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26-4 Who Controls the Global Petrochemical Industry, and How Might That Change?

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ABSTRACT

Petrochemicals are integral to modern economies. They are used in many products such as fertilizers, plastics, fibers and clothing, cosmetics, electronics, and medicines. Petrochemicals are also becoming the fastest-growing source of demand for oil. The 2026 conflict in the Middle East has underscored vulnerabilities in the petrochemical sector and food security. Middle Eastern producers account for much of the global supply of key petrochemical products, including fertilizers, and one-third of global seaborne fertilizer trade transits the Strait of Hormuz. It is, therefore, important to understand the structure of the industry to attenuate supply chain vulnerabilities. In this paper, we examine both geographical dispersion and corporate control over the industry. Our analysis shows that the global petrochemical industry is largely concentrated in China, the United States, and Saudi Arabia. However, control is more pronounced in China and other Asian countries, whereas US investors exercise relatively limited control over the global petrochemical industry.

JEL Codes: G3, L1, L7, Q3, Q5
Key Words: ownership, voting power, supply chain, petrochemicals, geopolitics

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I INTRODUCTION

Petrochemicals are integral to modern economies. They are used in products such as fertilizers, plastics, fibers and clothing, cosmetics, electronics, and medicines. The conflict in the Middle East in 2026 has underscored vulnerabilities in the petrochemical sector and food security. Middle Eastern producers—Bahrain, Iran, Iraq, Israel, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates—account for about 20 percent of the global supply of key petrochemical products (Barclays Investment Bank 2026). Moreover, approximately one-third of global seaborne fertilizer trade transits the Strait of Hormuz (UNCTAD 2026), creating substantial risks to global food supplies.

Understanding the topography of the petrochemical industry, including its size, geographical distribution, and ownership and control structure, is essential to grasp this critical component of global economic activity. In this context, mapping the industry's evolving ownership structure and regional concentration has emerged as a key prerequisite for assessing supply chain resilience and national security risks.

Some of the main reasons for closely monitoring developments in the petrochemical industry include:

- Petrochemicals are rapidly becoming the fastest-growing component of global oil demand, as the relevance of crude oil to chemical technologies has grown. According to the International Energy Agency (IEA 2025), the petrochemical sector is expected to remain the primary source of oil demand growth through 2030.[1] This trend may particularly benefit regions such as the Middle East and North America (IEA 2018, OPEC 2024), which traditionally produce lighter oil grades favored in producing petrochemicals.
- Petrochemicals are essential inputs for clean energy technologies. They are used in components for solar panels, wind turbines, and electric vehicles, making them central to global shifts away from fossil fuels. At the same time, the industry aims to transition to sustainable materials and cleaner production technologies, driven by heightened public awareness of environmental challenges.
- The petrochemical industry has followed the reorientation in global trade and economic growth, with developing economies leading the growth. The industry has shifted significantly from Western to Eastern companies, with production capacity and consumption centers increasingly concentrated in Asia, particularly China. As petrochemical products are key inputs to many industries, supply chain disruptions are a challenge in the short run, especially in the context of potential geoeconomic fragmentation and tensions. The concentration of medical supplies during the COVID-19 pandemic and export control mechanisms for rare earth elements have highlighted that continuity of supply chains is crucial to the dependent economies. Similarly, the war in Ukraine disrupted the global fertilizer market, a significant factor in food

1 Except for Europe and Africa, the IEA (2025) expects oil demand for petrochemicals to grow in most regions. Similarly, the Organization of the Petroleum Exporting Countries (OPEC 2024) anticipates that most of the growth in demand for oil will come from the Middle East and non-OECD Asia due to numerous ongoing projects in those regions.

security, leading to shortages, price hikes, and food security issues, as the market is controlled by a few major players.

Nonetheless, the petrochemical industry faces several challenges:

- First, the global push to reduce reliance on fossil fuels is reshaping the sector. As oil demand declines, oil and petrochemical companies are expected to further integrate their value chains (IEA 2018). Such integration can occur upstream (sourcing and production), midstream (transportation and storage), and downstream (refining and processing). Middle Eastern producers are likely to focus more on downstream activities; for example, Saudi Arabia aims to leverage its privileged access to feedstock to capture more value across the petrochemical supply chain. On the other hand, Europe's energy transition has outpaced its industrial control over the sector.
- Second, intensifying geopolitical tensions increase the risks of trade disruptions and oil price volatility, dampening petrochemical growth in a softer macroeconomic environment, but they may also promote reshoring or "friend-shoring" of critical industries, petrochemicals included, that are deemed important to national security. The current war in the Middle East shows the vulnerability of supply chains to geopolitics, including for fertilizers, which could raise food prices.
- Third, despite forecasts of rising demand, the industry is currently facing reduced growth and improved supply conditions, leading to potential cost-cutting measures, rationalization (including leveraging artificial intelligence), and possible closures of capacities (Çetinkaya and Prieto 2024).
- Fourth, Chinese and US producers have increased their market share in the industry, leading to overcapacity among producers in other regions (IEA 2025).

Against this backdrop, a clear understanding of the structure and dynamics of the global petrochemical industry is critical for assessing supply chain resilience. This is particularly relevant for the oil-producing nations seeking to optimize the value of their natural resources, for countries aiming to reduce reliance on external suppliers of key petrochemical products, and for firms engaged in sourcing these inputs. While questions of ownership and control in petrochemicals may not yet carry the same urgency as those surrounding critical minerals—where supply is heavily concentrated—such issues are likely to gain prominence over time. One potential vulnerability is the risk of hostile or strategically motivated acquisitions that could disrupt supply chains. As highlighted in this paper, several companies appear particularly exposed to such risks. Encouragingly, there are cost-effective strategies to mitigate these risks without compromising control over other segments of the supply chain.

We first analyzed the industry based on the geographic location of petrochemical companies. Our key findings are as follows:

- A group of 21 companies accounts for a large share of global petrochemical companies. The largest is China Petroleum and Chemical Corporation (Sinopec), followed by other companies incorporated in China, the United States, Saudi Arabia, and other Asian countries. Conducting the same analysis

on an expanded dataset produced broadly similar conclusions, reinforcing the dominance of these players.[2]

- Most shareholding ownership is by corporations at 72.4 percent, followed by government agencies at 9.1 percent, investment advisors at 7.9 percent, individual investors at 5.0 percent, and holding companies at 3.4 percent.
- Three countries stand out in terms of their shareholding entities: China at 52.6 percent, the United States at 13.5 percent, and Saudi Arabia at 9.1 percent. All other countries' entities each hold about—or well below—5 percent, with Thailand and India standing out among them at roughly 5 percent.

