrality, has a positive effect on market concentration, measured by HHI.*

Assuming that there are significant enough changes to market concentrations, undesirable implications to labor markets could arise. Foremost, a general rise in market concentration would lead to a drop in the demand for labor, especially for salaried administrative positions. Sharma and Rotthoff (2019) empirically show a link between market concentration (measured by HHI) and the number of positions within the insurance industry. They also show an inverse relationship between concentration and the share of labor. Additionally, consistent with Antón et al. (2018), investors wanting to promote anticompetitive behavior would advocate for lower management and executive salaries in order to decrease employee motivation. This introduces the second hypothesis of this paper:

H2: *An increase in the extent of common ownership and investor influence, captured by network centrality, will lead to a decrease in the labor expenditures of firms.*

If investors are successful in promoting anticompetitive behavior between companies, further implications concerning firm market performance could arise. As tested in Bajo et al. (2020), the acquisition of a substantial financial position in a firm by an influential investor could provide a positive signal to other investors within the equity market. Such signals even have the potential to affect stock prices. This leads to the third testable hypothesis:

H3: *The extent of common ownership and investor influence, captured by network centrality, will have a positive influence on firm market performance, measured by Tobin's Q.*

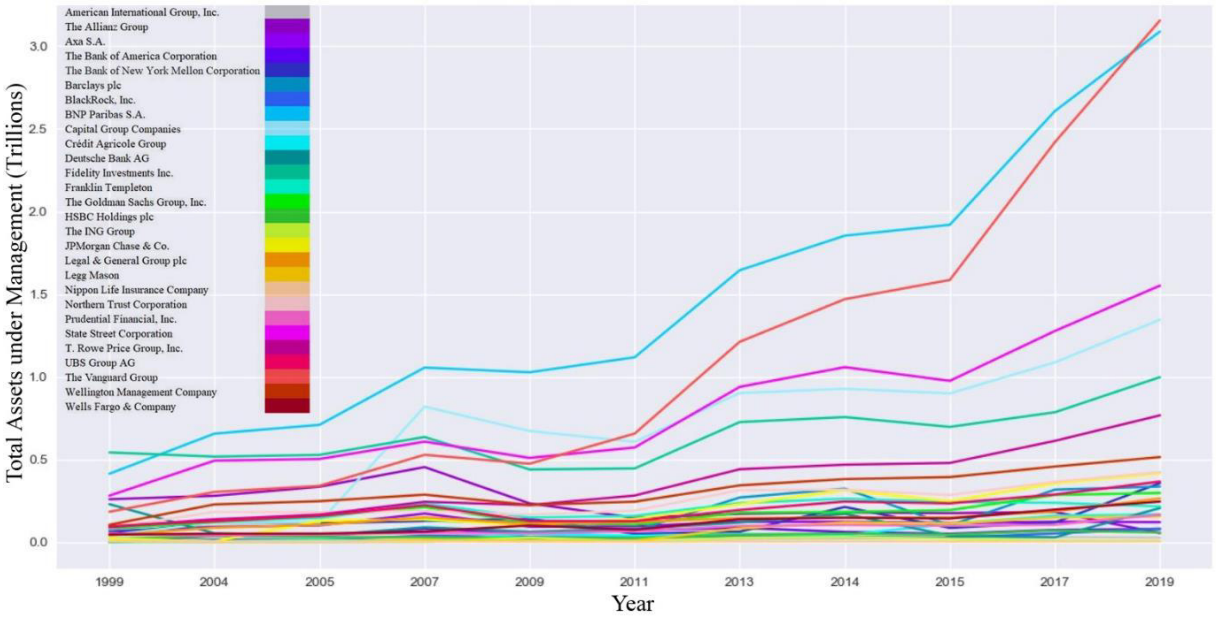
By utilizing multiple measurements for network centrality, these hypotheses can be tested to clarify the competitive effects that common ownership of institutional investors can have.

3. Data, Descriptive Statistics, and Methodology

To isolate the holdings data of institutional blockholders, the data collection process began by identifying the top twenty asset managers over the past twenty years. This ranking is

available from the Thinking Ahead Institute, which publishes a yearly report on the top 500 largest fund managers. Subsidiary and branch names for each of these firms were collected from annual reports, corporate structure documents, and SEC form 13F filings in order to group collected holdings information by each parent investor. Information on the specific sources of this subsidiary information is contained in Appendix A. For this paper's purposes, data on the institutional holdings of public firms incorporated in either the United States or Europe was collected for various years between 1999 and 2019 from the Thomson Reuters financial dataset. The holdings of each parent investor are shown below in Figure 1. The rapid growth of assets under management of the top two investors is notable, as it illustrates a rising market concentration within the fund management industry. Additional financial data was queried from Thomson Reuters to construct the firm financial dataset containing financial accounting control variables. These variables are discussed further in Section 3.3 and 3.4, and detailed information about all variables is available in Appendix B of this paper.

Figure1: Holdings of Top Institutional Asset Managers

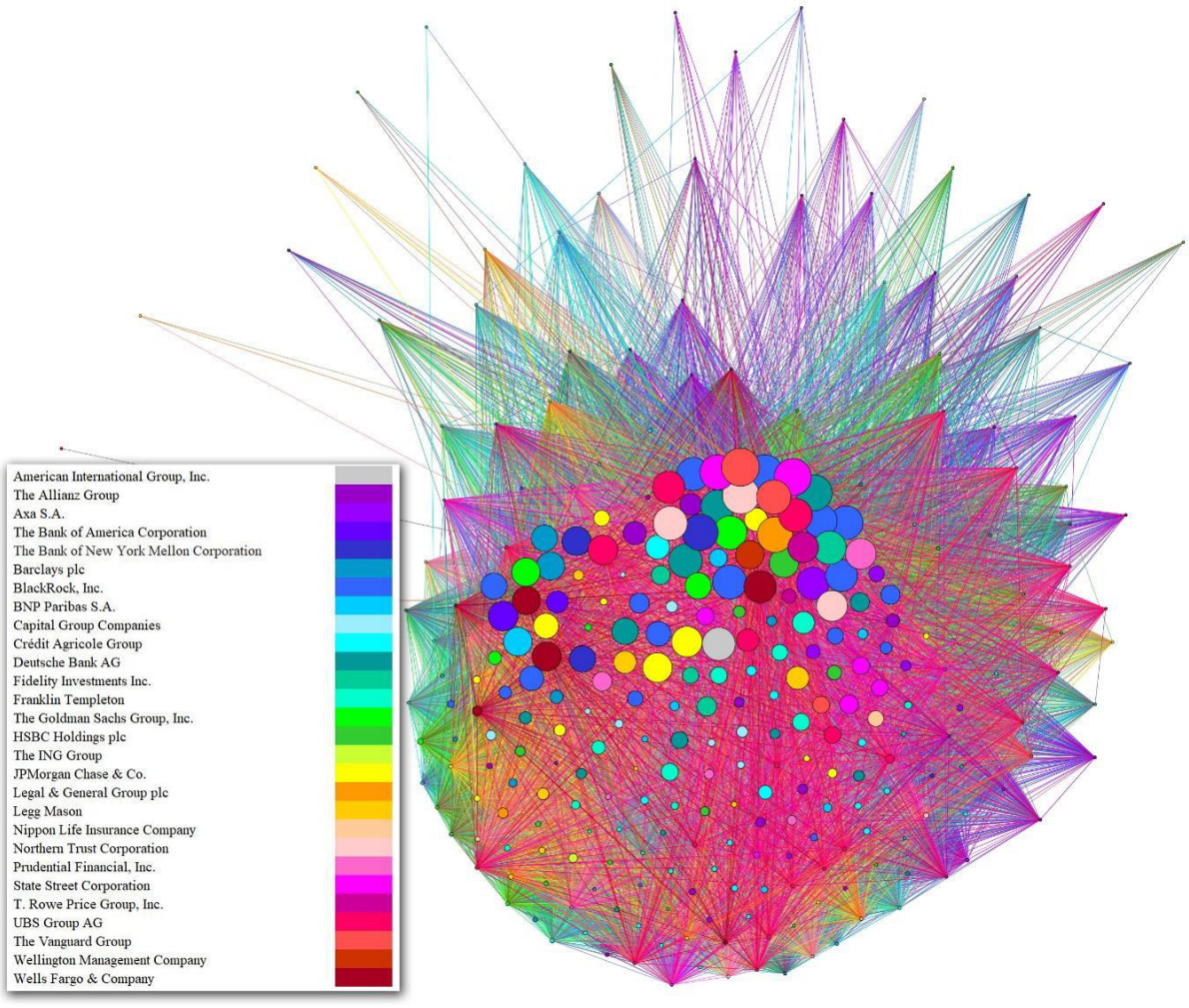


3.1 Network Centrality Variables

In the context of common and cross-ownership, networks and graph theory are useful for illustrating complex relationships and quantifying investor heterogeneity in terms of their relative influence. With large institutional investors holding significant financial interests in many firms, stakeholders become intertwined in an intricate network of direct relationships (investors holding a direct financial interest in a firm) and indirect relationships (two different investors sharing a financial interest in a firm). Within graph theory, this type of network is referred to as "bipartite" because it contains two separate agent types. Following Bajo et al.

(2020), this structure is compressed utilizing one-mode projection. This creates a new network, where the agents are exclusively institutional investors, and the connections represent a common financial interest in a given firm. From this structure, each investor can be ordered in terms of their total connectedness within the network, or relative *centrality,* which dynamically changes over time. For each year of institutional holdings data, the network's structure evolves as new agents emerge and leave. Figure 2 below shows the investor network for 2019, where each node represents a unique investor, the node size reflects the investor's centrality, and the color corresponds to its respective parent company within the top institutional asset managers. Additional visualizations for each year are contained in Appendix C of this paper. As the assets under management expand each year for the parent companies, the total number of nodes, as well as the overall densities of the networks, have also increased. These network illustrations offer a unique insight into the complexity of the relationship structures that common and cross-ownership introduce into equity markets.

Figure 2: Institutional Investor Network 2019



Within empirical sociological research, network centrality is frequently used as a proxy for prestige and influence (Burt, 1980). According to Bajo et al (2020), "A blockholder which is more densely connected to other active institutional investors is likely to hold a more privileged position within the network of active institutional investors" (p. 69). Additionally, the more diversified an investor is, the more likely, it will have a high centrality measure.

The *degree centrality* measure is foremost utilized for this analysis, quantified by the total number of connections a particular investor has to other investors in the network. This is done by creating a binary investor adjacency matrix, with the investor names listed on each axis and the respective element of the two investors indicating their relationship. Here, a shared common interest of investors *i* and *j* would be indicated with the number one within their respective matrix entries, and no common interest with a zero. The degree centrality for investor *i* is formally expressed as :

$$d_i = \sum_{i \neq j}^{N} x_{ij} \tag{1}$$

where *i* and *j* indicate the investor names as well as the matrix row- and column-indicators, $x_{i,j}$ is the corresponding adjacency matrix value, and *N* represents the total investors within the network. Because the network is temporally dynamic, the number of connections will vary each year, on which the degree centrality measure is dependent. In order to conduct time-series analysis, the centrality measure is standardized by dividing it by the total number of investors minus one (*N* - 1), formally:

$$d_i^N = \frac{\sum_{i \neq j}^{N} x_{ij}}{(N-1)} \tag{2}$$

This standardized measure can be interpreted as the percentage of total possible connections a given investor has to the rest of the network.

In addition to the degree centrality, three modified centrality measures were calculated to indicate multiple network connections between two given investors. Within the adjacency matrix created through the binary degree calculation, each investor pair's matrix entry will have a maximum value of one, ignoring the case where two investors have multiple shared financial interests in several firms. To account for this possibility, a *cumulative centrality* is calculated by capturing multiple connections to a given investor and standardizing again by the number of total investors minus one. The formal notation for the cumulative centrality measurement is

identical to that of the binary case, except that the adjacency matrix value $x_{i,j}$ captures the total number of financial connections between investors *i* and *j*.

