Economics Bulletin

Volume 44, Issue 3

Institutional investors' ownership in the oil and gas industry: evidence from network analysis

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Abstract

This study investigates the presence of institutional investors in the ownership structure of oil and gas (O&G) corporations during the 2010s. By analyzing a sample of the 50 largest O&G companies, we use a two-mode network methodology to explore the dynamics of investor participation. The results show an increase in institutional investors' ownership share, rising from 23% to 29% over the decade. Furthermore, institutional investors exhibit high centrality within the ownership network, emphasizing their strategic importance. In addition, a substantial portion of investments is concentrated among major money managers, particularly those associated with U.S. companies. This work contributes to understanding the strategic role of institutional investors regarding carbon-intensive assets in a period characterized by changes in the energy paradigm.

The authors thank CAPES (Coordination for the Improvement of Higher Education Personnel – Brazil) for the financial support of this research.

Citation: João Victor Machado and Fernando Sarti and Rodrigo Lanna Franco Silveira and Camila Veneo Campos Fonseca, (2024) "Institutional investors' ownership in the oil and gas industry: evidence from network analysis", *Economics Bulletin*, Volume 44, Issue 3, pages 847-864

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Submitted: September 17, 2023. **Published:** September 30, 2024.

1 Introduction

The evolution of financial markets is intrinsically linked to the expansion of a group of agents known as institutional investors (II). This group encompasses pension funds, hedge funds, mutual funds, investment funds, and insurance companies, among others. Acting as financial intermediaries, these entities pool the savings of individual investors and allocate these substantial amounts into diversified portfolios, with the primary objective of ensuring financial returns (Çelik and Isaksson 2013; Farnetti 1998; OECD 1998).

Institutional investors have assumed a significant role in the centralization of debts and financial holdings. Since the 1980s, large corporations have increasingly issued securities for capital financing purposes. Consequently, the management of financial savings has predominantly transitioned from commercial banks to institutional investors. This shift has amplified the involvement of funds and insurers in the liabilities of non-financial companies. By investing their resources in these securities, institutional investors aim to maximize their portfolio returns. The increased engagement of institutional investors has subsequently contributed to the development of capital markets and enhanced their capacity to influence companies in maximizing shareholder value (Sakawa and Watanabel 2020; Çelik and Isaksson 2013).

Several studies have empirically explored the influence of institutional investors on corporate governance and strategic management of non-financial companies. The investments vary according to the nature of the participation (temporary or regular), the objectives of the institution, and its monitoring efforts in the target corporation (Katan and Mat Nor 2015). Given their heterogeneity (distinct characteristics, strategies, and time horizons), their impact on corporate strategies has shown mixed results (Fonseca, Silveira, and Hiratuka 2020; Froud et al. 2000; Lazonick and Shin 2020; Machado, Sarti, and Silveira 2024).

Some researchers have highlighted the 'myopic' pressures exerted by institutional investors (IIs) on management decisions, emphasizing the focus on achieving higher short-term returns (Çelik and Isaksson 2013; Sakawa and Watanabel 2020; Fisch and Momtaz 2020; Nurokhmah, Sudarto, and Laksana 2022). Other studies pointed to the positive impacts of such investors in designing and operating strategies that enhance the long-term sustainability of non-financial companies (Crane, Michenaud, and Weston 2016; Kim et al. 2019; Schoenmaker and Schramade 2019).

Since the early 21st century, institutional investors' participation in the oil and gas (O&G) market has gained substantial relevance (Machado, Sarti, and Silveira 2024), driven by their increased involvement in riskier activities and the concomitant proliferation of financial instruments, including oil and gas futures contracts (Ederer, Heumesser, and Staritz 2016; Fattouh 2012). Although the transition to a low-carbon economy is expected to negatively impact the value of O&G companies, fossil fuel companies have been reorienting their strategies toward renewable energy in response to the energy transition (Mäkitie et al. 2019; Alova 2022; Halttunen, Slade, and Staffell 2023). In this context, institutional investors wield significant influence, simultaneously shaping and being shaped by the ongoing energy transition within the companies they engage with (Polzin and Sanders 2020; Qadir et al. 2021).

In this context, the purpose of this study is to investigate the presence of institutional investors in the ownership structure of O&G companies throughout the 2010s. Given the scarcity of studies focused on the O&G sector, this research adds important insights to the literature on ownership structure using network methodology. Furthermore, changes in international market conditions (such as price fluctuations) and the energy transition to a low-carbon economy not only result in shifts in the strategic positioning of institutional investors within the O&G industry but also highlight the importance of better understanding the influence of these agents on corporate strategies (Krueger, Sautner, and Starks 2020).

2 Literature Review

This section is organized into two parts. Firstly, we review the literature on social network methods in corporate finance studies, focusing on their application to investigate ownership structures and financial interactions. Secondly, the influence of institutional investors on corporate strategies was explored, focusing on ESG practices.

Social network methods examine the relationships and connections between agents, groups, and organizations, exploring their patterns and characteristics, such as network density and properties, and identifying key actors. Advances in computational graph theory have facilitated the investigation of complex network compositions, with applications in economics, sociology, psychology, and physics, among other fields (Jackson 2008; Corrado and Zollo 2006; Rotundo and D'Arcangelis 2010).