A different pattern emerges when examining who controls these 21 companies:

- Chinese investors control almost one half (44 percent) of the companies in the sample (i.e., the companies that are incorporated in China). More broadly, Asian investors overall control almost 61 percent of the sample, while US investors control 16 percent.
- The degree of control exercised by these shareholders, as measured by our control metric (the ZENO indices, discussed in section II), varies substantially. US investors control very few of the companies they have invested in while Chinese investors have a significant level of control over their companies. Saudi investors have full control over the only company they have invested in. It is important to note that our analysis focuses on control over petrochemical companies rather than control at different stages along the value chain. A company or country could, in principle, enhance its control by moving up/down the value chain. While our methodology could be extended to assess such value chain dynamics, this paper does not explore that dimension.
- Overall, US investors hold relatively little control over the global petrochemical industry, in terms of both controlled revenue and governance influence. Their holdings are dominated by passive investment funds, which can divest quickly if incentivized by returns—limiting strategic control. Chinese investors, by contrast, hold direct and substantial positions, giving them meaningful, though not absolute, control. These stakes are held primarily by corporations, which tend to maintain stable shareholdings rather than behaving like passive financial investors. By comparison, Europe has limited presence in this segment of the industry, aside from several diversified industrial groups such as BASF—firms for which petrochemicals are important but not the core business.

The rest of the paper is organized as follows: Section II describes the methodology for measuring control. Section III provides an overview of the ownership structure in the petrochemical industry. Section IV identifies the main shareholders and presents our empirical estimates of the level of control they exercise. Section V offers a short historical perspective and examines how control

2 In appendix A, we explain the rationale for selecting these 21 companies and detail the difficulties in extracting information on petrochemical activities from available data.

has evolved over time. Section VI discusses how, looking ahead, ownership structures might shift, and the likelihood that companies could come under external control. Section VII concludes by bringing together key observations and their broader implications, including for policy.

II WHY CONTROL MATTERS AND HOW TO MEASURE IT

An important issue is the distinction between ownership and control. How firms are owned and controlled significantly influences their strategic decisions and performance (Shleifer and Vishny 1997). Ownership and control do not necessarily coincide. Ownership refers to cash flow rights—the right to receive a firm's profits—while control encompasses rights over decisions regarding corporate assets and strategies (Grossman and Hart 1986). As share ownership has become more widespread, the ownership structure of many corporations has become more diluted, with few entities holding a material share of outstanding voting shares. In the extreme case where there are no significant individual shareholders, this leads to a separation of ownership and control (Berle and Means 1932), with managers essentially free to run the company as they please.

The fact that an investor holds, directly or indirectly, a sizable percentage of the shares of a company does not necessarily imply that they will seek to control its management. Such investors treat their holdings as mere financial assets in a large portfolio, buying or selling as needed. Without any long-term commitment to the companies in their portfolios, these investors do not have much to gain from control. They will act as passive owners who could sell their shares whenever they consider that the price is right. Large passive funds are often associated with this behavior, although, as discussed later, they may use their leverage to influence the management of the companies where they have invested. This points to the importance of knowing who retains shares associated with control in a company beyond measuring that level of control.

Control matters for two main reasons. First, the ability to directly influence a significant part of world output confers market power, reducing the availability of truly independent alternatives for users. Second, control matters when the ordinary course of business is perturbed by unexpected events, such as geopolitical developments. For these two reasons, the issue of control also has serious implications for the management of risks. A 2022 analysis that measured control in the critical mineral sector revealed several risks and opportunities that clearly illustrated this (Leruth et al. 2022).

One type of control stems from the structure of corporate ownership. This type of control is at the core of this paper. A second type of control is linked to the territorial control of productive assets. If there is a very significant breakdown in international economic relationships, then assets perceived to be essential will end up under national control. In a sense, then, this second type of control is likely to matter under more drastic circumstances, such as during geopolitical changes, than the first one. The importance of this type of control, however, is limited if the local assets depend on a global network of supply that remains, at least partially, in the hands of the corporate owners.

For a government, the fact that a major national shareholder loses control of a firm could have a significant effect or not matter at all. In the case of very large firms operating in a strategic sector, understanding the nature of control by important shareholders and assessing the risk that an existing investor or a

new one, possibly hostile, can dislodge the dominant shareholder is of paramount importance. At the same time, owning 100 percent of the shares in a company is an ineffective way of controlling it. Even 51 percent is usually excessive. Below that, though, there is always the possibility that another shareholder reaches 51 percent. In some cases, it is nearly impossible, in some others, it would be feasible. In most cases, however, even a minority shareholding can very well guarantee a substantial level of control to the shareholder, and the assessment of risks is therefore not straightforward, as discussed below.

Some measures have been developed in the industrial organization and corporate finance literature to capture the separation of ownership and control, such as the wedge between voting rights and cash flow rights or the control-ownership ratio (Edwards and Weichenrieder 2009). More sophisticated approaches consider the distribution of voting power using game-theoretic concepts such as the Shapley-Shubik index or the Banzhaf index (both traditionally referred to as power indices). These measures consider the strategic interactions among shareholders in coalition formation and capture control dynamics better than simple voting rights (Leech 2002). These power indices can capture voting power in decision-making bodies, but they differ in their mathematical foundations and interpretation.[3] In the context of corporations (the ability to win a vote at an annual general meeting), the Banzhaf index is most useful and well suited to be computed algorithmically.

We examined the entities that control the key firms in the petrochemical industry using ZENO indices, the same methodology that was employed earlier in a study of control in the critical minerals industry (Leruth et al. 2022).[4] ZENO indices provide a measure of the level of control that shareholders can exercise over a company, whether directly or indirectly (through subsidiaries). They measure the ability of shareholders to influence voting outcomes, resulting in a single index that measures that level of control. The ZENO indices are based on the concept of ultimate controlling owner (UCO), which refers to those shareholders (direct or indirect) possessing the highest level of control.[5,6]

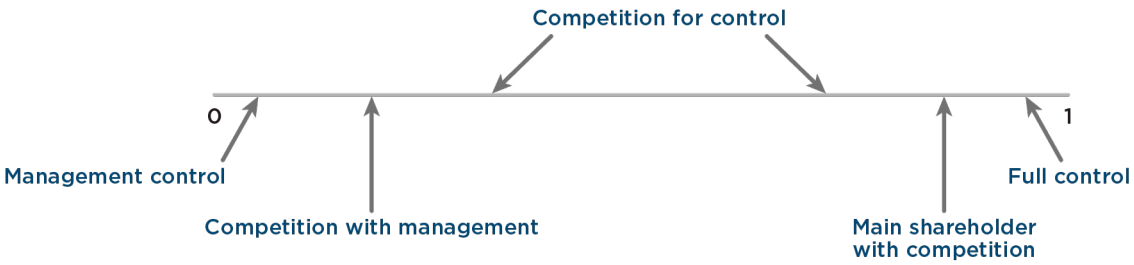
3 The Shapley-Shubik index is based on cooperative game theory and considers all possible orderings (permutations) of voters joining a coalition. It measures the proportion of permutations in which a voter is pivotal or decisive. The Banzhaf index focuses on the concept of "swing voters" or critical voters and measures the proportion of coalitions in which a voter's change in vote would change the outcome (Crama and Leruth 2013). Note that the Banzhaf Index was first and famously applied to the parliamentary process.