Finally, the two additional centrality measures express the extent of shared monetary connectedness between investors. Again, the formal notations of these dollar centrality measurements are similar to that of the degree centrality; however, the matrix value $x_{i,j}$ represents the sum of financial ties in dollars between investors *i* and *j*. Both the mean and minimum values of the investor holdings of a given firm are utilized to quantify each financial tie between the two investors. Like the cumulative centrality measurement, multiple connections between two investors are captured. The formal notations for the matrix value $x_{i,j}$ under both monetary centrality measurements are shown below.

$$x_{ij} = \sum_{k=1}^{N} \min \{h_{i,k}, h_{j,k}\} \tag{3}$$

$$x_{ij} = \sum_{k=1}^{N} \frac{h_{i,k} + h_{j,k}}{2} \tag{4}$$

Here *k* represents a firm in which both investors *i* and *j* own a financial interest. *N* represents the total number of these firms. The dollar centrality types are both standardized by the total monetary value of all institutional holdings. Summary statistics for the investor centrality measurements over the years of collected institutional holdings data are contained below in Table 1.

Table 1: Institutional Holdings Summary Statistics

Year	Institutional Held Firms	Institutional Investors	Degree Centrality (mean)	Degree Centrality (std dev)	Cumulative Centrality (mean)	Cumulative Centrality (std dev)	Dollar Centrality Min (mean)	Dollar Centrality Min (std dev)	Dollar Centrality Average (mean)	Dollar Centrality Average (std dev)
1999	11190	185	0.524	0.282	63.384	88.662	0.042	0.102	0.302	0.660
2004	8634	236	0.580	0.283	62.851	87.722	0.036	0.096	0.285	0.645
2005	8531	244	0.608	0.277	68.743	93.682	0.038	0.098	0.288	0.634
2007	9118	280	0.569	0.276	85.553	122.029	0.042	0.103	0.289	0.605
2009	8409	316	0.551	0.277	87.917	128.273	0.042	0.104	0.295	0.662
2011	7598	309	0.585	0.274	93.942	133.594	0.041	0.101	0.301	0.711
2013	7399	338	0.565	0.275	96.681	150.788	0.040	0.102	0.281	0.704
2014	7468	312	0.622	0.267	121.006	174.871	0.046	0.108	0.313	0.752
2015	7489	296	0.672	0.256	139.960	193.947	0.042	0.103	0.335	0.815
2017	7440	310	0.687	0.256	147.887	201.640	0.041	0.102	0.342	0.893
2019	8015	310	0.714	0.256	192.620	242.449	0.048	0.108	0.399	1.024

The yearly average connectivity level follows an upward trend for each centrality calculation method, especially for the degree centrality and cumulative centrality types. Additionally, the relative standard deviations for each connectivity measurement remain

somewhat constant. Because there is such a substantial increase in the total institutional assets under management throughout the years within this analysis, a general increase in the average connectivity measurements is expected.

After the creation of each centrality type, the firm-level investor centrality variables are created by taking the sum of the investor centrality levels weighted by the percent holdings they possess for the respective company. For the years of missing centrality data, the values from the last available year are carried forward, making the assumption that firm-level investor centrality remains constant through any missing years.

3.2 Industry Concentration

To capture industry concentration within this analysis, the Herfindahl-Hirschman Indices (HHI) are created for each industry with all available firm financial data. The Herfindahl-Hirschman Index is a common tool of the United States Department of Justice when analyzing antitrust cases[2]. Using each company's four-digit SIC code, industries were specified according to the Fama 48 industry portfolio classifications. Once the industries have been identified and labeled, the HHI for a given market is calculated with the sum of each firm's market share squared. Formally this is expressed as:

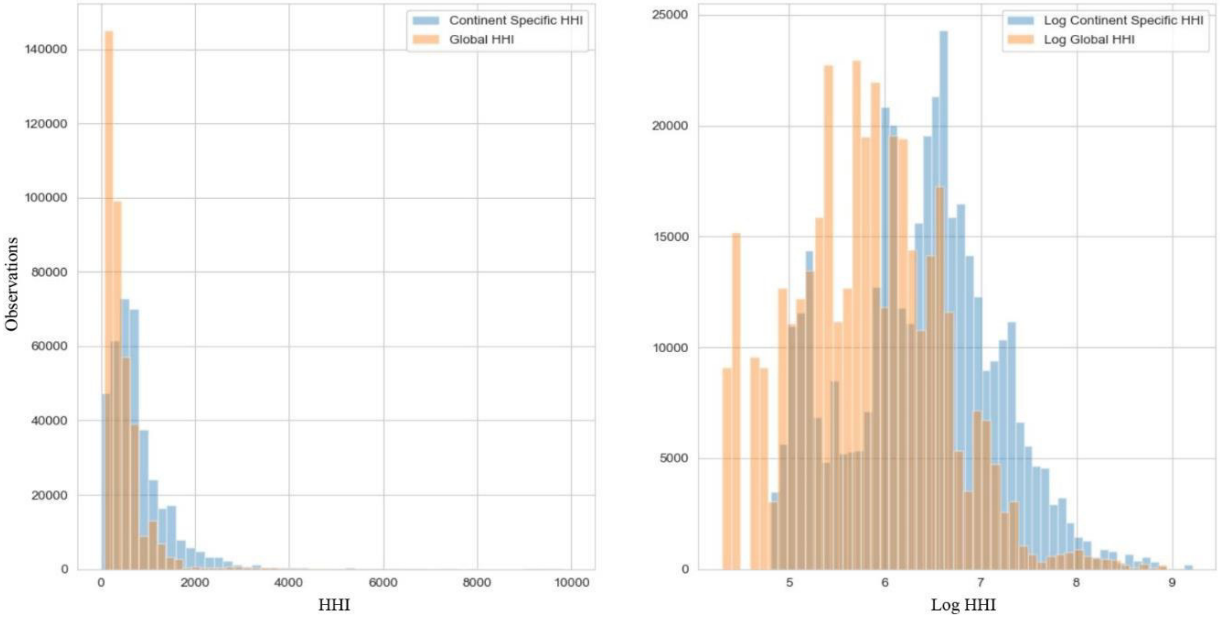
$$HHI = \sum_{i=1}^{N} (s_i \times 100)^2 \quad (5)$$

where s_i represents firm i's percent market share expressed as a decimal, and N is the total number of firms within the industry. Because the extent of international operations varies across industries, the HHI values are calculated for two scenarios. Under the first, it is assumed that firms maintain an international customer base, operate in a global market, and therefore generate sales from both the United States and Europe. This assumption leads to a generally lower HHI value, indicating a less concentrated market. The second scenario separates the U.S. and European markets, creating separate industry concentration measures for both geographical regions. Given this assumption of separate markets, the HHI values are higher on average, indicating higher market concentrations. This distinction between the two scenarios is

[2] The HHI serves as a scale between zero and 10,000. According to the U.S. Department of Justice and FTC Horizontal Merger Guidelines (2010), markets with an HHI measurement between 1,500 and 2,500 are classified to be moderately concentrated. Above 2,500 is highly concentrated. Additionally, any merger and acquisition agreements within a highly concentrated market that would lead to an increase of the market HHI by 200 or more are considered likely to increase market power.

particularly evident below in Figure 3, where the distributions of both competition measures are demonstrated.

Figure 3: Distribution of Continent Specific and Global HHI Measurements



3.3 Other Dependent Variables

To test the second hypothesis regarding the effects of institutional common and cross-ownership on the labor market, information on the total salary and benefits costs for all firms in the financial dataset was collected and standardized by the firm's total assets. The third hypothesis test requires a proxy for firm market performance, for which the Tobin's Q ratio is calculated for each firm.

3.4 Analysis Controls

Following Bajo et al. (2020) financial controls were constructed to control for differences in firm characteristics. First, the value of total assets is taken to proxy firm size, as larger firms likely have fewer growth opportunities, which could have a direct negative impact on market performance. Return on assets is used to proxy firm profitability and sales growth to capture growth opportunities. The firm's ratio of debt to assets controls for firm risk, while research and development costs, capital expenditures, and the net property, plant, and equipment account for both recent and long-term investments. Finally, the firms' intangible assets are used to control for firm opaqueness. All firm financial controls, with the exception of sales growth, are standardized by the firms' total assets and lagged one year. Additionally, all financial controls were winsorized to a degree of 0.5%, and financial firms were removed from the analysis. Detailed information about each variable is provided in the appendix of this paper.

In addition to the firm financial controls, testing the second hypothesis requires additional data to control for country differences in labor market regulations. The Heritage Foundation's Index of Economic Freedom incorporates a Labor Freedom dimension that, according to the most recent report:

> is a quantitative measure that considers various aspects of the legal and regulatory framework of a country's labor market, including regulations concerning minimum wages, laws inhibiting layoffs, severance requirements, and measurable regulatory restraints on hiring and hours worked (2020, p. 495).

This particular aspect of the Economic Freedom Index is sufficient to account for the country-specific regulations that could influence firm labor expenditures.

Altogether, the final panel dataset contains 109,532 firm-year observations. The summary statistics for all controls are provided below in Table 2.

Table 2: Summary Statistics for Firm Characteristics

Variable	Mean	Median	Min	Max	Std. Dev
Binary Degree Centrality	0.856	0.870	0.000	0.987	0.092
Cumulative Centrality	352.153	341.343	0.000	831.067	181.763
Dollar (Min) Centrality	0.331	0.376	0.000	0.752	0.195
Dollar (Mean) Centrality	2.596	2.532	0.000	12.572	1.897
Firm Size	13.029	13.004	4.804	18.706	2.207
CAPEX	0.048	0.031	0.000	0.478	0.058
R&D	0.043	0.000	0.000	1.421	0.114
NPPE	0.262	0.173	0.000	0.969	0.253
Sales Growth	0.239	0.070	-1.000	17.436	1.276
ROA	-0.046	0.030	-7.435	0.611	0.402
Leverage	0.247	0.205	0.000	3.713	0.265
Intangibles	0.189	0.112	0.000	0.856	0.205
Log Continent HHI	6.442	6.510	4.810	9.210	0.783
Log HHI	5.933	5.941	4.326	9.024	0.766
Tobin's Q	2.481	1.602	-24.070	53.261	4.227
Observations	109,532				

With the inclusion of the salary expenditure and labor regulation data, the panel data set diminishes to 32,322 firm-year observations. This is due to the limited availability of firm salary expenditure data, and because the Economic Freedom Index did not implement a labor freedom dimension until 2005. The summary statistics for the labor regressions data set are available below in Table 3, which appear consistent with those from the larger sample.