In the context of corporate finance studies, network methodology extends beyond the traditional framework of agency theory by examining the relationship between ownership and control of individual firms and incorporating their connections with other agents and organizations (Conyon and Muldoon 2008). Consequently, it is recognized that companies are embedded in complex and heterogeneous networks of agent relationships, which, in turn, influence corporate strategies (Li et al. 2016; Schweitzer et al. 2009).

Several empirical studies have analyzed corporate ownership and control structure using network methodology. Corrado and Zollo (2006), for example, evaluated the ownership networks of Italian companies in 1990 and 2000, a period characterized by a huge privatization process. Results showed a high fragmentation of the overall network but with a stable role by key players. Conyon and Muldoon (2008) contributed to this debate by analyzing publicly traded British companies listed on the London Stock Exchange in 2000. The authors found evidence that financial institutions play a fundamental role in creating different network topologies.[1] Finally, Bajo et al. (2020) used a network method to specifically evaluate the influence of institutional investors on firm value in the US. According to the authors, "*central and more prestigious active institutional investors may serve as a certification provider for the invested company which, in turn, increases its value*."

Ownership relations can occur (i) directly, when the shareholder owns shares of a particular company, or (ii) indirectly, through subsidiaries and associates. Due to indirect connections, control is transmitted through an extensive chain of relationships. The greater the control, the greater the ability to influence decisions. Hence, several studies have created algorithms to evaluate control channels. Gambarelli and Owen (1994) pioneered the modeling of indirect control. La Porta et al (1999), in turn, proposed identifying the ultimate shareholders and controllers of companies from 27 developed economies. The authors pointed out that control was concentrated between households and governments, especially in countries with weaker shareholder protection.

Using a model to evaluate global ownership, Vitali et al. (2011) showed that transnational corporations form a bow-tie structure in which a group of few integrated financial institutions, called a 'super-entity,' controls a large part of corporations. In terms of global financial stability, this concentration increases exposure to contagion while still allowing for risk diversification (Dastkhan and Gharneh 2016).

Mizuno et al. (2020) developed a network structure algorithm focused on indirect relationships through dispersed ownership to measure shareholder control. Their results showed that, contrary to the findings of conventional methods used to assess corporate control, a significant portion of corporate control is concentrated in the hands of sovereign

[1] According to the authors, the exclusion of financial institutions resulted in lower network connectivity, longer path lengths, and lower clustering coefficients.

governments. Furthermore, financial institutions do not appear to wield as much power as previously believed. In the energy industry, Li et al. (2021), using a multilayer cross-shareholding network, observed that cross-stock behavior is uncommon in the O&G chain, being more present among energy giants. Their findings showed that almost 17.5% of the corporations were responsible for approximately 60% of the total industry market value.

Regarding the implications of institutional investors on corporate strategies, Dyck et al. (2019) examined the relationship between institutional investor participation in ownership and corporate social responsibility practices. Their analysis across 41 countries revealed that institutional investors enhance environmental and social (E&S) performance, particularly in countries that share a belief in the importance of E&S issues. The authors also explored the mechanisms through which institutional investors encourage changes in these dimensions. On the one hand, they can indirectly promote such practices by threatening to exit ownership or by engaging directly with management. On the other hand, they may choose to invest only in companies with specific E&S policies, indicating endogeneity in the relationship between ownership participation and E&S policies.

Ren et al. (2023) investigated the relationship between institutional investor participation in the shareholder structure and greenhouse gas emissions among Chinese companies. They consider in their analysis not only the mechanisms through which investors exert influence, as Dyck et al. (2019), but also the heterogeneity of institutional investors. Their findings validated the hypothesis of endogeneity in the relationship under investigation and indicated a negative relationship between institutional investor participation and emissions. Pressure-resistant investors and qualified foreign investors, from countries with stringent compliance policies, had a more significant impact on reducing emissions. In addition, Xu et al. (2023) assessed the role of institutional investors in promoting environmentally friendly technologies. They analyzed patent data from publicly traded Chinese companies between 2003 and 2015. The results suggest that the participation of institutional investors, particularly domestic ones, is positively correlated with the proportion of environmental patents in pollution-intensive sectors.

The impact of institutional investor participation within corporate ownership has also been evaluated using network methodology. Bajo, Croci, and Marinelli (2020) analyzed a bipartite network of institutional investors and companies, as well as a one-mode network derived from these connections. Based on a sample of US companies analyzed from 2001 to 2013, the authors showed that the centrality level of institutional investors is positively associated with firm value. This is because these investors are influential and have strong connections with other players, which acts as a signaling mechanism to certify the company's quality.

Despite the increasing use of complex network approaches in corporate finance analysis, as this brief review demonstrates, few studies have applied these methods to analyze ownership structures in oil and gas (O&G) companies. This gap is particularly significant given the industry's importance to the global economy, energy transition, and sustainability. In the next section, we discuss the methodology aimed at addressing this gap.