4 The ZENO methodology is discussed in appendix A of Leruth et al. (2022), which explains why traditional control indices in the Herfindahl family are inadequate and clarifies why control is not merely a function of the percentage of shares held. To compute Banzhaf indices, we used the ZENO-Indices software (www.ZENO-indices.com), which has been developed as a practical way to measure indices that are close to those of Banzhaf.

5 UCOs are related to the concept of ultimate beneficial owners (UBOs). UBOs are defined based on legal texts whereas UCOs are identified using quantitative methods. Typically, there are UBOs that have no control over the company and hence are not UCOs, while some UCOs may not be identified as UBOs (usually because these UCOs operate through layers of subsidiaries). In all cases, the UCOs are those that matter when analyzing the shareholding structure.

6 The index of control we have used factors in the presence of free float, even if it is large. Float refers to shares that can be publicly traded because they are not subject to restrictions.

Figure 1
Index of corporate control



The ZENO indices measure the potential level of control that a company's top shareholders can exercise through direct or indirect shareholding, or both. It ranges from 0 to 1, with 1 indicating full control (figure 1).[7] Specifically:

- A ZENO index of 1 (Z1) means a single top shareholder (UCO1) controls the company and usually hires the management. There is no other UCO. If the highest ZENO index is strictly below 1 but close to it (say, 0.7 < Z1 < 1), one UCO (UCO1) has considerable influence, even if it owns substantially less than 50 percent of the shares, which is the case when there is a large float (i.e., many small and dispersed shareholders). The company could (but need not) have one or two additional top shareholders with low ZENO indices, such as a UCO2 (perhaps UCO3) with a small Z2 (perhaps Z3).[8]
- If the highest ZENO index Z1 lies between, say, 0.3 and 0.7, UCO1 may have a substantial level of control but face competition for control from other UCOs (UCO2 and perhaps UCO3, with Z3 < Z2 < Z1).
- If the highest ZENO index falls below 0.3, management retains most of the control and becomes the UCO1. The company is considered independent of external influence.

Furthermore, the ZENO index quantifies the level of control that all UCOs of a company can exercise and ranks them based on their corporate influence. Although UCOs may not necessarily utilize this influence, they have the capability to do so. In this paper, to simplify the interpretation and analysis, we limit the number of UCOs to two, such that $Z1 \geq Z2$, and consider the second UCO only when $Z2 > 0.2$ (the assumed threshold). Below this threshold, any shareholder is assumed to hold its shares for portfolio purposes. If all shareholders fall below the threshold, the company is run by its management.

III AN OVERVIEW OF THE INDUSTRY

The global petrochemical industry can be broadly grouped into four blocks: China, the United States, the Middle East, and Europe.

7 The ZENO indices of all identified shareholders need not sum to 1.

8 In a case like this, UCO1 can occasionally lose a vote if UCO2 mobilizes a large set of small shareholders to form a coalition against it, which is difficult if Z2 is much smaller than Z1.

- China has the largest petrochemical products market in the world. Although it is a net exporter of petrochemicals, the industry remains heavily dependent on imports of feedstock (table 1).
- The United States is in a relatively advantageous position, benefiting from abundant domestically sourced feedstock for its petrochemical industry. At the same time, geopolitical considerations—particularly US-China trade tensions—have led the US government to restrict exports of certain petrochemical products (such as ethane) to China.
- The Middle East's petrochemical production capacity has expanded rapidly due to the availability of cheap domestic feedstock and the region's desire to lower dependence on oil exports. Nonetheless, the sector remains exposed to regional geopolitical risks.
- Europe's petrochemical industry is much more exposed to geopolitical and market risks because of its heavy reliance on feedstock imports.

Table 1 shows countries accounting for more than 1 percent of global imports or exports of petrochemicals and derivatives in 2024. The trade amounts are driven by several factors:

- Resource-advantaged exporters, such as Saudi Arabia, leverage their abundant natural reserves to produce petrochemicals and derivatives domestically, thus reducing imports.
- High-value export hubs, such as Switzerland, are characterized by a small domestic market and focus on exporting sophisticated products.
- Integrated trade hubs (e.g., Belgium, Netherlands, the United Kingdom, Singapore), favored by their geographic locations, have very high import and export flows relative to their domestic market. They sit in the middle of global chains by importing, processing, and exporting.
- Large domestic markets (e.g., China, the United States, Germany) feature internal consumption that is so large that even sizable trade flows are relatively small in proportion and domestic value chains that are highly developed.
- Some countries (e.g., Italy, Slovenia, Brazil) depend heavily on imports to meet domestic demand.
- Some countries (e.g., France, Spain) have a well-balanced profile across processing, domestic consumption, and trade.

The next step is to map the global landscape of the petrochemical industry by identifying its major firms. To obtain further insight, we examined the importance of various petrochemical companies around the world. To do this, we relied on data from the American Chemical Society (ACS), which publishes an annual snapshot of the world's top 50 chemical companies. The ACS dataset provides information on sales, operating income, chemical-related assets, and R&D spending. Our analysis uses annual data from 2007 to 2024.

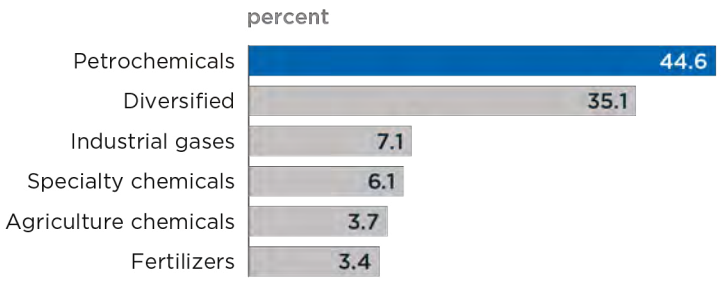
Table 1
Top importers and exporters of petrochemicals and derivatives, 2024 (billions of US dollars)