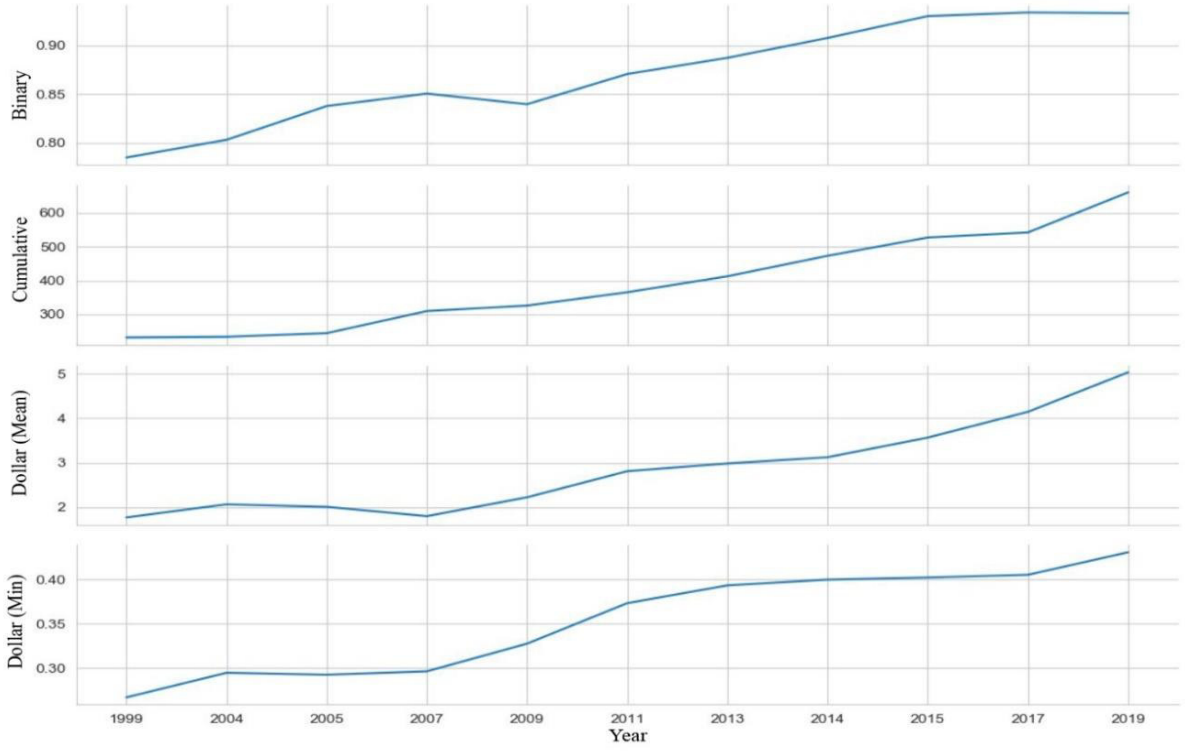
Table 3: Summary Statistics for Labor Dataset

Variable	Mean	Median	Min	Max	Std. Dev
Binary Degree Centrality	0.867	0.883	0.000	0.987	0.105
Cumulative Centrality	322.447	296.494	0.000	831.067	187.261
Dollar (Min) Centrality	0.244	0.216	0.000	0.752	0.187
Dollar (Mean) Centrality	1.957	1.252	0.000	12.572	1.814
Firm Size	13.303	13.289	4.804	18.706	2.246
CAPEX	0.044	0.028	0.000	0.478	0.052
R&D	0.023	0.000	0.000	1.421	0.080
NPPE	0.251	0.169	0.000	0.969	0.249
Sales Growth	0.208	0.062	-1.000	17.436	1.230
ROA	0.000	0.036	-7.435	0.611	0.271
Leverage	0.236	0.205	0.000	3.713	0.226
Intangibles	0.213	0.146	0.000	0.856	0.212
Log Continent HHI	6.461	6.536	4.810	9.210	0.826
Log HHI	5.930	5.940	4.481	9.024	0.750
Salary Expenditure	0.244	0.180	0.000	2.150	0.257
Observations	32,322				

3.5 Descriptive Statistics

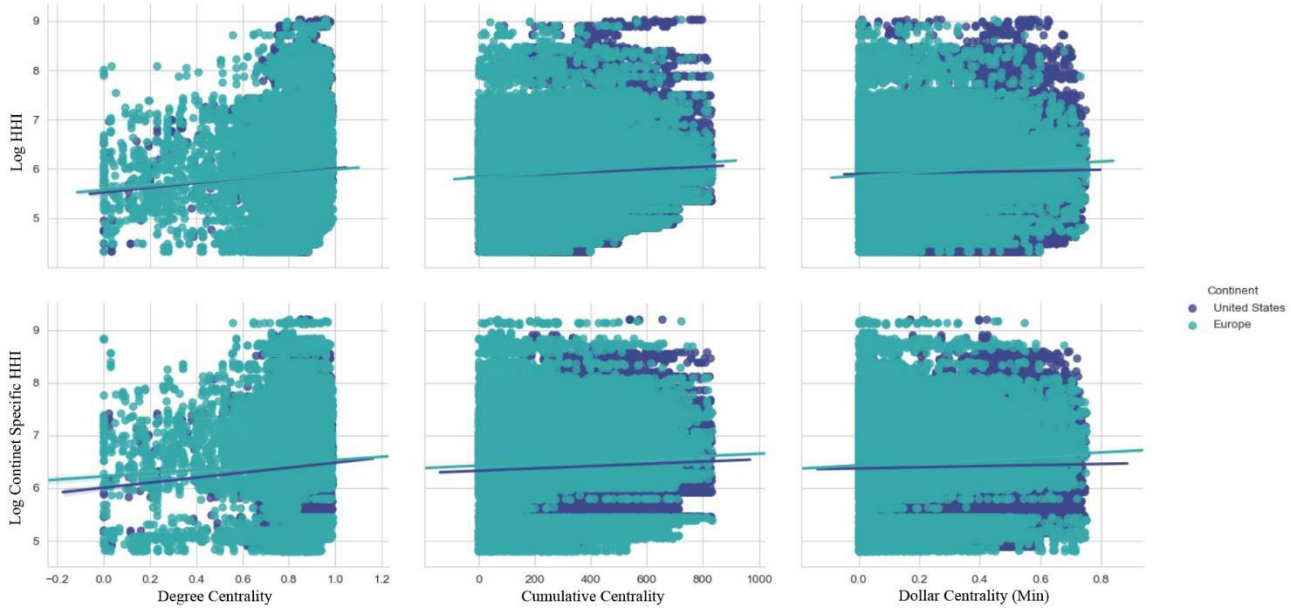
Because the total assets under management of the top institutional investors have increased each year, it is reasonable to predict a similar increase in the average weighted firm-level investor centrality measures. As investors increase their total holdings, diversification increases, intertwining them further within the network. This trend is shown below in figure 4, where the yearly averages of all four weighted investor centrality measures increase together over time.

Figure 4: Yearly Average Firm-level Centrality



With the investor connectivity measures and endogenous variables fully constructed, scatterplots were formed to determine possible correlations visually. Although this is only a univariate analysis, it could provide some qualitative confirmation of the hypotheses proposed in Section 2. Each scatterplot is divided between United States and European firm observations, including geographic-specific regression lines. Figure 5 below indicates the relationships between three different investor centrality measures and the log-transformed market concentration indicators.

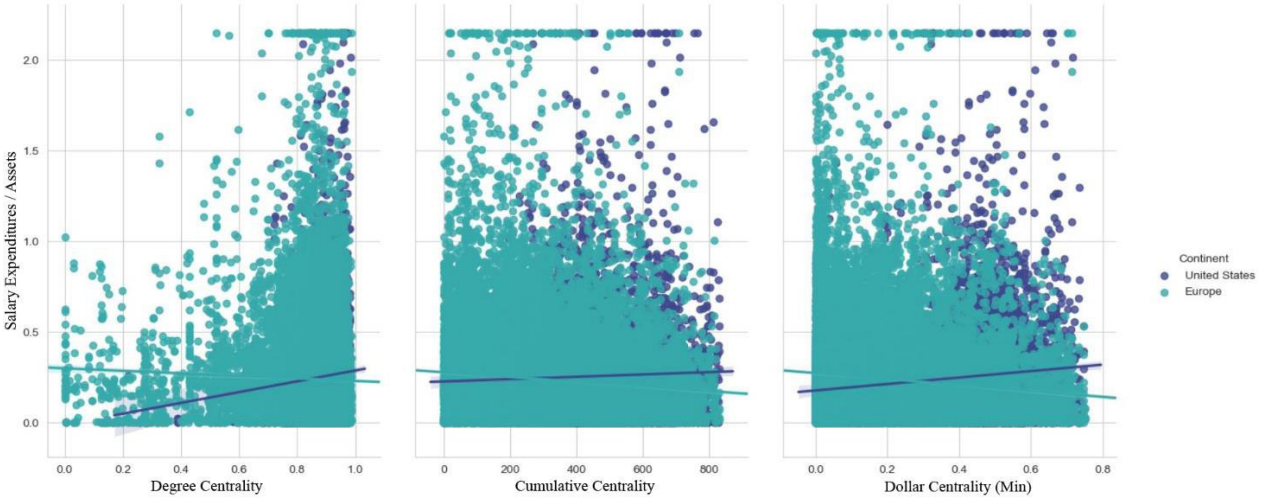
Figure 5: Investor Centrality against HHI Scatterplots



Clearly, there is much overlap between the U.S. and European observations, while the directions of regression lines remain consistent across both market concentration measurement types. Overall, the positive correlations indicated by these lines can qualitatively support a positive relationship between investor network centrality and market concentration.

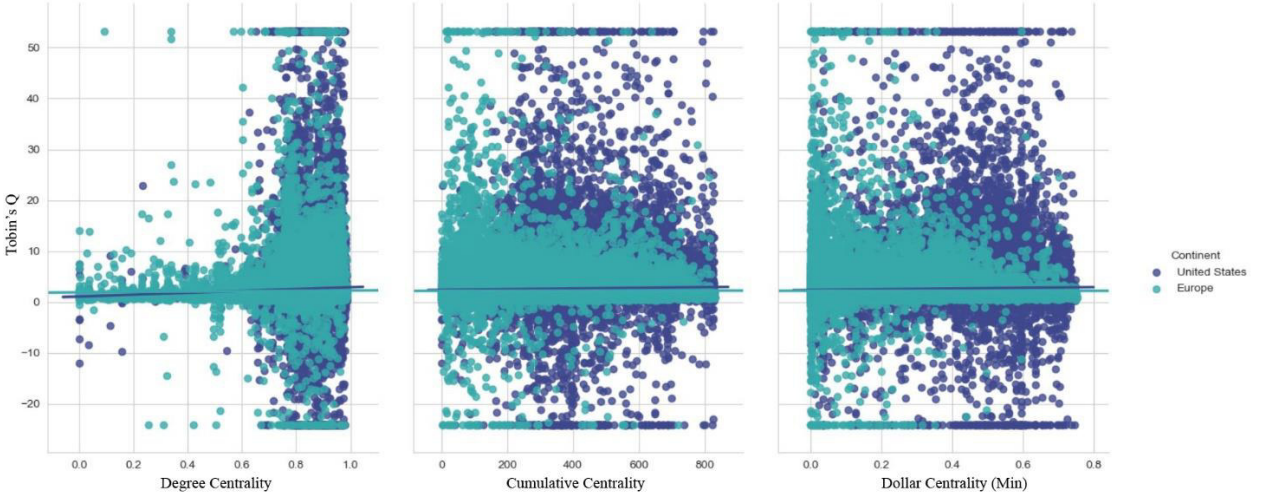
Figure 6 below illustrates the relationship between investor centrality and firm salary expenditures. The relationship between investor connectivity and labor costs is negative as expected within the European observations; however, the U.S. regression lines for all centrality measures have positive slopes. This distinction could be partially attributed to country-specific labor market regulations, which could vary substantially between the two geographic regions. Overall, the univariate relationship between labor costs and investor centrality is left ambiguous from these charts.

Figure 6: Investor Centrality against Salary Expenditure Scatterplots



For the last hypothesis, Figure 7 below demonstrates the relationship between investor centrality and the Tobin's Q ratio. The slopes of the regression lines within the Tobin's Q scatterplots are slightly positive, with the positive correlation being stronger among U.S. firms. This is consistent with the third hypothesis proposed in this paper.

Figure 7: Investor Centrality against Tobin's Q Scatterplots



4. Regression Analysis Results

This analysis utilizes fixed effects panel regressions to quantify the various intertemporal effects of investor centrality. All regressions utilize robust standard errors to account for heteroskedasticity.

4.1 Market Concentration and Investor Centrality Regressions

Table 4 below displays the results of the fixed effects regressions of continent-specific industry HHI on each investor centrality type. Each odd column reports regressions with firm fixed effects, while the even columns show outputs of both firm and year fixed effects.