3 Methodology

Social networks are models used to represent individuals and the connections between them. A network, denoted as a graph $G(V, E)$, consists of a set of nodes or vertices (V), which represent the agents, and a set of edges or links (E), indicating the relations between these individuals (Jackson 2008).

The edge (E) is denoted as an ordered pair (i, j), pointing to the existence of a link from vertex i to vertex j. These relations between i and j are mathematically represented by adjacency matrices A_{ij}, in which row i and column j show the "from" and "to" vertices, respectively. Considering N individuals, we have an adjacency matrix $N \times N$ defined as:

$$A_{ij} = \begin{cases} 1, & (i,j) \in E \\ 0, & else \end{cases} \quad (1)$$

If $A_{ij} = A_{ji} = 1$, the individuals i and j have a reciprocal connection; if $A_{ij} = A_{ji} = 0$, there is no relation. In the case of $A_{ij} = 1$ and $A_{ji} = 0$, there is a link from i to j with no reciprocity.

Our study used a two-mode weighted network (Figure 1) since we have two types of nodes – O&G companies and institutional investors – one directed link – from institutional investors (II) to corporations (B) – and a weight – given by the level of shareholding (Bajo, Croci, and Marinelli 2020). We considered: institutional investors and O&G companies as nodes (vertices), the relationship between them, given by II shareholding in a specific Oil and Gas (O&G) company, as edges; and the level of shareholding (the product of the stock price and the number of shares, expressed in dollars) as the weight. Thus, we explored the role of institutional investors and their relations in the O&G industry by calculating the topological features of the network (Conyon and Muldoon 2008; Corrado and Zollo 2006; Li et al. 2014; 2016; 2017). The network was built using the Yifan Hu layout algorithm (Hu 2005) due to its efficiency and high quality.

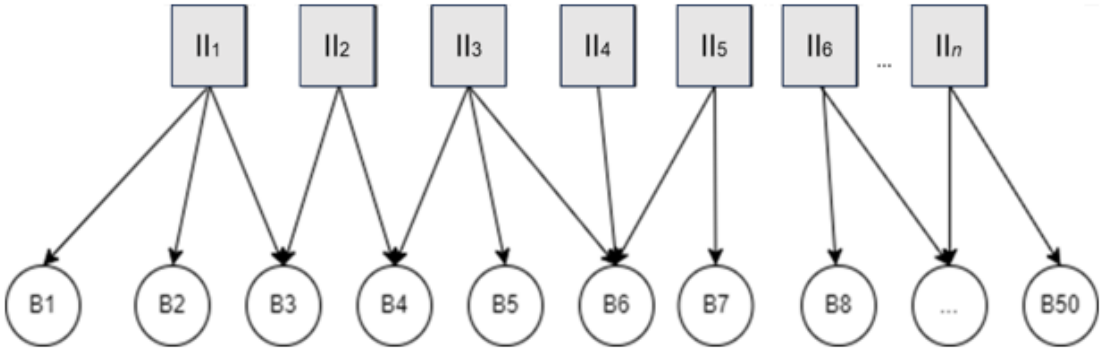


Figure 1: Two-mode network of institutional investors (II) and O&G companies (B)

Note: II_i represents the institutional investor i who holds one or more O&G companies from the sample in their investment portfolio. *Bj* represents the company j (j = 1, …, 50).

The analysis was structured into network-level and node-level measures. To evaluate the network level, we analyzed the number of nodes and edges in each network from 2010 to 2019. Additionally, we calculated the network density and the average degree of connectivity in the network.

Degree centrality quantifies the connectivity level of a node based on the count of its connections with other actors (Jackson 2008). The higher the degree of centrality, the stronger the connection between shareholders, and the greater the expected influence of these investors on the companies. Degree centrality measures identify the actors with privileged position within the network. This characterization is important, as institutional investors with greater centrality tend to play a relevant role in the flow of information and control of O&G companies (Bajo, Croci, and Marinelli 2020; Dastkhan and Gharneh 2016; Sun et al. 2020). The average degree indicates how many connections, on average, the nodes in the network have.

Network density indicates the ratio between all potential connections (edges) and the actual connections in the network. The calculation is performed by dividing the average degree by $(n-1)$ (Jackson 2008). These measures evaluate the level of connectedness within a network by indicating the potential and effectiveness of the integration between companies in the O&G sector and institutional investors. This metric ranges between 0 (network with no relations – completely disconnected) and 1 (all agents are directly connected – fully connected).

As we are dealing with a directed network, it is important to distinguish between the in-degree and the out-degree of a given node. The in-degree measures the number of direct connections that terminate at node V (i.e., the number of nodes that connect incoming edges to node V), while the out-degree measures the number of direct connections that originate from node V (i.e., the number of nodes that connect outgoing edges from node V). These measures can provide the basis for classifying nodes as "transmitters" or "receivers". In the case of transmitters, the in-degree is zero and the out-degree is greater than zero; conversely, for receivers, the out-degree is zero and the in-degree is nonzero (Mueller, Buergelt, and Seidel-Lass 2008).