Country	Exports	Imports	Net trade
Switzerland	26.3	6.7	19.6
China	61.2	48.4	12.9
South Korea	23.3	14.0	9.3
Saudi Arabia	11.5	2.9	8.5
United States	37.3	29.0	8.3
Netherlands	31.5	24.9	6.6
Singapore	14.3	10.5	3.8
Indonesia	8.4	5.7	2.7
Malaysia	8.3	6.2	2.2
Japan	14.4	13.4	1.0
Thailand	5.4	4.8	0.6
France	13.0	12.4	0.5
Spain	10.4	11.0	−0.6
Belgium	26.1	27.5	−1.4
Russia	3.1	4.5	−1.4
Poland	2.7	4.4	−1.7
United Kingdom	8.0	9.8	−1.8
Taiwan	5.2	7.1	−1.9
Canada	4.3	7.8	−3.5
Vietnam	1.0	5.0	−4.0
India	19.8	24.6	−4.8
Germany	28.1	34.0	−5.8
Turkey	1.7	8.8	−7.0
Mexico	0.3	7.5	−7.1
Brazil	2.9	12.1	−9.2
Slovenia	0.5	10.9	−10.4
Italy	6.1	19.1	−13.1
World	**429.5**	**442.3**	**−12.9**

Note: The original data are in euros and are converted to US dollars using a rate of 1.082 US dollars per euro, which corresponds to the average conversion rate in 2024.
Sources: VCI and Chemdata International (2025) and authors' calculations.

Within the broader "chemicals" industry, the ACS classifies chemical companies into six subindustries: petrochemicals, diversified, industrial gases, specialty chemicals, fertilizers, and agricultural chemicals. We restricted our analysis to the 21 companies classified as petrochemicals, which accounted for nearly 45 percent of sales among the top 50 chemical companies in 2024 (figure 2), or almost $450 billion in revenue (table 2). The remaining companies were excluded either because petrochemicals are not their primary line of business or because they are diversified companies from which petrochemical revenue could not be disaggregated (appendix A).

Figure 2
ACS global top 50 chemical firms' revenue by subindustry, 2024



ACS = American Chemical Society dataset.
Source: Tullo (2025) and authors' calculations.

Table 3 shows the primary country of incorporation of the 21 firms. China accounts for the largest share, followed by other Asian countries, the United States, and Saudi Arabia.

Analyzing the ownership structure of petrochemical companies through their shareholding entities provides insights into how these firms are interconnected. Our analysis focused on all identified direct shareholders holding at least 2 percent in shares in any of the top 21 petrochemical companies. To ensure an accurate representation of influence, the percentage calculations are carried out on a weighted basis to account for the ratio of shares each shareholding entity holds, as opposed to the raw number of entities present in each country or that are classified as a certain type.[9] In particular:

- The industry exhibits limited interconnectedness, with most investment flowing neatly following country boundary lines. Of the 82 shareholding entities, only 8 are based outside the country where the company is headquartered, representing about 5 percent of the total revenues from the entities holding shares in the top 21 companies. These include Saudi Aramco owning shares in a Chinese-based petrochemicals company, Norway's

9 Limiting the analysis to 2 percent and above, as opposed to looking at all shareholding entities with any share percentage above 0, reduces the number of entities to 82 entries and the representation as a percentage of the total revenues from the top 21 companies to 63.7 percent at $288.3 billion. These entity entries include duplicates when a given shareholding entity owns at least 2 percent in shares in more than one petrochemical company.

sovereign wealth fund investing in the United Kingdom and Brazil, some US institutional advisors holding shares in a UK company, the UAE holding shares in an Austria-based company, and some shell companies in Luxembourg and the British Virgin Islands owning shares in, respectively, a US and a Taiwanese petrochemical company.

Table 2
Main petrochemical companies by country of incorporation and size, 2024

Company	Country of headquarters	Revenue (billions of US dollars)
China Petroleum and Chemical Corp	China	58
PetroChina Co Ltd	China	43
ExxonMobil Corp	United States	41
Saudi Basic Industries Corporation SJSC	Saudi Arabia	37
LyondellBasell Industries NV	United States	32
Formosa Plastics Corp	Taiwan	30
Rongsheng Petrochemical Co Ltd	China	26
Reliance Industries Ltd	India	25
Hengli Petrochemical Co Ltd	China	21
Indorama Ventures PCL	Thailand	15
Jiangsu Eastern Shenghong Co Ltd	China	15
Braskem SA	Brazil	14
Tongkun Group Co Ltd	China	14
Chevron Phillips Chemical	United States	12
Hengyi Petrochemical Co Ltd	China	12
Sibur	Russia	11
Shell PLC	England	10
Xinfengming Group Co Ltd	China	9
Borealis	Austria	8
Westlake Corp	United States	8
PTT Global Chemical PCL	Thailand	8
Total		**449**

Sources: Tullo (2025) and authors' calculations.

Table 3
Market share per country of incorporation, 2024 (percent of total revenues)

Country	Share
China	43.9
United States	20.7
Saudi Arabia	8.3
Taiwan	6.7
India	5.5
Thailand	5.2
Brazil	3.2
Russia	2.5
England	2.1
Austria	1.9

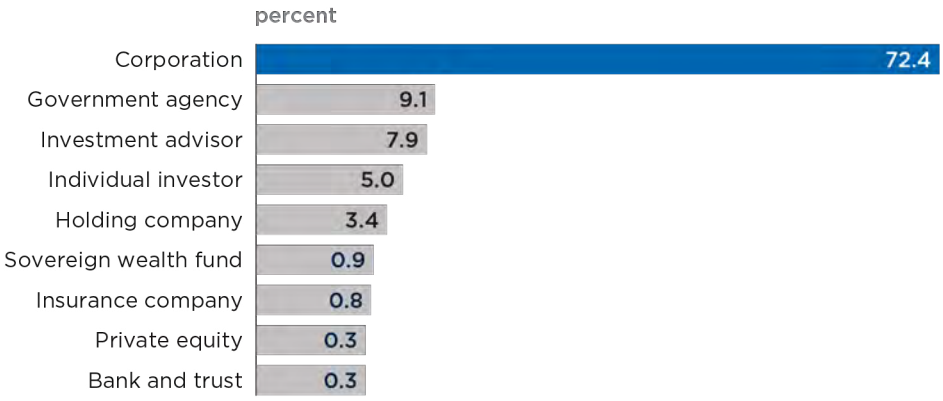
Source: Authors' calculations based on information in table 2.