Table 4: Market Concentration and Investor Network Centrality Regressions

	Degree Centrality		Cumulative Centrality		Dollar Centrality (Mean)		Dollar Centrality (Min)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Centrality	0.212***	0.012	0.000***	0.000	0.012***	0.000	0.110***	0.019
	(9.64)	(0.57)	(11.81)	(1.04)	(10.16)	(-0.06)	(8.80)	(1.62)
Firm Size	-0.001	-0.016***	-0.010***	-0.016***	-0.003	-0.016***	0.001	-0.016***
	(-0.38)	(-4.36)	(-2.80)	(-4.35)	(-0.91)	(-4.36)	(0.36)	(-4.37)
Leverage	0.033***	0.027***	0.029***	0.027***	0.029***	0.027***	0.033***	0.027***
	(3.83)	(3.17)	(3.40)	(3.17)	(3.41)	(3.16)	(3.85)	(3.19)
CAPEX	-0.017	0.069***	0.004	0.070***	-0.007	0.070***	-0.015	0.070***
	(-0.71)	(2.96)	(0.15)	(2.98)	(-0.32)	(2.97)	(-0.63)	(2.98)
Intanglibles	0.072***	0.046***	0.073***	0.046***	0.077***	0.046***	0.075***	0.046***
	(4.91)	(3.13)	(4.96)	(3.14)	(5.20)	(3.14)	(5.05)	(3.14)
Sales Growth	-0.004***	-0.001**	-0.004***	-0.001**	-0.004***	-0.001**	-0.004***	-0.001**
	(-7.32)	(-2.07)	(-6.83)	(-2.09)	(-7.51)	(-2.08)	(-7.63)	(-2.09)
ROA	0.000	0.005	0.002	0.005	0.001	0.005	0.001	0.005
	(0.09)	(1.46)	(0.56)	(1.46)	(0.32)	(1.46)	(0.18)	(1.46)
R&D	0.032*	-0.006	0.016	-0.006	0.028	-0.005	0.036**	-0.006
	(1.82)	(-0.32)	(0.91)	(-0.33)	(1.60)	(-0.32)	(2.08)	(-0.34)
NPPE	-0.026	-0.009	-0.023	-0.009	-0.033	-0.009	-0.034*	-0.009
	(-1.29)	(-0.43)	(-1.16)	(-0.45)	(-1.61)	(-0.43)	(-1.67)	(-0.45)
Constant	6.275***	6.511***	6.506***	6.516***	6.448***	6.520***	6.388***	6.516***
	(140.84)	(132.78)	(151.52)	(142.03)	(150.80)	(142.20)	(149.39)	(142.57)
Observations	93,516	93,516	93,516	93,516	93,516	93,516	93,516	93,516
R-squared	0.011	0.055	0.017	0.055	0.012	0.055	0.010	0.055
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes

Note: Robust t-statistics are included in parentheses. Significance is indicated with *, **, and *** at $p < 0.10$, $p < 0.05$, and $p < 0.01$.

The coefficients of each centrality measure remain positive across each model specification as expected; however, the variable coefficients lose significance when incorporating year fixed effects. This suggests a substantial correlation over time but provides limited evidence of a causal relationship between investor connectedness and industry concentration. This correlation is consistent with the scatterplots in Figure 5; however, incorporating further macroeconomic and investor characteristic controls would be necessary to provide additional evidence of a causal relationship. The regression results of models incorporating the global HHI measurement are included in Appendix D of this paper, whose coefficients remain consistent with those of the continent-specific HHI specifications.

4.2 Firm Salary Expenditure and Investor Centrality Regressions

The regression results of the fixed-effects panel regressions of salary and benefits expenditures on investor centrality are displayed below in Table 5. Each model specification incorporates both firm and year fixed effects. Consistent with this paper's second hypothesis, the coefficient is negative and statistically significant, at least at a p-value of 10% for each centrality type[3]. Specifically, full investor connectedness of a given firm leads to a drop in salary spending as a proportion of total assets of over 2.3%. This provides strong evidence that investor centrality is associated with lower salary and benefits expenditures.

[3] Due to rounding, the coefficient of the cumulative centrality model specification indicates a level of zero. This is because the cumulative centrality values are substantially higher than the other model variables on average. The more precise value of this coefficient is -0.0000179 and statistically different than zero, assuming a p-value of 5%.

Table 5: Salary Expenditure and Investor Centrality Regressions

	Degree Centrality	Cumulative Centrality	Dollar Centrality (Mean)	Dollar Centrality (Min)
	(1)	(2)	(3)	(4)
Centrality	-0.023*	-0.000**	-0.002**	-0.014*
	(-1.91)	(-1.98)	(-2.26)	(-1.72)
Firm Size	-0.029***	-0.029***	-0.030***	-0.029***
	(-6.50)	(-6.55)	(-6.58)	(-6.53)
Leverage	0.030*	0.030*	0.031*	0.030*
	(1.84)	(1.85)	(1.86)	(1.85)
CAPEX	-0.026	-0.028	-0.027	-0.027
	(-1.31)	(-1.38)	(-1.36)	(-1.35)
Intangibles	-0.050**	-0.050**	-0.050**	-0.050**
	(-2.56)	(-2.57)	(-2.57)	(-2.56)
Sales Growth	0.000	0.000	0.000	0.000
	(0.56)	(0.59)	(0.62)	(0.59)
ROA	-0.038**	-0.038**	-0.038**	-0.038**
	(-2.42)	(-2.42)	(-2.43)	(-2.43)
R&D	0.107*	0.107*	0.106*	0.106*
	(1.93)	(1.92)	(1.92)	(1.92)
NPPE	0.033**	0.033**	0.033**	0.033**
	(2.39)	(2.40)	(2.40)	(2.40)
Log Continent HHI	-0.003	-0.003	-0.004	-0.003
	(-0.55)	(-0.56)	(-0.62)	(-0.55)
Labor Freedom	0.000	0.000	0.000	0.000
	(0.65)	(0.61)	(0.61)	(0.61)
Constant	0.657***	0.642***	0.645***	0.640***
	(8.40)	(7.99)	(8.12)	(8.00)
Observations	26,037	26,037	26,037	26,037
R-squared	0.035	0.035	0.035	0.035
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Note: Robust t-statistics are included in parentheses. Significance is indicated with *, **, and *** at $p < 0.10$, $p < 0.05$, and $p < 0.01$.

4.3 Tobin's Q and Investor Centrality Regressions

Table 6 reports the panel regression results of Tobin's Q on investor degree centrality. The models utilizing the cumulative centrality measurement are included in Appendix E of this paper and are consistent with the results of the degree centrality type. Column 1 displays the model specification that exclusively incorporates firm fixed effects. As expected, the centrality coefficient is positive and statistically significant. With the inclusion of year fixed effects in column 2, and firm-country fixed effects in column 3, the coefficient becomes negative and

loses significance. The other coefficients are consistent between these two specifications. Like the market concentration regressions, this indicates a clear intertemporal correlation between the centrality measure and investor centrality; however, further macroeconomic and investor characteristic controls would be necessary to provide additional evidence of a causal relationship.

Table 6: Tobin's Q and Investor Centrality Regressions

	Degree Centrality			
	(1)	(2)	(3)	(4)
Centrality	1.106***	-0.182	-0.240	-0.304
	(4.78)	(-0.67)	(-0.87)	(-1.07)
High Continent HHI				-1.385***
				(-3.06)
High Continent HHI * Centrality				1.516***
				(2.89)
Firm Size	-0.459***	-0.548***	-0.556***	-0.551***
	(-9.44)	(-10.14)	(-10.05)	(-10.20)
Leverage	0.378	0.334	0.330	0.341
	(1.25)	(1.10)	(1.08)	(1.13)
Capex	0.819**	1.029***	0.996**	1.026***
	(2.12)	(2.62)	(2.51)	(2.61)
Intangibles	-1.680***	-1.540***	-1.479***	-1.532***
	(-5.71)	(-5.20)	(-4.97)	(-5.17)
Sales Growth	0.042**	0.038**	0.038**	0.038*
	(2.18)	(1.96)	(1.97)	(1.93)
ROA	0.101	0.094	0.089	0.097
	(0.56)	(0.51)	(0.49)	(0.53)
R&D	0.503	0.375	0.346	0.376
	(0.47)	(0.35)	(0.32)	(0.35)
NPPE	-1.310***	-1.368***	-1.374***	-1.368***
	(-5.39)	(-5.63)	(-5.60)	(-5.63)
Log Continent HHI	0.045	0.110	0.125	
	(0.52)	(1.27)	(1.45)	
Constant	7.638***	9.742***	9.731***	10.585***
	(9.44)	(10.61)	(10.60)	(14.59)
Observations	93,516	93,516	93,516	93,516
R-squared	0.011	0.021	0.025	0.021
Firm FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes
Year * Country FE	No	No	Yes	No

Note: Robust t-statistics are included in parentheses. Significance is indicated with *, **, and *** at $p < 0.10$, $p < 0.05$, and $p < 0.01$.

The model specification in column 4 utilizes a new interaction variable to capture whether the influence of investor centrality could be dependent on firm industry concentration. A new binary control is introduced that takes a value of one when a firm's continent-specific HHI value is greater than the yearly average. In this model, both the binary HHI and interaction terms are statistically significant, while the centrality coefficient remains insignificant. Because the interaction coefficient is substantially higher than that of the centrality variable, the effects of investor centrality can be positive to Tobin's Q in the context of a concentrated market. Specifically, the positive effects of the interaction variable are likely enough to overcome the negative coefficient of centrality present in the case of low market concentration. This implies that the effect of investor degree centrality is more positive in the context of industries that are more concentrated on average.

4.4 Robustness Checks

This paper utilizes additional robustness checks to strengthen the validity of these results. First, regressions were implemented with a new dataset that excludes U.S. firms. This is because the United States is the most frequent country of incorporation within this analysis. The outputs of these European-specific regressions are available in Appendix F of this paper. The results are consistent with those of the full dataset, indicating that the initial findings hold true despite changes to the sample.

Firm market performance is measured in this paper by one of many different methods of calculating Tobin's Q. To mitigate the possibility of any measurement errors with this variable, an additional specification of Tobin's Q, as utilized in Bris et al. (2009), was constructed and implemented into the corresponding regressions. Details on the calculation of the two versions are in Appendix B, and the regression outputs utilizing the alternative form are available in Appendix G of this paper. These results are consistent with those employing the primary Tobin's Q measurement, providing further assurance of the analysis findings.

5. Conclusion

As the total equity holdings of the largest institutional asset managers have risen, the economic consequences of growing common and cross-ownership has dominated the discussion about the power of institutional blockholders. Some of these potential effects are explored in this analysis, specifically, changes to market concentration, salary expenditures, and firm market performance. This paper first quantifies significant intertemporal correlations between various measures of firm network centrality and industry concentration. Additionally,

there is a statistically significant negative relationship between firm salary expenditure and the centrality measures. Finally, further correlations are observable between investor centrality and Tobin's Q, with the effect of investor connectedness being more positive in the case of high industry concentration. This paper helps confirm the broad influence of the largest institutional investors and how the relationships and incentives created through common and cross-ownership could encourage potentially undesirable outcomes. Such effects could confirm the need for antitrust intervention in cases that could lead to inefficiencies; however, the necessary degree of this intervention is left ambiguous for further research.