However, the degree does not provide any information about the intensity of the relationships. To address this limitation, we assigned a weight to each connection based on the value of the investment. We used frequency distribution histograms to examine the number of nodes with many connections (hubs), detect patterns within the ownership, and monitor changes over time. It was expected that most nodes would have a few degrees, while only a few nodes would be hubs.

3.1. Data

The database is based on the ownership of the world's 50 largest O&G companies between 2010 and 2019[2]. The total number of ordinary shares (ORD) and the number of ORD shares held by institutional investors for the period 2010-2019 were obtained using the Refinitiv Eikon database. We classified institutional investors into four groups as provided by the database: hedge funds, insurance companies, investment advisory/hedge funds, and pension funds, following recent studies (Fonseca, Silveira, and Hiratuka 2019; Machado, Sarti, and Silveira 2024). We then organized the sector data according to the updated version of the European Classification of Economic Activities, NACE rev. 2. We selected companies in the exploration, support, refining, and equipment activities (Eurostat 2008).

Table 1 summarizes the amount invested by institutional investors (II) in O&G corporations, indicating that investments fluctuated throughout the 2010s, peaking at US$ 525 billion in 2013. Investment Advisory/Hedge Funds were the largest group of investors in the series, with this category increasing investments by more than US$ 40 billion between 2010 and 2019. Consequently, as shown in Figure 2, institutional investor participation in the ownership of O&G companies increased from 23% to 29% during the period (considering only ordinary shares).

[2] The classification was based on the revenues of the OPG companies in 2018. The period was chosen considering data availability and the pre-pandemic timeframe.

Table 1. II investments in the O&G sector (US$ billion) between 2010 and 2019.
This table reports the amount invested (in US$ billion) by institutional investors in O&G corporations during the 2010-2019 period.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Var. 2010/2019
Hedge Funds	9	10	14	18	14	13	11	13	12	14	56%
Insurance company	12	12	15	20	14	16	20	22	12	12	-1%
Investment Advisory/ *Hedge Funds*	340	339	350	420	383	333	399	411	352	380	12%
Pension Funds	57	61	64	67	61	45	55	57	51	50	-12%
Total	418	422	442	525	473	407	486	503	428	456	9%

Source: Reuters (2022).

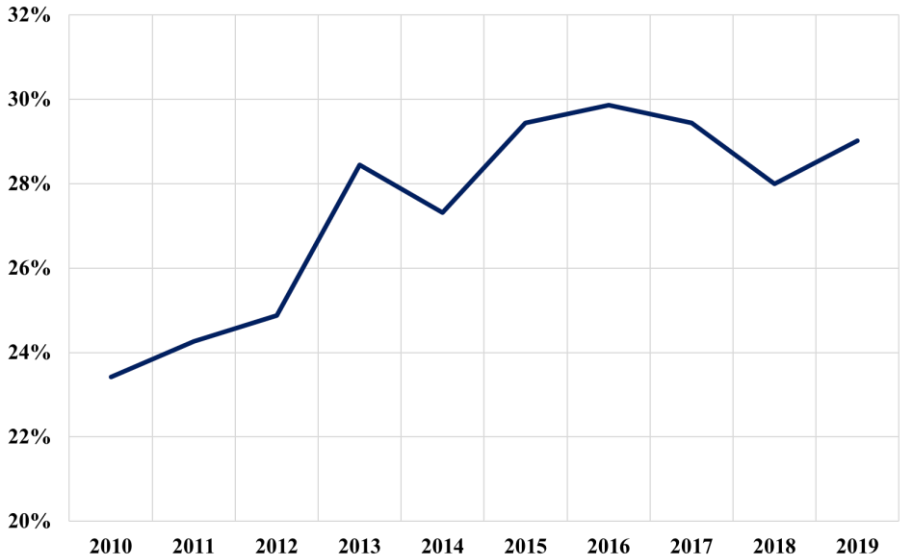


Figure 2. II ownership participation in O&G companies (2010-2019) considering ordinary shares between 2010 and 2019
Source: Reuters (2022).

Table 2 shows the number of institutional investors in the O&G industry ownership between 2010 and 2019, indicating a greater diversification in the set of institutional shareholders. All four categories increased their number of investors in the oil market, with the total number of players growing by 45% from 2010 to 2019. Even if, on average, the size of the holdings was reduced, we observe widespread penetration of these investors in the ownership of O&G companies, indicating a significant potential to influence their management.

Table 2. The evolution of the number of II in the ownership structure of companies in the oil and gas sector between 2010 and 2019.
This table reports the number of institutional investors in the O&G industry ownership during the 2010-2019 period.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Var. 2010/2019
Hedge Funds	597	663	774	752	707	768	762	816	843	894	50%
Insurance company	183	197	233	238	235	256	321	338	298	284	55%
Investment Advisory/ Hedge Funds	4,978	5,336	5,587	6,212	6,511	6,679	6,945	7,056	7,159	7,093	42%
Pension Funds	596	684	805	813	872	900	976	967	967	969	63%
Total	**6,354**	**6,880**	**7,399**	**8,015**	**8,325**	**8,603**	**9,004**	**9,177**	**9,267**	**9,240**	**45%**

Source: elaborated by the authors.