- Three countries stand out in terms of the location of shareholding entities. China accounts for 52.6 percent—meaning that slightly more than half of global petrochemical revenues can be traced to shareholders based in China. The United States follows with 13.5 percent, and Saudi Arabia with 9.1 percent. All other countries' entities hold shares at around or below 5 percent, with Thailand and India as the largest among them at about 5 percent. Given the limited cross-country interconnectedness, it is unsurprising that the industry, in terms of both primary activity of companies and location of shareholding entities, is heavily dominated in China, which alone accounts for about half of the global total.
- Most shareholding ownership is by corporations at 72.4 percent, followed by government agencies at 9.1 percent, investment advisors at 7.9 percent, individual investors at 5.0 percent, and holding companies at 3.4 percent (figure 3). The other investor types (sovereign wealth funds, insurance companies, banks and trusts, and private equity) each account for less than 1 percent.[10]
- Ownership structure differs markedly across countries (figures 4 and 5). Among the three countries with the largest shareholding presence, China stands out: 93.5 percent of its shareholding entities are corporations. In the United States, ownership is more fragmented, with 45.2 percent held by investment advisors and 40.3 percent by corporations. In Saudi Arabia, by contrast, 100 percent of the identified shareholders are government entities

10 The classification of shareholding entities is based on LSEG data.

(e.g., SABIC is 70 percent owned by Saudi Aramco). A similar pattern of corporate dominance is found in other major Asian countries with significant shareholding roles—namely Thailand and India—where corporations hold more than 80 percent of ownership. Total ownership concentration also varies substantially across countries. China and Saudi Arabia exhibit the highest levels of shareholding-entity ownership, at 77.7 percent and 70.0 percent, respectively, while the United States shows a much lower level at 47.9 percent, reflecting a larger proportion of free-floating shares.

Figure 3
Global petrochemical companies' shareholding entities by type, 2024



Source: Authors' calculations.

IV WHO CONTROLS PETROCHEMICAL COMPANIES?

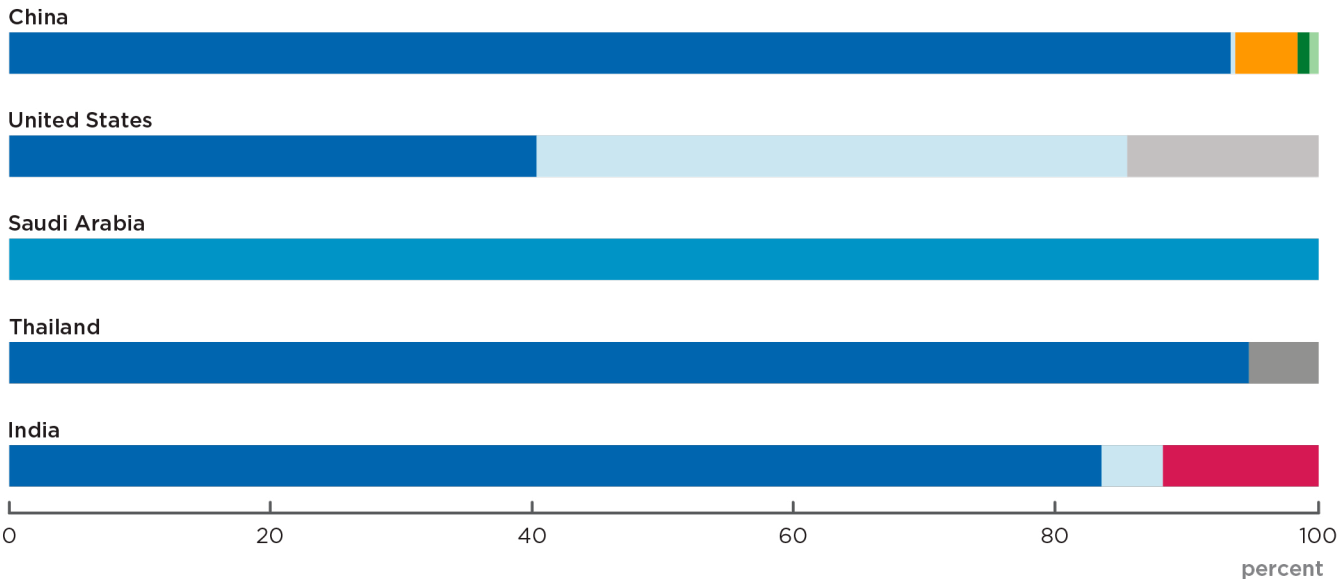
Having laid out our methodology for measuring control in section II, we can contrast the results obtained by looking at direct ownership (section III) with those based on a control-based analysis. Note, however, that governments can exert control in ways that do not require holding a controlling share, which could be a very potent control mechanism for geopolitical considerations, but we do not look at that aspect of control in this paper.

Table 4 presents the ZENO indices of the main UCOs of the top 21 petrochemical companies. It lists each company's main UCO (UCO1) and the level of control (Z1) of that UCO1, as well as its country of origin. For example, for ExxonMobil, the UCO is Vanguard, based in the United States, with a Z1 of 0.42 (enough to give it substantial control, despite its passive investor status) despite holding less than 10 percent of shares. In contrast, China's Rongsheng Petrochemical is fully controlled by the Zhejiang Rongsheng Holding Group (Z1 = 1), which has a shareholding of 53 percent. In some markets, such as China, the country of origin of UCO1 is the same as the country where the company is incorporated, although this is not always the case.

In table 5, we present the main types of investors and the market share that they control.

Figure 4

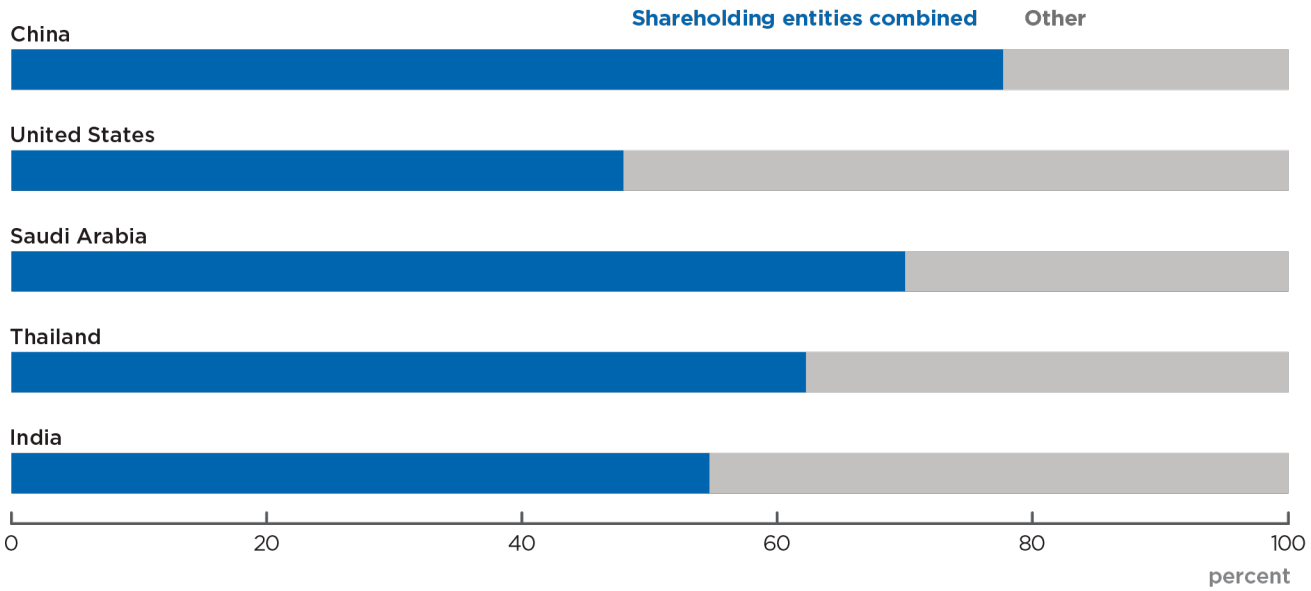
Identified shareholding entity ownership of global petrochemical companies by type in the top 5 countries, 2024



Source: Authors' calculations.