Appendix A: Information on Years of Collected Parent Investor Subsidiary Names

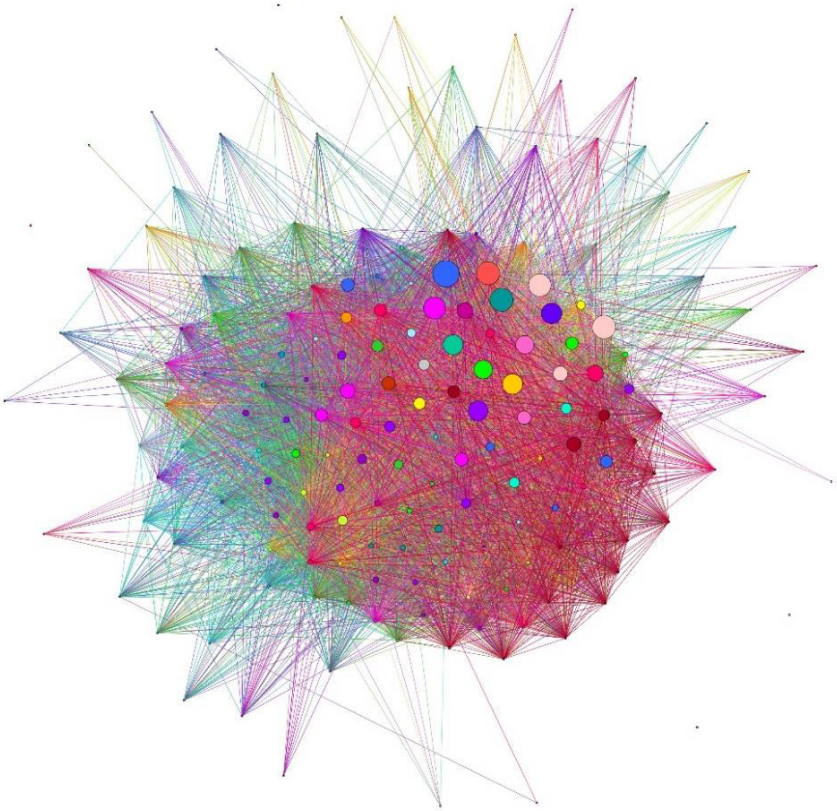
Asset Manager	Dates on Willis Towers Watson List	Dates of Data from Annual Reports	Dates of Data from 13f Forms
American International Group, Inc.	2007	2003, 2005, 2007, 2008, 2015, 2018	1999, 2004, 2009, 2013, 2014, 2017, 2019
Allianz SE	2007, 2009, 2011, 2013, 2014, 2015, 2017, 2018	1999, 2007, 2011, 2015, 2019	2013 , 2014, 2017
Axa S.A.	2007, 2009, 2011, 2013, 2014, 2015, 2017, 2018	2008, 2011, 2019	1999, 2009, 2013, 2014, 2015, 2017
The Bank of America Corporation	2009	2007, 2009, 2010, 2015, 2017, 2019	
The Bank of New York Mellon Corporation	2007, 2009, 2011, 2013, 2014, 2015, 2017, 2018	2007, 2009, 2011, 2014, 2015, 2018	
Barclays Bank Group	2007	2005, 2007, 2009, 2011, 2019	2013, 2014, 2015, 2017
BlackRock, Inc.	2009, 2011, 2013, 2014, 2015, 2017, 2018	1999, 2005, 2007, 2009, 2011, 2014, 2017, 2019	2013
BNP Paribas S.A.	2007, 2009, 2011, 2013, 2014, 2015, 2017, 2018	2007, 2009, 2014, 2018	2011, 2013, 2019
Capital Group	2007, 2009, 2011, 2013, 2014, 2015, 2017, 2018		1999, 2004, 2005, 2007, 2009, 2011, 2013, 2014, 2017, 2019
Crédit Agricole Group	2009	2002, 2005, 2007, 2009, 2010, 2014, 2019	2007, 2009, 2011, 2013, 2015, 2017
Deutsche Bank AG	2007, 2009, 2011, 2013, 2014, 2015, 2017, 2018	2007, 2011, 2017, 2019	2004, 2005, 2009, 2013, 2014, 2015,
Fidelity Investments Inc.	2007, 2009, 2011, 2013, 2014, 2015, 2017, 2018		1999, 2004, 2005 2007, 2009, 2011, 2013, 2014, 2015, 2017, 2019
Franklin Templeton	2011, 2013	2000, 2005, 2011, 2013, 2015, 2019	1999, 2004, 2007, 2009, 2014, 2017
The Goldman Sachs Group, Inc.	2007, 2009, 2011, 2013, 2014, 2015, 2017, 2018	2000, 2003, 2007, 2010, 2011, 2015, 2018, 2019	1999, 2004, 2005, 2009, 2013, 2014, 2017
HSBC Holdings plc	2007, 2009, 2011, 2013, 2014, 2015	2004, 2007, 2011, 2015, 2019	1999, 2005, 2009, 2013, 2014, 2017
The ING Group	2007	2003, 2004, 2005, 2007, 2011, 2015, 2017	2009, 2013, 2014
JPMorgan Chase & Co.	2007, 2009, 2011, 2013, 2014, 2015, 2017, 2018	2001, 2004, 2005, 2007, 2009, 2011, 2015, 2018	1999, 2013, 2014, 2017, 2019
Legal & General Group plc	2014 2015, 2017, 2018	2009, 2014, 2019	1999, 2004, 2005, 2007, 2011, 2013, 2015, 2017
Legg Mason	2007, 2009	2004, 2009, 2011, 2015, 2018, 2019	1999, 2005, 2007, 2013, 2014, 2017
Nippon Life Insurance Company	2011	2004, 2011, 2014, 2019	
Northern Trust Corporation	2007, 2009, 2011, 2013, 2014, 2015, 2017, 2018	2004, 2007, 2011, 2014, 2017, 2018	1999, 2005, 2009, 2013, 2015, 2019
Prudential Financial, Inc.	2009, 2011, 2013, 2015, 2017, 2018	2002, 2004, 2009, 2011, 2013, 2014, 2018	2005, 2007, 2015, 2017, 2019
State Street Corporation	2007, 2009, 2011, 2013, 2015, 2017, 2018	2004, 2007, 2009, 2011, 2013, 2014, 2018, 2019	2005, 2015, 2017
T. Rowe Price Group, Inc.	2018	2000, 2004, 2009, 2011, 2014, 2018, 2019	
UBS Group AG	2007, 2009, 2011, 2013, 2014, 2015, 2017, 2018	2007, 2014, 2018, 2019	2015, 2017
The Vanguard Group	2007, 2009, 2011, 2013, 2014, 2015, 2017, 2018		2019
Wellington Management Company	2013, 2014, 2015, 2017, 2018	2019	1999, 2004, 2005, 2007, 2009, 2011, 2013, 2014, 2015, 2017
Wells Fargo & Company	2015, 2017, 2018	2004, 2007, 2009, 2011, 2017, 2019	1999, 2005, 2013, 2014, 2015

Appendix B: Variable Descriptions

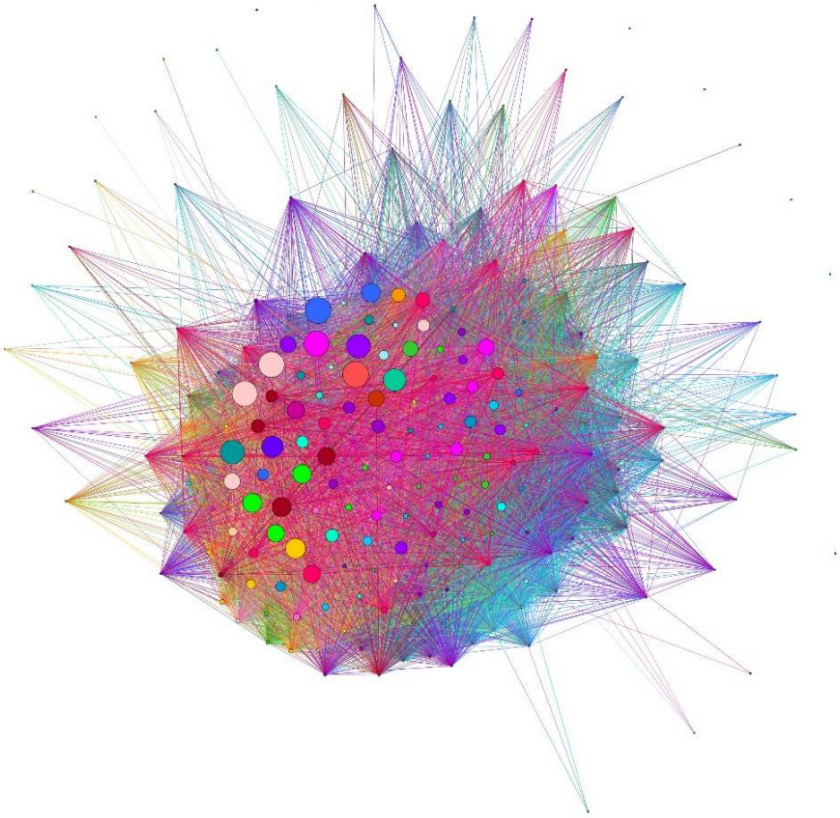
Variable	Definition
CAPEX	Reported firm capital expenditures divided by total assets.
Centrality	Firm-level weighted investor centrality. Construction of the four centrality types are described in Section 3.1.
Firm Size	Log of firm total assets.
High Continent HHI	Binary variable indicating a one if an industry's continent-specific HHI meausrement is greater than the year average.
Intangibles	Reported firm intangible assets divided by total assets.
Labor Freedom	Dimension from the Economic Freedom Index. Labor Freedom is a scale from 0 to 100 that captures country-differences in labor market regulations.
Leverage	Firm debt divided by total assets.
Log Continent HHI	Log of firm continent-specific HHI. The computation of HHI is explained in Section 3.2.
NPPE	Firm net property, plant, and equipment divided by total assets.
R&D	Research and development expenditures divided by total assets.
ROA	Net income divided by total assets.
Salary Expenditure	Firm salary and benefits expenditures divided by total assets.
Sales Growth	Difference in net sales from the previous period, divided by the previous period's net sales.
Tobin's Q	Firm market value of equity plus book value of liabilities, divided by book value of equity plus book value of liabilities. [Equity Market Value + Liabilities Book Value] / [Equity Book Value + Liabilities Book Value]
Tobin's Q (Alternative)	Firm total assets minus the book value of equity, plus the market value of equity, divided by total assets. [Equity Market Value + Total Assets - Equity Book Value] / Total Assets