4 Results

Table 3 presents the network-level metrics. The findings indicate a growing number of institutional investors in the ownership of the companies in a low connectivity context. The number of nodes increased from 1,196 in 2010 to 1,236 in 2019, while the number of edges rose from 6,354 to 9,240 over the same period. This trend is also reflected in the network density. During the period, there was a rise in the proportion of network connections compared to the total potential connections, climbing from 0.4% to 0.6%. This result was expected, given the significant prevalence of cross-shareholdings among corporations and institutional investors. Furthermore, the average degree of connectivity in the network exhibited substantial growth, rising from 5.31 in 2010 to 7.48 in 2019. The higher average degree suggests a greater level of interconnectedness among the entities studied.

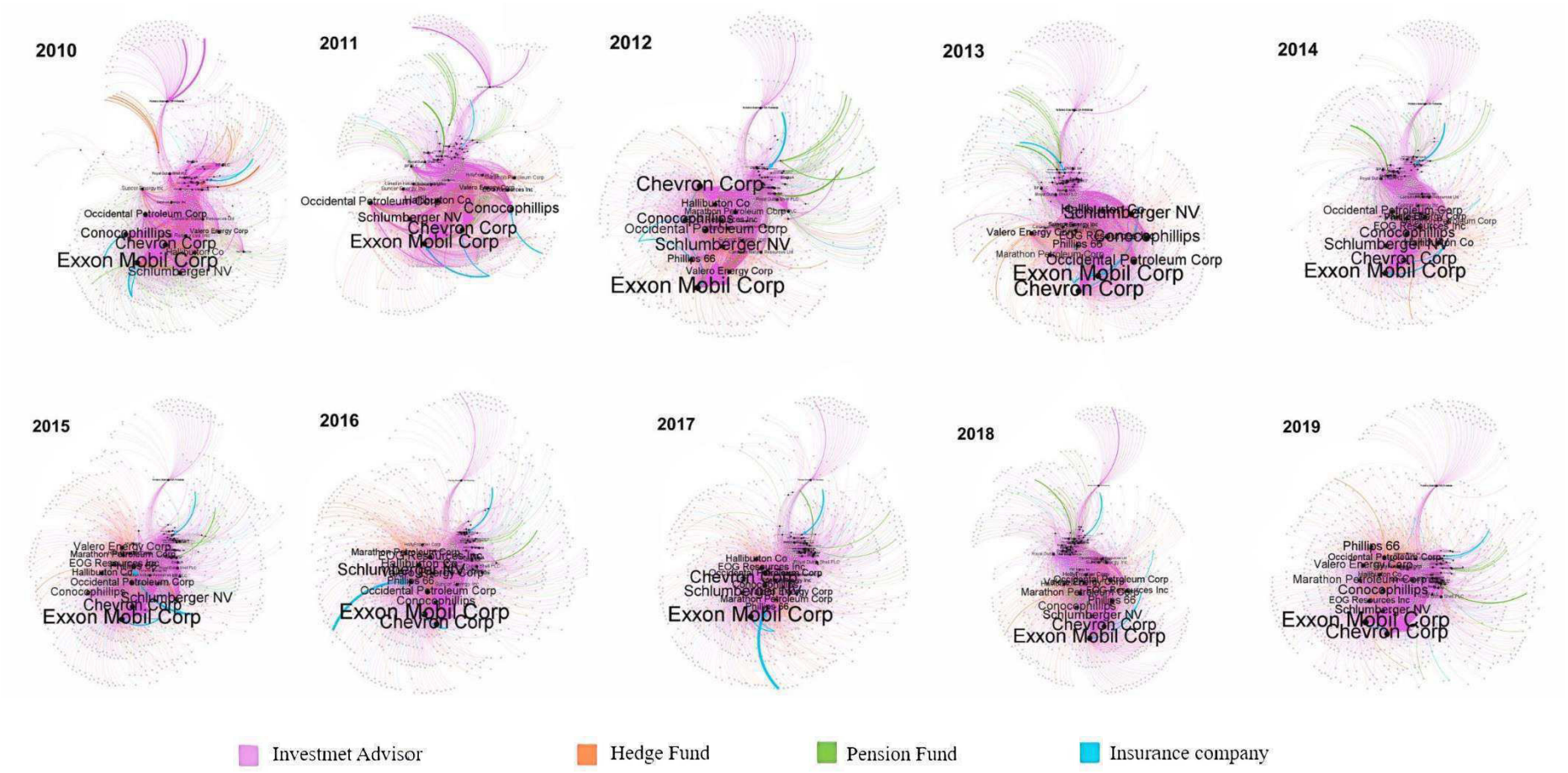
Table 3. Network-level measures between 2010 and 2019.
This table reports the network-level metrics during the 2010-2019 period, indicating the number of nodes, the number of edges, density, and average degree.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of nodes	1,196	1,190	1,190	1,232	1,210	1,198	1,235	1,225	1,203	1,236
Number of edges	6,354	6,880	7,399	8,015	8,325	8,603	9,004	9,177	9,267	9,240
Density	0.004	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.006
Average degree	5.31	5.78	6.22	6.51	6.88	7.18	7.29	7.49	7.70	7.48

Source: elaborated by the authors.