Figure 5

Ownership concentration in global petrochemical companies in the top 5 countries, 2024



Note: "Other" represents the total percentage of entity ownership, in a given country, that is not linked to shareholding entities with at least 2 percent in shares in any of the top 21 petrochemical companies.

Source: Authors' calculations.

Table 4

Petrochemical companies by country of origin of their main ultimate controlling owner (UCO1), 2024

Company	UCO1	UCO1 type	UCO1 country	Z1
China Petroleum and Chemical Corp	Government of China	Government agency	China	1.00
Indorama Ventures PCL	Indorama Resources Ltd	Corporation	Thailand	1.00
Jiangsu Eastern Shenghong Co Ltd	Jiangsu Shenghong Science and Technology Corporation Co Ltd	Corporation	China	1.00
PetroChina Co Ltd	Government of China	Government agency	China	1.00
PTT Global Chemical PCL	Ministry of Finance Thailand	Government agency	Thailand	1.00
Rongsheng Petrochemical Co Ltd	Zhejiang Rongsheng Holding Group Co Ltd	Corporation	China	1.00
Saudi Basic Industries Corporation SJSC	Government of Saudi Arabia	Government agency	Saudi Arabia	1.00
Sibur	Leonid Mikhelson	Individual investor	Russia	1.00
Westlake Corp	TTWF LP	Corporation	United States	1.00
Hengyi Petrochemical Co Ltd	Zhejiang Hengyi Group Co Ltd	Corporation	China	1.00
LyondellBasell Industries NV	LYB Holdco LLC	Holding company	Luxembourg	0.74
Borealis	Oesterreichische Beteiligungs AG	Holding company	Austria	0.71
Tongkun Group Co Ltd	Tongkun Holdings Group Co Ltd	Corporation	China	0.70
Hengli Petrochemical Co Ltd	Hengli Group Ltd	Corporation	China	0.68
Xinfengming Group Co Ltd	Zhuang Kuilong	Individual investor	China	0.64
Braskem SA	Odebrecht SA	Holding company	Brazil	0.51
Formosa Plastics Corp	Chang Gung Medical Foundation	Corporation	Taiwan	0.43
ExxonMobil Corp	The Vanguard Group Inc	Investment advisor	United States	0.42
Chevron Phillips Chemical	The Vanguard Group Inc	Investment advisor	United States	0.41
Reliance Industries Ltd	Srichakra Commercials LLP	Corporation	India	0.38
Shell PLC	BlackRock	Investment advisor	United States	0.23

Source: Authors' calculations using London Stock Exchange Group (LSEG) data, processed with Z-CAT software provided by ZENO-Indices.

Table 5
Main types of investors in global petrochemical companies, 2024

UCO1 type	Share of revenue (percent)
Corporation	37
Government agency	32
Investment advisor	14
Holding company	12
Individual investor	5
Total	**100**

Source: Authors' calculations based on information in tables 2 and 4.

Corporations and government agencies are the main investor type in the market, but institutional investors (including passive funds) are also present (mostly as UCO1s in US companies).

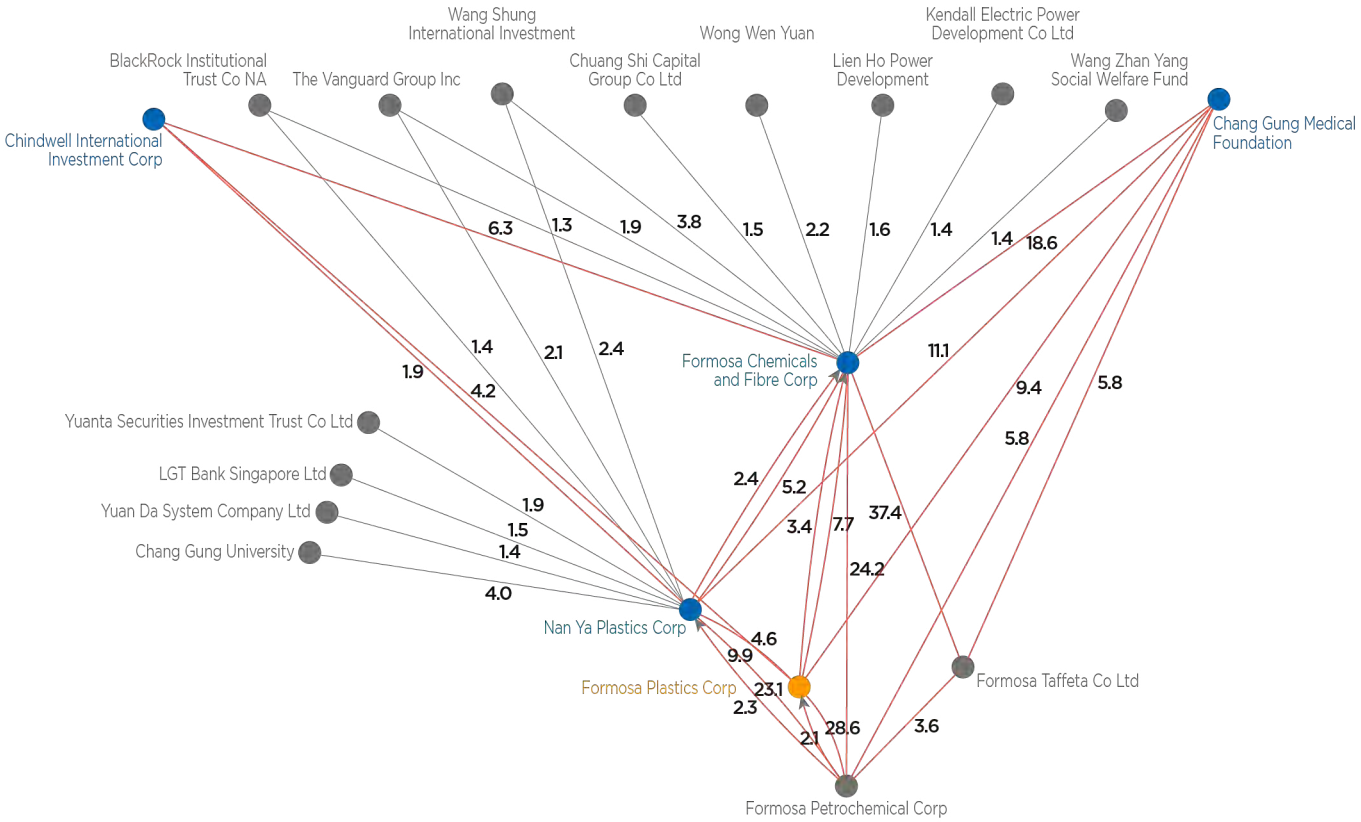
The level of control that UCO1s from various countries and regions enjoy differs widely, as revealed by the average ZENO index of control, discussed below. As in most markets, the types of UCO1s also vary.