Appendix C: Investor Network Diagrams

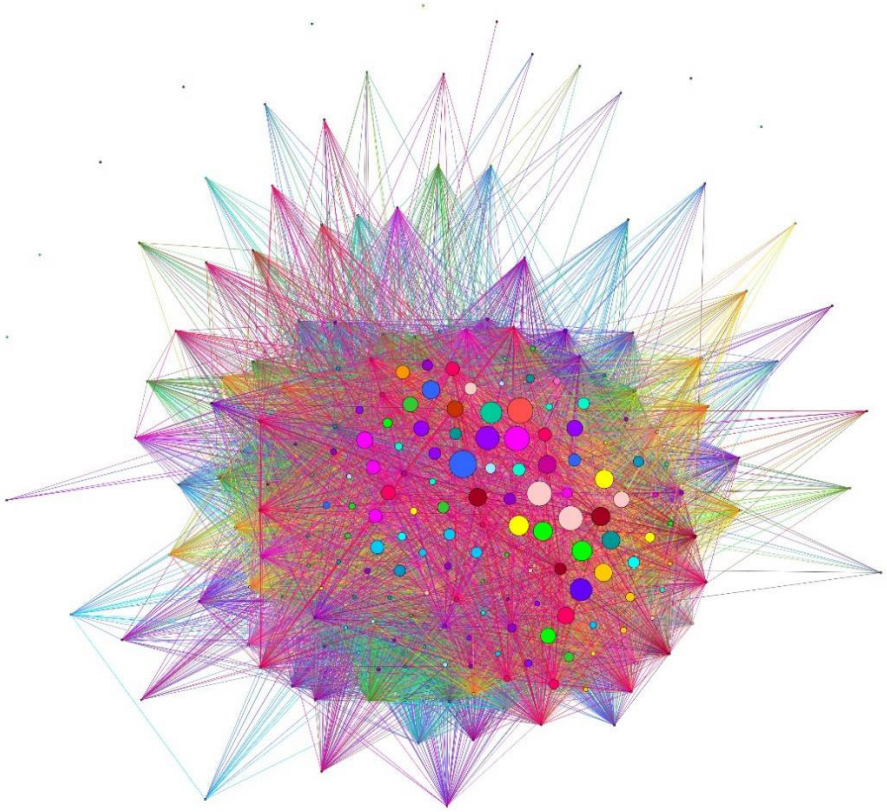
1999



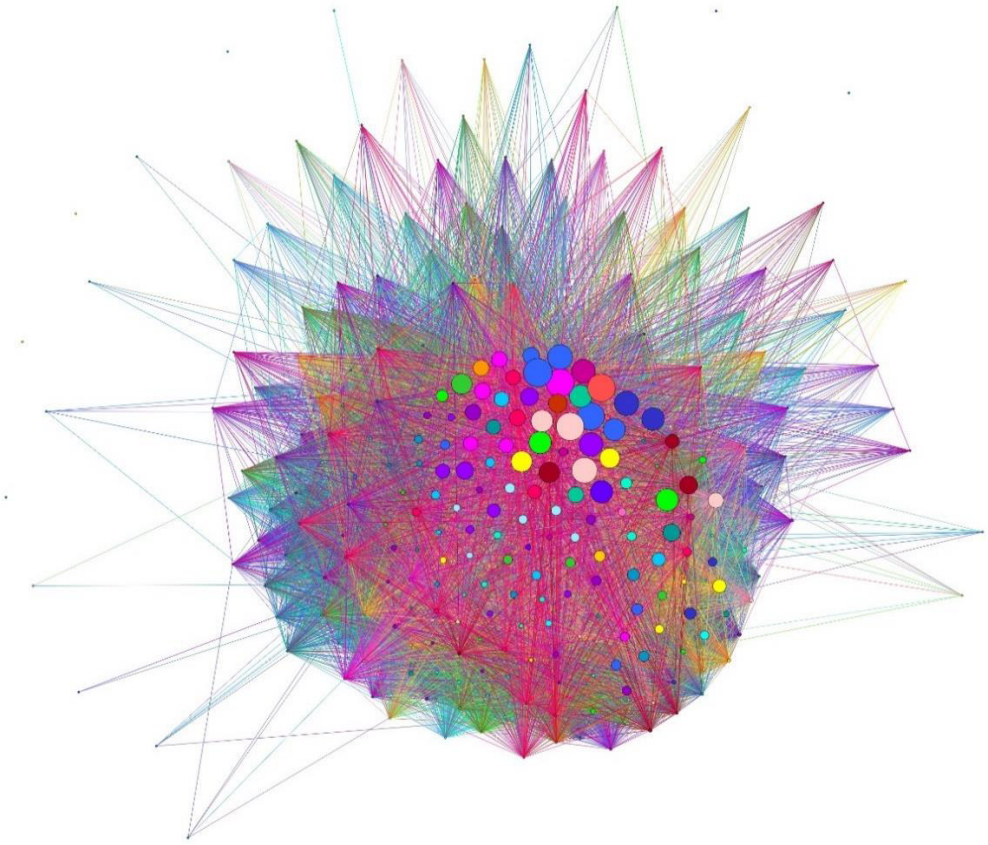
2004



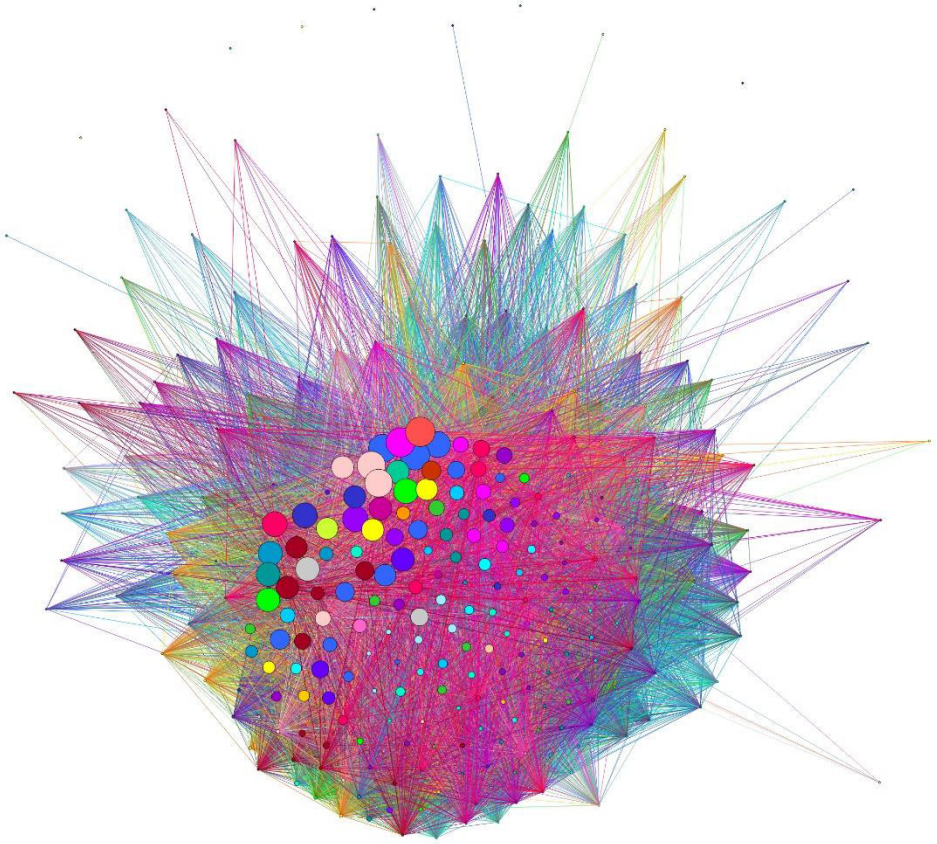
2005



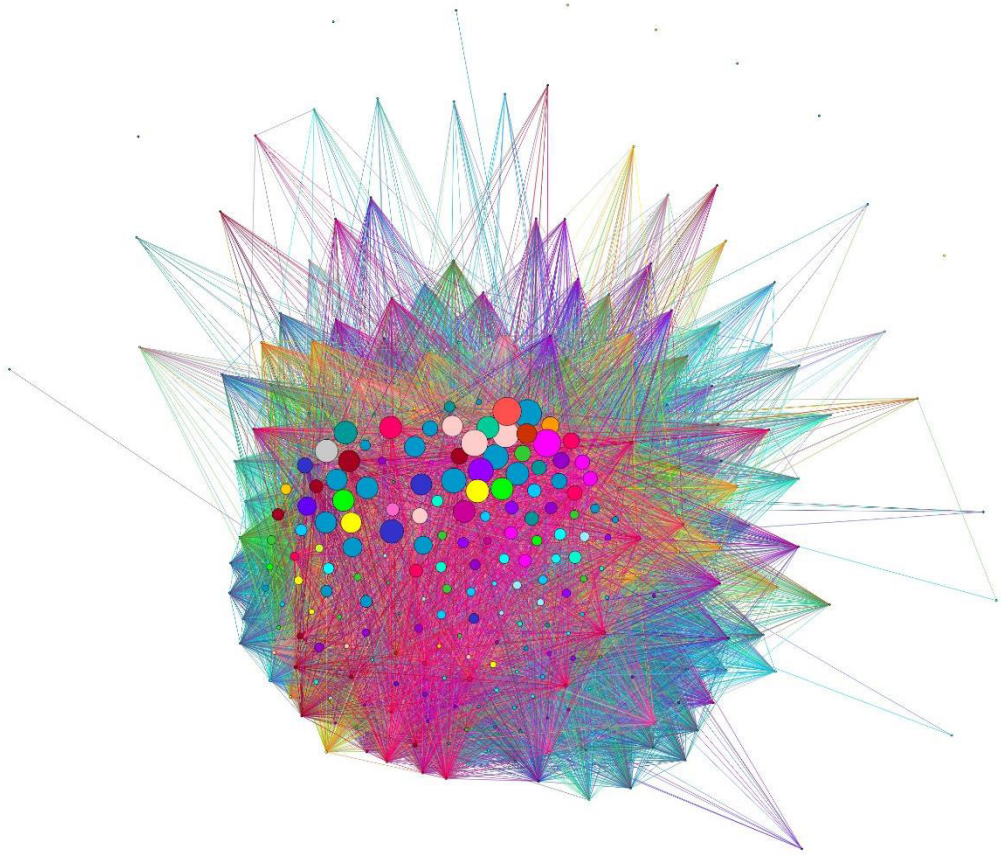
2007



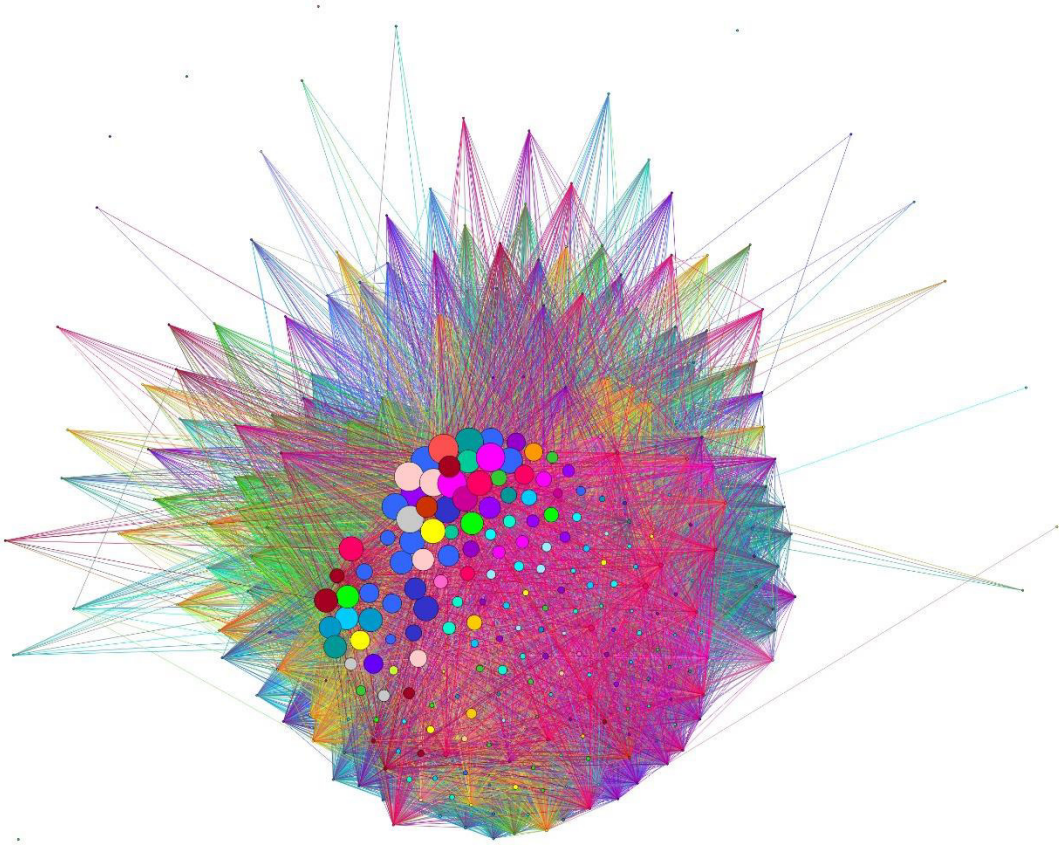
2009



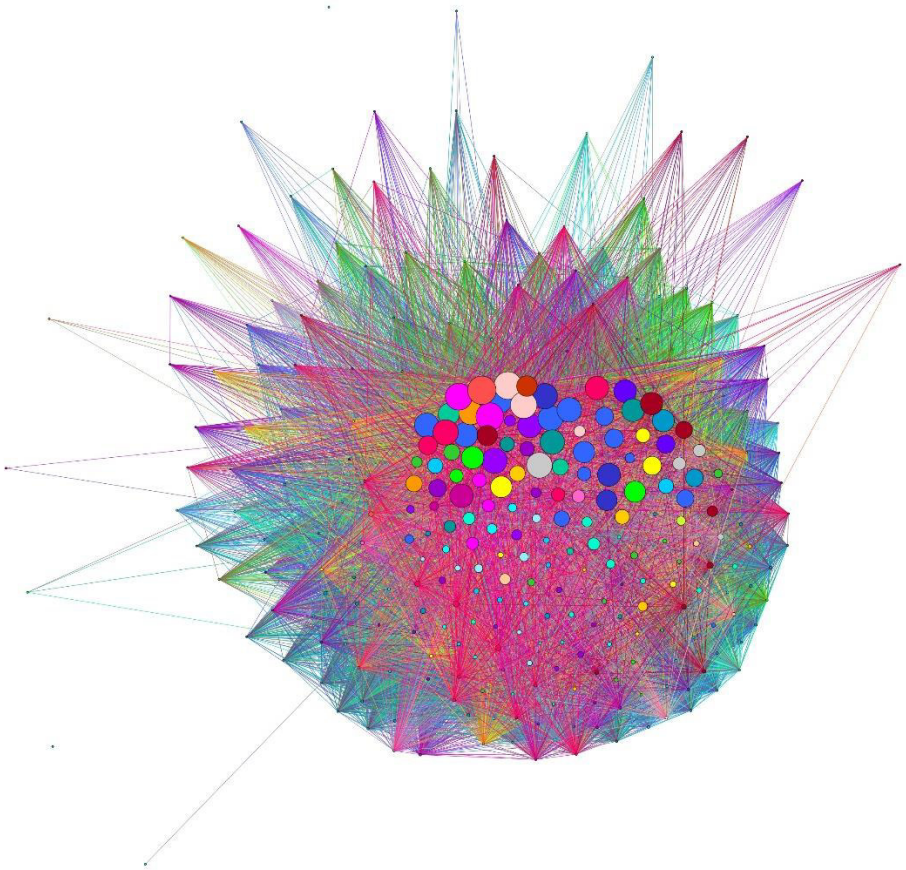
2011



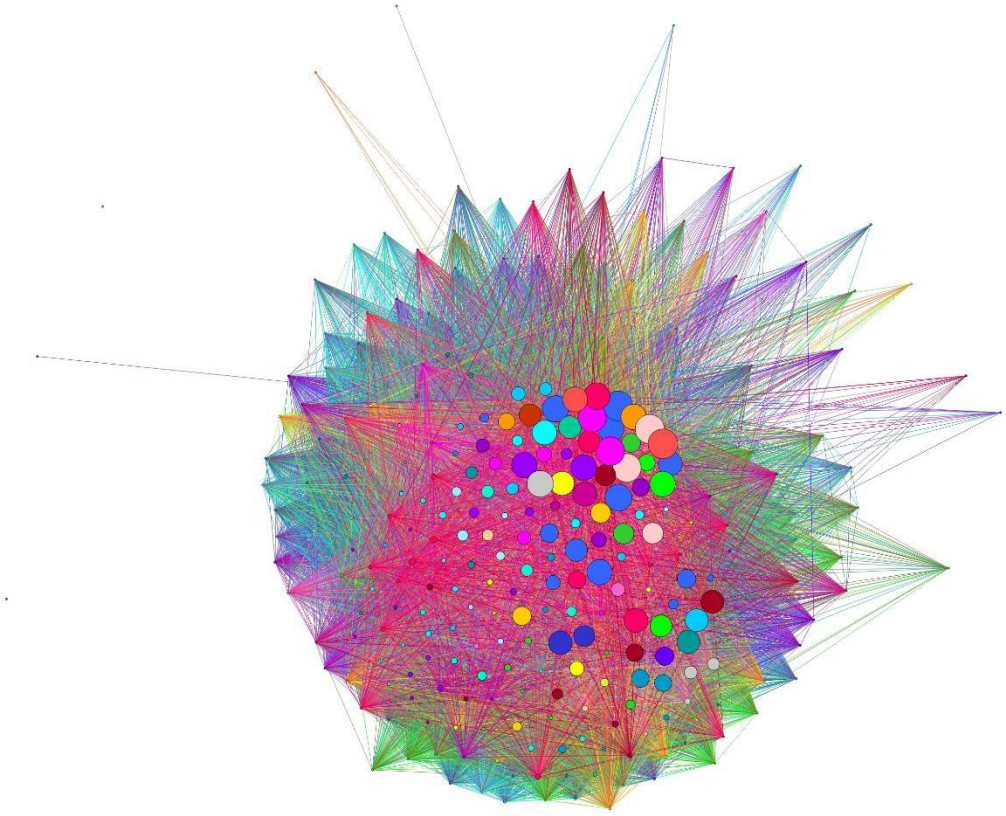
2013



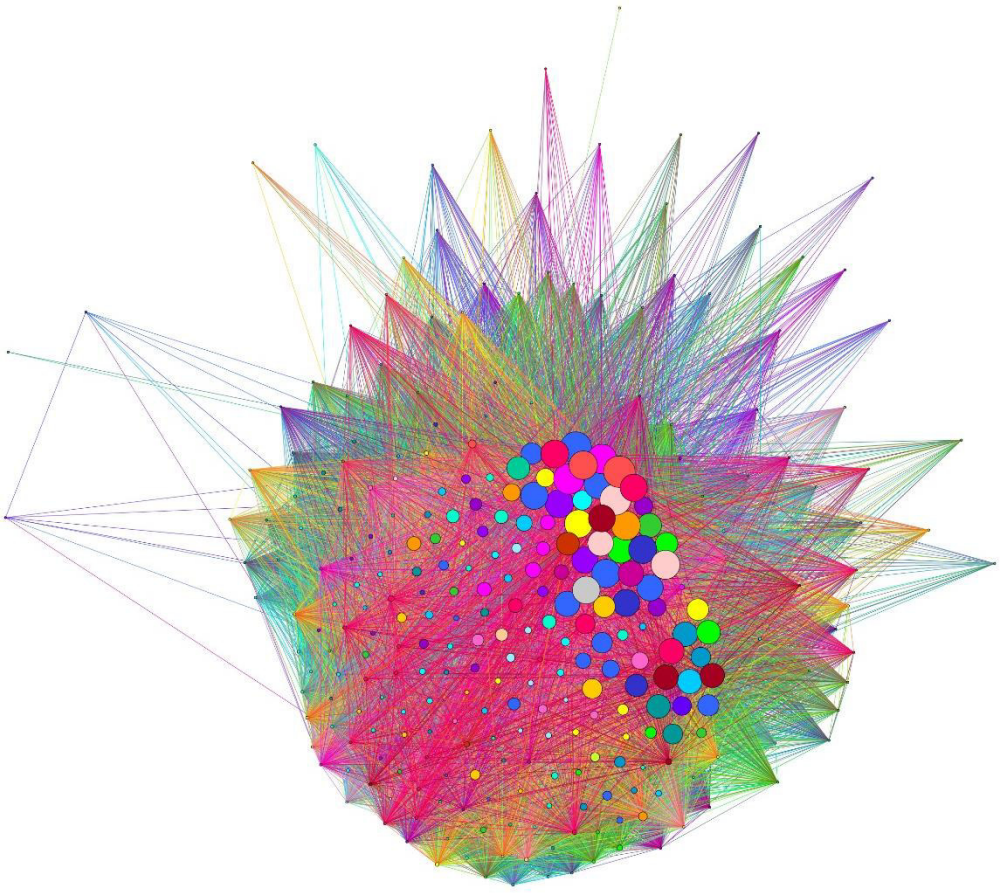
2014



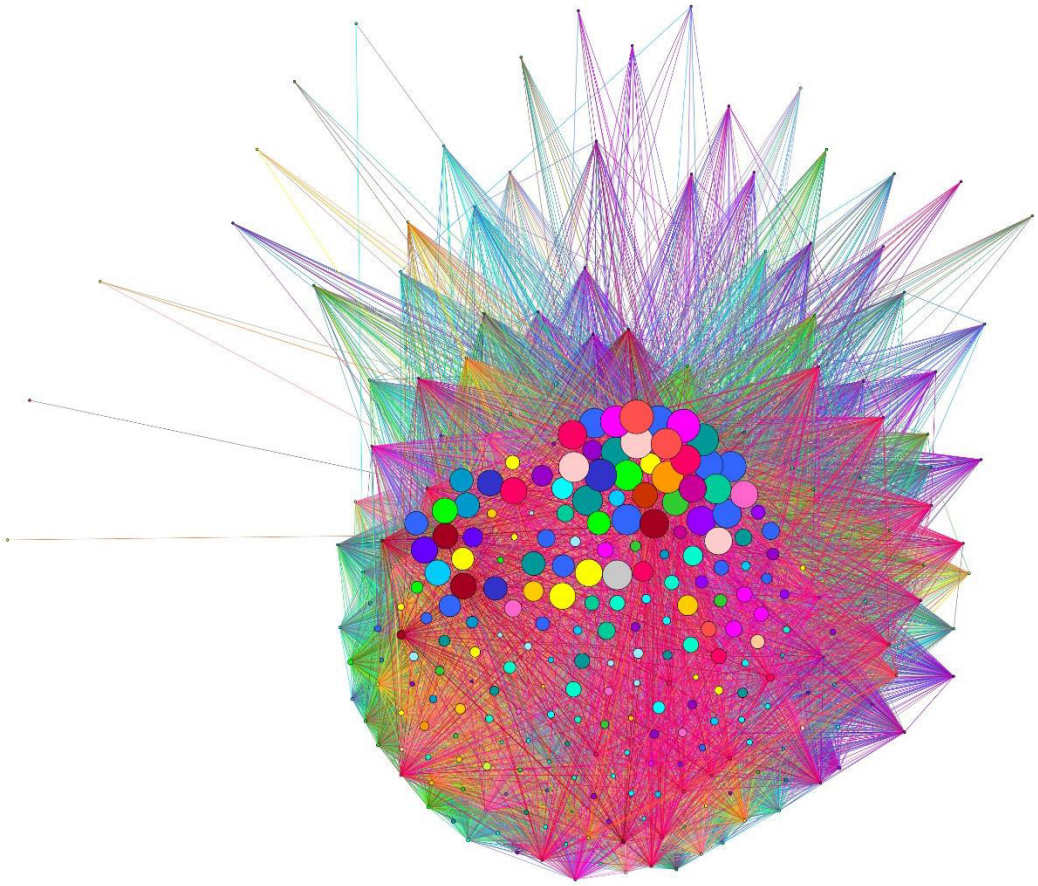
2015



2017



2019



Investor Parent Company Color Legend

American International Group, Inc.
The Allianz Group
Axa S.A.
The Bank of America Corporation
The Bank of New York Mellon Corporation
Barclays plc
BlackRock, Inc.
BNP Paribas S.A.
Capital Group Companies
Crédit Agricole Group
Deutsche Bank AG
Fidelity Investments Inc.
Franklin Templeton
The Goldman Sachs Group, Inc.
HSBC Holdings plc
The ING Group
JPMorgan Chase & Co.
Legal & General Group plc
Legg Mason
Nippon Life Insurance Company
Northern Trust Corporation
Prudential Financial, Inc.
State Street Corporation
T. Rowe Price Group, Inc.
UBS Group AG
The Vanguard Group
Wellington Management Company
Wells Fargo & Company

Appendix D: Global HHI and Investor Centrality Regressions

	Binary Centrality		Cumulative Centrality		Dollar Centrality (Mean)		Dollar Centrality (Min)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Centrality	0.303***	-0.021	0.000***	-0.000	0.018***	-0.003**	0.153***	0.003
	(13.87)	(-1.12)	(19.85)	(-0.76)	(15.62)	(-2.54)	(13.08)	(0.28)