Figure 3 illustrates the directed and weighted networks between 2010 and 2019. Links indicate institutional investor ownership in the O&G corporations. The connections were color-coded according to four categories representing institutional investors. The larger the font size used for the II name, the greater the participation of II (in-degree) in the company ownership.

Figure 3. Ownership networks of O&G companies and institutional investors from 2010 to 2019.



Note: name size was structured by the in-degree. The connection color characterizes the categories of institutional investors.

In 2010, major U.S. oil companies such as Exxon Mobil, Chevron, and ConocoPhillips were the primary recipients of capital from institutional investors, predominantly from the investment advisory/hedge fund category. Over the subsequent years, an increasing number of companies attracted institutional investors as shareholders. Starting in 2014, there was a noticeable increase in the interconnectedness among companies within the network. The prominence of U.S. companies as investment targets became particularly evident when compared to their European counterparts.

Table 4 presents the top five measures of in-degree centrality and the total investment by institutional investors for each company in the years 2010 and 2019. The main target companies (in-degree) remained the same in both years. In 2010, the most substantial investment was made by State Street in Exxon Mobil, totaling US$14.5 billion. Conversely, in 2019, the largest investment was allocated to Exxon Mobil as well, but this time by Vanguard, amounting to US$24 billion. ExxonMobil represented 22% of the total invested by II in the top 50 companies in the sector, with the top five companies accounting for 63% of total institutional investment in 2010. In 2019, the total value invested by the top five decrease to 52.6%. In both cases, the concentration of investments in US companies is prominent.

Table 4. Five highest in-degree and total investment.
This table reports the top five measures of in-degree centrality and the total investment by institutional investors for each company in 2010 and 2019.

	No	In-degree	Total II investment (billion US$)	% total
2010	Exxon Mobil Corp	582	93.2	22.3%
	Chevron Corp	514	58.2	13.9%
	ConocoPhillips	469	34.3	8.2%
	Schlumberger NV	449	42.7	10.2%
	Occidental Petroleum Corp	389	34.7	8.3%
Total			**263.1**	**63.0%**
2019	Exxon Mobil Corp	654	87.6	19.2%
	Chevron Corp	619	81.4	17.9%
	ConocoPhillips	502	28.2	6.2%
	Phillips 66	473	17.4	3.8%
	Schlumberger NV	464	25.3	5.6%
Total			**239.9**	**52.6%**

Source: elaborated by the authors.

The prominent investors, particularly Vanguard, State Street, and Geode Capital, maintained a persistent presence in the ownership of Oil and Gas (O&G) companies from 2010 to 2019, as evidenced in Table 5. These major investment entities were notably represented across nearly all sampled companies; for instance, in 2019, Vanguard was involved in 49 out of 50 companies. Moreover, they consistently held the highest invested values throughout the period, thus playing a significant role in the overall assessment. It is pertinent to highlight the concentration of investment: Vanguard's share of all institutional investment rose from 9.5% in 2010 to 21.5% in 2019. Similarly, the collective investment by the top five investors increased from 28.4% of the total institutional investment in 2010 to 41.2% in 2019.

Disregarding the sectoral component, the literature has already pointed out the centrality and concentration of the largest institutional investors in the financial market. Vitali et al. (2011) observed that Fidelity Management & Research, Capital Group, and BlackRock were the financial corporations with the greatest control in the global investment network in 2007. Fichtner et al. (2017) reported that BlackRock, Vanguard, and State Street owned about 88% of the S&P 500 in 2015. Lazonick and Shin (2020) showed that the top three funds held more than US$ 5 trillion in equities in 2018, which represented 33.8% of the total investment made by the top 100 institutional investors.

Table 5. Five highest out-degree and total investment.
This table reports the top five measures of out-degree centrality and the total investment by institutional investors for each company in 2010 and 2019.