If we now look at the various petrochemical companies by country of origin of their UCO1s, we have the following results:

- In China, UCO1s hold a substantial level of control (averaging 0.88), but they do not necessarily have an absolute majority in the firms that they control, as their ZENO indices are less than 1. This reflects that some Chinese UCO1s have leveraged other sources of funds without allowing those other investors to exert a substantial level of control over the company. The analysis also shows that half of Chinese UCO1s are corporations, while a quarter are government agencies. This is an important aspect of the shareholding structures controlled by Chinese interests.
- By contrast, US interests enjoy only a moderate level of control, with a Z1 averaging 0.52. US UCO1s are typically passive funds. Note that there are few significant UCO2s even though passive funds exercise their control through a small percentage of the shares. This reflects a common characteristic of shareholdings in the United States, where shares are widely held by many small investors, which does not prevent activism (Gillan and Starks 2000, and Gilson and Gordon 2013). This has also been observed in the case of critical minerals (Leruth et al. 2022).
- In Saudi Arabia, the state owns over 70 percent of shares in a single company, with the public holding the remaining 30 percent, resulting in full control (ZENO index = 1) by the state.
- Formosa Plastics of Taiwan displays a complex pattern of cross shareholdings (figure 6). Shareholdings in percent are indicated by red lines, which show

shares associated with control, and grey lines, which show shares held for portfolio management purposes. Circular and complex multilayered shareholding structures have been common among firms in Japan, South Korea, and Taiwan (called keiretsu and historically zaibatsu in Japan, or chaebol in South Korea [Kim and Kwon 2008]), although they have become less prevalent in recent decades (Bena and Ortiz-Molina 2013 and He and Huang 2017).

Figure 6.
Ownership pattern of Formosa Plastics



Note: Shareholdings in percent are indicated by red lines, which show shares associated with control, and grey lines, which show shares held for portfolio management purposes.
Source: ZENO-Indices.

In appendix B, we present a more detailed version of table 4, including UCO2s, their level of control, type, and origin. Table 6 summarizes the results of our analysis by the country/region of origin of each UCO1, including the average Z1 and Z2 of the UCO2s, as well as the percentage of the market that they control. The presence of a UCO2 with a sizable level of control helps understand the nature of the shareholding structure and the possible presence of some degree of competition for control. It also reveals whether there is a potential contender to take over the position of UCO1 (when Z2 is close to Z1) or whether the UCO2 can at best exercise some small leverage over managerial decision (Z2 is low). If there is no UCO2, UCO1 is firmly in control (and Z1 is usually high unless the shareholding is highly dispersed).

Table 6
Average level of control by country/region of the main ultimate controlling owner (UCO1), 2024

UCO1 country	Z1 average	Share of revenue (percent)	Z2 average
China	0.88	44	0.29
Other Asia	0.70	17	0.31
United States	0.52	16	0.26
Other non-Asia	0.65	12	0.29
Saudi Arabia	1.00	8	
Russia	1.00	2	

Sources: Tables 2 and 4 and ZENO-Indices.

Note that Asian UCO1s control almost two-thirds (61 percent) of the companies considered here, against 16 percent for the United States.

The identification through ZENO of the 31 controlling shareholders (UCO1 and UCO2) in the sample yields a different picture from that of the 82 direct shareholders noted in section III, filtering out those unable to influence the company.

Corporations, representing 72 percent of the direct shareholders' sample, fall to 45 percent of the UCOs, whereas financial actors increase from 8 percent of direct shareholders to 19 percent of UCOs. Individual and familial (holding) investors increase from 8 percent to 16 percent.

Segmenting by shareholder country, the direct approach in the United States shows a balanced split of 45 percent investment advisors and 40 percent corporations, whereas with ZENO the control is exerted at 86 percent by investment advisors and only at 14 percent by corporations. In China, corporations fall from 93.5 percent to 73 percent while government agencies increase from 0 to 18 percent. In Thailand, the direct approach puts corporations at 95 percent whereas ZENO reveals the control is split 50/50 between corporations and the government. With the direct approach, 53 percent of shareholding is in China and 14 percent in the United States, whereas ZENO places China at 35 percent and the United States at 23 percent of the UCOs.

V THE EVOLUTION OF CONTROL IN THE PETROCHEMICAL INDUSTRY

Since the early 2000s, the geography of control in the petrochemical sector has shifted significantly, revealing contrasting strategies among key players. We ran the analysis for 2007 and 2015 because those years correspond to major structural shifts in the industry: the landscape before and after the global financial crisis. Nevertheless, some key features emerge:

- Saudi Arabia has had full control (Z1 = 1) over SABIC across all periods. Listed on the Tadawul stock exchange since 1984, SABIC has consistently been

majority-owned by the state, with 70 percent of share capital, initially via the PIF, and since 2020 through Saudi Aramco.

- China, by contrast, moved from full control to a state-anchored mixed-ownership model where it lets other investors, Chinese or others, finance Chinese petrochemical companies but not at the cost of losing too much control. This happened after 2007. Hengli Petrochemical Co Ltd, for example, moved from full control (Z1 = 1) in 2007 to a Z1 of 0.68 in 2024. Control remained firmly in Chinese hands, with dominant shareholders either directly state-owned or closely aligned with local governments or industrial conglomerates backed by state capital.
- Passive funds have been the main players in US-controlled petrochemicals for a long time. In 2007, most were controlled by one major passive fund or another. Before 2000, control often rested with management, as most firms had dispersed ownership, and institutional investors played a minor role. ExxonMobil, for example, was primarily governed internally, with no dominant external shareholder.
- Petrochemical control has largely eluded Western Europe since the early 2000s. Shell, the only public European-headquartered company in the sample, has been controlled by American passive funds throughout the period, while Sibur remains Russian-owned. Borealis stands as the sole dedicated petrochemical company under Western European control (Z1 = 0.71), albeit with the government of Abu Dhabi as a secondary UCO (Z2 = 0.29). Combined with the shift toward green energy, this leaves Western Europe exposed to dependence in a sector that remains important, particularly amid ongoing geopolitical tensions.