Firm Size	0.018***	-0.008**	0.004	-0.008**	0.015***	-0.008**	0.022***	-0.008**
	(5.86)	(-2.43)	(1.34)	(-2.44)	(4.93)	(-2.45)	(7.10)	(-2.43)
Leverage	0.036***	0.023***	0.030***	0.023***	0.030***	0.023***	0.036***	0.023***
	(4.36)	(2.97)	(3.73)	(2.98)	(3.74)	(2.99)	(4.36)	(2.99)
CAPEX	-0.077***	0.041*	-0.044**	0.041*	-0.063***	0.041*	-0.076***	0.041*
	(-3.48)	(1.94)	(-2.03)	(1.91)	(-2.87)	(1.92)	(-3.41)	(1.92)
Intangibles	0.061***	0.034**	0.061***	0.034**	0.067***	0.033**	0.064***	0.034**
	(4.41)	(2.49)	(4.45)	(2.47)	(4.87)	(2.46)	(4.66)	(2.48)
Sales growth	-0.006***	-0.002***	-0.005***	-0.002***	-0.006***	-0.002***	-0.006***	-0.002***
	(-11.34)	(-4.54)	(-10.62)	(-4.51)	(-11.66)	(-4.46)	(-11.81)	(-4.52)
ROA	-0.001	0.008***	0.002	0.008***	0.001	0.008***	-0.000	0.008***
	(-0.18)	(2.60)	(0.61)	(2.59)	(0.18)	(2.61)	(-0.05)	(2.59)
R&D	0.080***	0.026	0.053***	0.026	0.073***	0.027*	0.087***	0.026
	(4.65)	(1.60)	(3.11)	(1.60)	(4.26)	(1.66)	(5.02)	(1.58)
NPPE	-0.021	-0.003	-0.015	-0.003	-0.030	-0.002	-0.032	-0.003
	(-1.01)	(-0.15)	(-0.74)	(-0.14)	(-1.44)	(-0.12)	(-1.53)	(-0.15)
Constant	5.436***	5.913***	5.787***	5.900***	5.688***	5.903***	5.598***	5.896***
	(131.60)	(135.96)	(146.69)	(142.32)	(143.54)	(142.48)	(141.30)	(142.51)
Observations	93,516	93,516	93,516	93,516	93,516	93,516	93,516	93,516
R-squared	0.032	0.112	0.052	0.112	0.036	0.112	0.028	0.112
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes

Note: Robust t-statistics are included in parentheses. Significance is indicated with *, **, and *** at $p < 0.10$, $p < 0.05$, and $p < 0.01$.