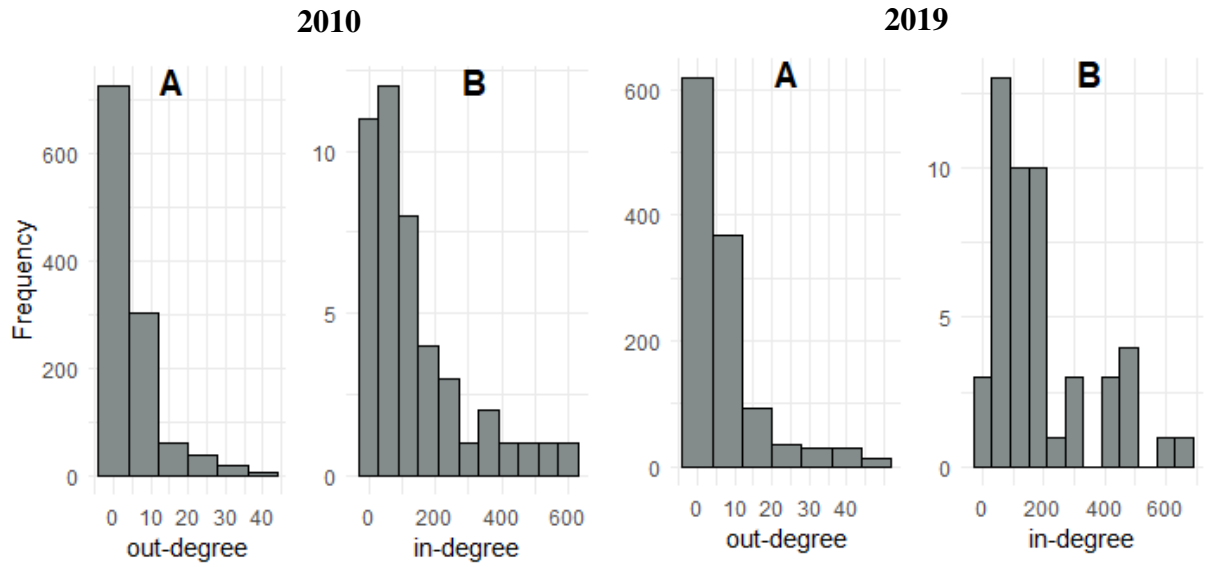
	Top 5 investors (out-degree centrality)	Out-degree	Top 5 investors (total investment)	Investment (billion US$)	% total
2010	The Vanguard Group, Inc.	41	The Vanguard Group, Inc.	39.8	9.5%
	Lyxor Asset Management	40	State Street Global Advisors (US)	39.5	9.5%
	State Street Global Advisors (US)	39	Wellington Management Company, LLP	17.4	4.2%
	Caisse de Depot et Placement du Quebec	38	Legal & General Investment Management Ltd.	13.1	3.1%
	Geode Capital Management, L.L.C.	37	BlackRock Advisors (UK) Limited	8.8	2.1%
Total				**118.6**	**28.4%**
2019	The Vanguard Group, Inc.	49	The Vanguard Group, Inc.	98.2	21.5%
	Geode Capital Management, L.L.C.	48	State Street Global Advisors (US)	48.1	10.5%
	Florida State Board of Administration	47	Wellington Management Company, LLP	15.8	3.5%
	Credit Suisse Asset Management	47	Geode Capital Management, L.L.C.	15.3	3.4%
	State Street Global Advisors (US)	47	Dimensional Fund Advisors, L.P.	10.6	2.3%
Total				**187.9**	**41.2%**

Source: elaborated by the authors.

In-degree indicates the level of integration or exposure of the company to institutional investors, while out-degree represents portfolio diversification or how ownership is distributed (Dastkhan and Gharneh 2016). The higher the level of integration, the greater the influence and control of these investors over the business model. To understand the importance of central nodes and the dispersion of nodes, the frequency distribution of in-degree and out-degree were analyzed.

Figure 4 presents the histograms for the in-degree and out-degree. In both cases, results suggest a network characterized by a few nodes with high degrees (hubs). For out-degree, most institutional investors manage a portfolio of up to 10 O&G companies, while only a few have a portfolio with more than 30 companies. Regarding in-degree, most O&G companies in the sample have up to 200 institutional investors, with only a few having more than 400. In general, these characteristics have been maintained during the period 2010-2019. However, results show that, on one hand, there is an increase in the number of IIs with up to 20 companies in their portfolios. On the other hand, there is a reduction in the number of companies with up to 50 IIs in their capital structure.

Figure 4. Frequency distribution histogram of nodes, 2010 and 2019 networks.



Source: elaborated by the authors.
Note: out-degree was calculated only for institutional investors and in-degree for the 50 O&G companies.

5. Implications

The findings of the study indicate significant centrality of institutional investors in the O&G sector. The increased participation of institutional investors in the ownership of these companies has the potential to have substantial implications for the decision-making process in both financial and Corporate Social Responsibility (CSR) dimensions. Given that institutional investors do not represent a homogeneous group (Fonseca, Silveira, and Hiratuka 2020; 2019; Froud et al. 2000; Lazonick and Shin 2020), their influence on company strategies varies according to each company's business model (Çelik and Isaksson 2013) and their monitoring efforts in the invested companies (Katan and Mat Nor 2015).

Recent studies have confirmed the significant influence of institutional investors on corporate strategies. Abedin et al. (2022), for example, evaluated the impacts of institutional investors' actions on the performance of publicly traded companies. Their findings indicate that the participation of institutional investors positively affects the performance of the evaluated companies. Similar findings were observed in other research, such as Rashid (2020) and (Yeh 2019).

Previous works also investigated the influence of institutional investors on companies' dividend policy. Crane, Michenaud, and Weston (2016), Bataineh (2021), and Hazmi et al. (2023) argue that greater institutional investment leads to higher dividend payments. In this context, it is necessary to consider the potential endogenous relationship between the participation of institutional investors in the shareholder structure and dividend payments. While these investors are attracted by high dividend payments, they also influence resource allocation based on their management guidelines. While investing large amounts of capital enables institutional investors to increase the financial resources available to companies, thereby benefiting projects in need of funding (Ajina, Lakhal, and Sougné 2015; Blume and Keim 2012), some authors argue that these agents exert 'myopic' pressures on corporate management to secure short-term returns (Bataineh 2021; Crane, Michenaud, and Weston 2016; Hazmi et al. 2023).