Appendix E: Tobin's Q and Cumulative Centrality Regressions

	Cumulative Centrality			
	(1)	(2)	(3)	(4)
Centrality	0.001***	-0.000	-0.000	-0.000
	(7.08)	(-0.80)	(-1.17)	(-1.16)
High Continent HHI				-0.407***
				(-3.09)
High Continent HHI * Centrality				0.001***
				(2.75)
Firm Size	-0.509***	-0.549***	-0.557***	-0.551***
	(-9.97)	(-10.14)	(-10.05)	(-10.21)
Leverage	0.357	0.334	0.331	0.343
	(1.18)	(1.11)	(1.09)	(1.13)
CAPEX	0.938**	1.023***	0.988**	1.022***
	(2.42)	(2.61)	(2.49)	(2.60)
Intangibles	-1.678***	-1.541***	-1.482***	-1.536***
	(-5.70)	(-5.20)	(-4.98)	(-5.18)
Sales Growth	0.044**	0.038**	0.039**	0.038*
	(2.27)	(1.97)	(1.97)	(1.94)
ROA	0.112	0.094	0.090	0.097
	(0.62)	(0.51)	(0.49)	(0.53)
R&D	0.407	0.376	0.348	0.377
	(0.38)	(0.35)	(0.33)	(0.35)
NPPE	-1.291***	-1.366***	-1.371***	-1.368***
	(-5.32)	(-5.63)	(-5.60)	(-5.64)
Log Continent HHI	0.020	0.110	0.125	
	(0.23)	(1.27)	(1.45)	
Constant	9.071***	9.637***	9.601***	10.408***
	(10.69)	(10.83)	(10.73)	(15.30)
Observations	93,516	93,516	93,516	93,516
R-squared	0.012	0.021	0.025	0.021
Firm FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes
Year*Country FE	No	No	Yes	No

Note: Robust t-statistics are included in parentheses. Significance is indicated with *, **, and *** at $p < 0.10$, $p < 0.05$, and $p < 0.01$.

Appendix F: European Dataset Regressions, Market Concentration on Investor Centrality

	Binary Centrality		Cumulative Centrality		Dollar Centrality (Mean)		Dollar Centrality (Min)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Centrality	0.101***	-0.009	0.000***	-0.000	0.013***	0.001	0.112***	0.031*
	(4.12)	(-0.35)	(6.97)	(-0.08)	(6.50)	(0.52)	(5.97)	(1.70)
Firm Size	0.010*	-0.013**	-0.000	-0.013**	0.005	-0.013**	0.006	-0.013**
	(1.71)	(-2.03)	(-0.00)	(-2.03)	(0.83)	(-2.04)	(0.97)	(-2.09)
Leverage	0.020	0.025	0.026	0.025	0.022	0.025	0.021	0.025
	(1.07)	(1.40)	(1.38)	(1.41)	(1.16)	(1.41)	(1.12)	(1.43)
CAPEX	-0.033	0.074*	-0.005	0.074*	-0.014	0.074*	-0.018	0.074*
	(-0.80)	(1.82)	(-0.13)	(1.81)	(-0.35)	(1.82)	(-0.44)	(1.82)
Intangibles	0.010	-0.028	0.005	-0.029	0.008	-0.028	0.006	-0.028
	(0.36)	(-1.01)	(0.16)	(-1.01)	(0.30)	(-1.01)	(0.23)	(-1.00)
Sales Growth	-0.003***	-0.000	-0.003***	-0.000	-0.003***	-0.000	-0.003***	-0.000
	(-3.01)	(-0.47)	(-2.62)	(-0.46)	(-3.00)	(-0.48)	(-2.98)	(-0.48)
ROA	-0.044***	-0.026**	-0.040***	-0.026**	-0.041***	-0.026**	-0.042***	-0.026**
	(-3.77)	(-2.31)	(-3.47)	(-2.32)	(-3.51)	(-2.31)	(-3.59)	(-2.30)
R&D	-0.032	-0.078	-0.042	-0.078	-0.037	-0.079	-0.036	-0.078
	(-0.55)	(-1.40)	(-0.71)	(-1.39)	(-0.64)	(-1.40)	(-0.63)	(-1.39)
NPPE	-0.070**	-0.048	-0.060**	-0.048	-0.068**	-0.048	-0.068**	-0.049
	(-2.28)	(-1.62)	(-1.99)	(-1.62)	(-2.23)	(-1.62)	(-2.23)	(-1.64)
Constant	6.293***	6.583***	6.470***	6.577***	6.423***	6.577***	6.412***	6.580***
	(84.04)	(80.32)	(85.40)	(83.49)	(86.02)	(83.53)	(85.97)	(83.58)
Observations	34,247	34,247	34,247	34,247	34,247	34,247	34,247	34,247
R-squared	0.006	0.060	0.012	0.060	0.010	0.060	0.009	0.060
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes

Note: Robust t-statistics are included in parentheses. Significance is indicated with *, **, and *** at $p < 0.10$, $p < 0.05$, and $p < 0.01$.

European Dataset Regressions, Salary Expenditure on Investor Centrality

	Binary Centrality	Cumulative Centrality	Dollar Centrality (Mean)	Dollar Centrality (Min)
	(1)	(2)	(3)	(4)
Centrality	-0.028**	-0.000**	-0.003***	-0.019**
	(-2.25)	(-2.28)	(-3.00)	(-2.25)
Firmsize	-0.027***	-0.027***	-0.027***	-0.027***
	(-5.15)	(-5.20)	(-5.26)	(-5.17)
Leverage	0.032*	0.032*	0.032*	0.032*
	(1.78)	(1.79)	(1.80)	(1.80)
CAPEX	-0.021	-0.023	-0.023	-0.022
	(-1.09)	(-1.17)	(-1.17)	(-1.14)
Intangibles	-0.032	-0.033	-0.033	-0.033
	(-1.59)	(-1.61)	(-1.59)	(-1.60)
Sales Growth	-0.000	-0.000	-0.000	-0.000
	(-0.53)	(-0.50)	(-0.45)	(-0.49)
ROA	-0.036**	-0.036**	-0.036**	-0.036**
	(-2.20)	(-2.20)	(-2.21)	(-2.21)
R&D	0.131**	0.131**	0.131**	0.131**
	(2.10)	(2.10)	(2.10)	(2.09)
NPPE	0.026**	0.026**	0.026**	0.026**
	(2.04)	(2.05)	(2.05)	(2.07)
Log Continent HHI	-0.005	-0.005	-0.005	-0.005
	(-0.90)	(-0.91)	(-0.92)	(-0.88)
Labor Freedom	0.000	0.000	0.000	0.000
	(1.38)	(1.33)	(1.36)	(1.34)
Constant	0.625***	0.607***	0.609***	0.604***
	(7.42)	(6.97)	(7.07)	(6.97)
Observations	22,122	22,122	22,122	22,122
R-squared	0.033	0.032	0.033	0.033
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Note: Robust t-statistics are included in parentheses. Significance is indicated with *, **, and *** at $p < 0.10$, $p < 0.05$, and $p < 0.01$.

European Dataset Regressions, Tobin's Q on Investor Centrality

	Binary Centrality			
	(1)	(2)	(3)	(4)
Centrality	0.637**	-0.162	-0.238	-0.275
	(2.27)	(-0.53)	(-0.77)	(-0.85)
High Continent HHI				-1.169**
				(-2.38)
High Continent HHI * Centrality				1.316**
				(2.33)
Firm Size	-0.388***	-0.394***	-0.399***	-0.397***
	(-5.52)	(-4.85)	(-4.69)	(-4.89)
Leverage	-0.273	-0.159	-0.111	-0.156
	(-0.40)	(-0.23)	(-0.16)	(-0.23)
CAPEX	1.482***	1.549***	1.460***	1.537***
	(2.79)	(2.84)	(2.62)	(2.81)
Intangibles	-2.584***	-2.332***	-2.303***	-2.331***
	(-7.57)	(-6.79)	(-6.64)	(-6.80)
Sales Growth	0.056**	0.049**	0.047*	0.049**
	(2.28)	(2.02)	(1.90)	(1.99)
ROA	0.648	0.640	0.633	0.641
	(1.62)	(1.56)	(1.53)	(1.56)
R&D	3.110	3.310	3.319	3.306
	(1.21)	(1.29)	(1.29)	(1.29)
NPPE	-1.286***	-1.410***	-1.351***	-1.412***
	(-4.04)	(-4.51)	(-4.21)	(-4.53)
Log Continent HHI	-0.011	0.063	0.072	
	(-0.09)	(0.53)	(0.61)	
Constant	7.479***	8.362***	8.294***	8.914***
	(6.03)	(6.05)	(5.90)	(8.40)
Observations	34,247	34,247	34,247	34,247
R-squared	0.022	0.039	0.046	0.039
Firm FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes
Year*Country FE	No	No	Yes	No

Note: Robust t-statistics are included in parentheses. Significance is indicated with *, **, and *** at $p < 0.10$, $p < 0.05$, and $p < 0.01$.

Appendix G: Alternative Tobin's Q and Investor Centrality Regressions

	Binary Centrality			
	(1)	(2)	(3)	(4)
Centrality	0.897***	-0.091	-0.089	-0.188
	(6.01)	(-0.55)	(-0.54)	(-1.08)
High Continent HHI				-1.121***
				(-3.72)
High Continent HHI * Centrality				1.167***
				(3.35)
Firmsize	-0.380***	-0.448***	-0.457***	-0.449***
	(-14.17)	(-14.71)	(-14.57)	(-14.80)
Leverage	0.673***	0.644***	0.642***	0.648***
	(5.09)	(4.87)	(4.83)	(4.90)
CAPEX	0.791***	1.031***	1.016***	1.022***
	(3.69)	(4.74)	(4.63)	(4.70)
Intangibles	-1.092***	-1.010***	-0.968***	-1.006***
	(-8.76)	(-8.03)	(-7.68)	(-8.00)
Sales Growth	0.023*	0.022*	0.023*	0.022*
	(1.87)	(1.86)	(1.87)	(1.82)
ROA	-0.301**	-0.297**	-0.301**	-0.297**
	(-2.40)	(-2.37)	(-2.40)	(-2.37)
R&D	1.214**	1.113**	1.092**	1.114**
	(2.54)	(2.31)	(2.27)	(2.31)
NPPE	-1.062***	-1.102***	-1.109***	-1.097***
	(-7.01)	(-7.24)	(-7.18)	(-7.23)
Log Continent HHI	-0.053	-0.026	-0.010	
	(-1.12)	(-0.55)	(-0.21)	
Constant	6.716***	8.338***	8.305***	8.279***
	(13.50)	(14.56)	(14.24)	(19.33)
Observations	93,516	93,516	93,516	93,516
R-squared	0.048	0.070	0.077	0.071
Firm FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes
Year*Country FE	No	No	Yes	No

Note: Robust t-statistics are included in parentheses. Significance is indicated with *, **, and *** at $p < 0.10$, $p < 0.05$, and $p < 0.01$.

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