On the other hand, long-term institutional investors moderate the expected positive relationship between corporate sustainability and future financial performance (Velte 2022). As discussed in the literature review, these investors are expected to take an active role in optimizing resource allocation, promoting better governance, enhancing environmental and social practices, stimulating innovations, and reducing greenhouse gas emissions. Thus, they play a crucial role in improving ESG performance, particularly in the environmental dimension.

This debate gains prominence in an energy transition scenario. During the 2010s, institutional investors show no withdrawal from carbon-intensive assets. However, the O&G companies are already seeking to position themselves as energy companies, which tends to maintain their valuation potential (Mahoney and Mahoney 2021).

The adoption of proactive strategies towards sustainability, especially in strategic sectors like O&S, is driven by a growing global focus on carbon neutrality. Green investment tends to be strengthened in the coming years, with direct effects on the valuation and diversification of oil companies' portfolios. While some corporations are specializing in wind, others are investing in solar and biofuels. Some companies are also positioning themselves in the distribution of electricity, and charging electric vehicles and batteries, among other activities involving research and development (IEA 2020).

In general, institutional investors, increasingly aware of this market demand, recognize that responsible investments and innovations not only align with environmental sustainability but also generate financial returns. This dual benefit makes such investments more attractive in the long term, reinforcing the vital role of these investors not only in guiding corporate strategies toward sustainability but also in directing long-term capital in line with long-term climate goals (Xu et al. 2023; McDonnell and Gupta 2024; Persad, Xu, and Greening 2024). Table 6 illustrates this scenario. Companies with higher environmental innovation metrics (grades A and B) presented higher participation of institutional investors in their ownership structure[3]. This finding is particularly evident between 2017 and 2019.

[3] This analysis considers the E-innovation grade metric, provided by Refinitiv Eikon (Reuters). According to Thomson Reuters: "Environmental innovation category score reflects a company's capacity to reduce the environmental costs and burdens for its customers, and thereby creating new market opportunities through new environmental technologies and processes or eco-designed products".

Table 6. II ownership participation in O&G companies considering E-innovation grades[a].
This table reports the participation of institutional investors in companies' ownership structure considering the environmental innovation metrics of these companies.

E-innovation grades	II ownership: average participation		II ownership: median participation	
	2010-2012	**2017-2019**	**2010-2012**	**2017-2019**
A-B	26.42%	34.15%	17.62%	39.08%
C-D	20.25%	26.95%	12.80%	21.33%
Diference	6.17%	7.19%	4.83%	17.75%
t de *Student*	1.3260 (0.1892)	1.8209 (0.0721)		
Adj. Med. Chi-square – value *p-value*			3.3601 (0.0668)	5.9395 (0.0148)
Observations: Grade A-B	42	44	42	44
Observations: Grade C-D	29	45	29	45
Observations: Grade total	71	89	71	89

Source: Elaborated by the authors.
[a] Note: The environmental innovation grade was obtained from the Thomson Reuters Database.

6 Conclusions

This study investigated the presence of institutional investors in the ownership structure of the oil and gas industry. The results showed the extensive capillarity of these investors within the analyzed sample, including state-owned companies. Furthermore, while the majority of investments were allocated by the largest investment managers' networks, the findings indicated a greater diversification of institutional investor categories throughout the 2010s.

Consistent with the literature on institutional investors' participation in the ownership of non-financial corporations, the findings indicate that institutional investors' participation in oil and gas companies significantly increased from 2010 to 2019, particularly in U.S. companies. The high level of participation and centrality of institutional investors not only underscores the importance of gaining a deeper understanding of their position and influence within the sector but also raises important questions regarding the financing of carbon-intensive assets and the potential impact these entities have on corporate strategies.

However, some limitations must be acknowledged. Firstly, the study is restricted to the 2010s. Future studies may consider a longer time horizon, including even more recent data, given the current energy transition scenario (Alova 2022; Halttunen, Slade, and Staffell 2023; Wu et al. 2024). In addition, the work used only degree indicators as a measure of network connectivity. It is possible to broaden the analysis to include several other indicators that could capture more comprehensive information about the network´s layout and the institutional investors' influence. Moreover, network analysis is limited by its tendency to simplify relationships into binary connections, overlooking key aspects such as strength, directionality, and quality, which can lead to a restricted understanding of network dynamics. Finally, the focus on static representations fails to account for the dynamic and evolving nature of real-world networks, reducing the accuracy of the findings.

Based on our findings, future studies could explore the influence of institutional investors on corporate strategies within the O&G sector, particularly regarding dividend policies and activism aimed at enhancing the adoption and performance of ESG (Environmental, Social, and Governance) practices. Furthermore, future research could not only consider changes in the ownership of companies in the sector, incorporating the heterogeneity in the investment horizons of equally diverse investors but also examine how the financing structure of companies varies according to their business model. Although investments outside of the traditional oil and gas supply are relatively small, these companies have been making strategic shifts within the context of the energy transition. This shift has increasingly become a focal point for investors.

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