This discussion shows that the current state of control of major petrochemical industries is the result of a gradual evolution over 20 years. In Saudi Arabia, both ownership and control have remained the same; in the United States, passive funds have acquired shares that may be associated with some modest level of control, an easy task since shares were largely dispersed; in China, the gradual inclusion of shareholders with limited controls has diluted the capital but not substantially decreased the control held by corporations or the government; and European companies are worryingly exposed although some European companies (e.g., BASF) are major players in the petrochemical industry even though they do not appear in our sample because it is not their main activity.

The discussion also points to the importance of liquidity. When stocks can easily be acquired, there is a risk of some investors acquiring them to exert control. We discuss this in the next section.

VI HOW CONTROL COULD CHANGE: THE ISSUE OF LIQUIDITY

Notwithstanding data limitations, the previous sections describe the present state of ownership and control of the petrochemical industry. While changes have been observed in the past, as discussed in section V, these changes could accelerate in the current uncertain geopolitical climate. Such changes may result through mergers, vertical or horizontal, that could alter, and perhaps put at risk, the stability of supply chains associated with the petrochemical industry.

Concentration of Shares and of Control

Concentration refers to the distribution of market shares across companies. Control refers to the distribution of market shares across controlling owners. Because effective control does not require 100 percent ownership or even majority ownership, the two concepts can paint a different picture of the same industry. Still, the basic logic of the analysis is similar. It is well accepted that assessing the distribution of market power in any given industry normally entails taking both a vertical view and a horizontal view. This is why merger control, for example, considers both the extent of horizontal overlap between parties at each level of the supply chain, but also examines whether the proposed transaction creates new vertical linkages. In principle, a similar approach should apply to the analysis of control rights. This would, however, require that we identify relevant markets for all major petrochemical products as well as the markets for all major inputs. Such a task would be daunting, as mentioned above. Besides, it could not be carried out based on publicly available information.

We therefore focus on the notion of control and show that (1) the shareholding structure of some of the companies makes them an easy target for the acquisition of a controlling block of shares by a hostile investor, but (2) the supply chain can also be protected by the acquisition by friendly investors of a controlling block in selected petrochemical companies. While it narrows the analysis, we believe that this approach is relevant for at least two reasons:

- First, vertical linkages matter only if a given entity (or a coalition of owners) controls significant shares of the markets at different stages of the value chain. This seems unlikely as the production of the most important input (oil) is not overly concentrated; refining capacity is reasonably widespread; and methods of production for most products are widely known (which rules out the possibility of natural monopolies). The loss from ignoring the vertical dimension of the industry is therefore unlikely to be significant.
- Second, the conclusions of our analysis based on revenue shares per company must be generally valid for horizontal mergers. The reason is as follows. Let us assume that there are *N* petrochemical products where the companies in our list are active. It may be that one company (or a few) has (have) a larger share of that market than the others. If that is the case, the implication is that this company must necessarily be less present in the markets for other petrochemical products. Therefore, if concentration is higher for a few companies in certain markets, it must be lower in others. Hence, while our conclusions do not necessarily apply to each of the main petrochemical products, they must be relevant for most of them.

We therefore focus on the possible acquisition of shares by potential UCOs in the companies of our sample. Historically, as shown in the previous section, shareholding blocks have changed over time. In the future, such changes could be a threat to the stability of the chain. However, and fortunately, the acquisition of shares could also help protect the stability of the supply chain.

Changes could occur if a party purchases the shares of a key petrochemical company, but that will depend in part on the liquidity of the shares (in the case of listed companies). Liquidity is a variable often defined as how quickly an investment can be sold without affecting its price. It is available from most data suppliers and is calculated, for example by London Stock Exchange

Group (LSEG), as "a four-tier approach that includes an Average Traded Value Approach along with minimum size, cumulative market capitalization and trading frequency" (FTSE Russell 2025, p. 8). It is useful to give an idea about shares that can be acquired by (portfolio) investors without a major price movement if it is a small percentage. A concept more relevant for this study would be the percentage of shares that could be acquired to gain a significant level of control in a company (or increase the control already held).

Measuring Liquidity

Table 7 lists the liquidity measure according to LSEG for each of the 18 public companies of the sample. Next to it is an alternative indicator of liquidity computed as the sum of all shares held by shareholders that do not carry any significant control (ZENO liquidity). The set of shares that are excluded includes those held by all UCOs including a possible UCO3 or UCO4 (if any) as long as their level of control is greater than 0.1.[11] Another way to look at this is to say that the LSEG definition would, for example, assume that institutional investors are ready to sell their shares if they can make a small margin (e.g., even if BlackRock holds a controlling percentage of shares, it can sell any time if the price is right and those shares are therefore liquid).

We take an alternative view. There is an abundant literature (Appel et al. 2016; Barko, Cremers, and Renneboog 2022; Liang and Renneboog 2017; McCahery, Sautner, and Starks 2016) on the role of large passive funds in influencing governance, and this suggests that they value control; the shares they hold, when they are associated with control, are therefore not liquid. The definition based on the percentage of shares not associated with control is more appropriate for the purpose of determining to what extent the company could be controlled by a contender as the result of an aggressive move. The numbers are therefore not the same. To take the example of China Petroleum (the largest in revenue), the liquidity ratio proposed by LSEG corresponds essentially to the shares not held by the important shareholders (our computation of liquidity according to LSEG is 13 percent, but we do not have the exact details of the methodology; LSEG values it at 11.6 percent), whereas the ZENO approach would consider that the second shareholder does not have enough shares to have any control (and neither do smaller shareholders), so that the ZENO liquidity ratio is slightly higher (e.g., 100% − 85.4% = 14.6%). When the main UCO is a passive fund, the liquidity ratio proposed by LSEG is usually higher than that computed using ZENO (and that is the case for US companies, for example).

A lesson from table 7 is that companies incorporated in the United States enjoy some degree of protection against an aggressive takeover because their liquidity (defined as shares not associated with control) is lower than the standard liquidity ratio (e.g., as supplied by LSEG) would suggest. At the same time, these liquidity ratios for US companies are higher than for the others, except for Shell.

11 To analyze control in shareholding structures, we have cut the ZENO indices at 0.2. In the case of liquidity, we have lowered that threshold to 0.1 so that the liquidity figure we compute is as low as possible (indeed, a shareholder with Z = 0.15, for example, could argue that the shares it owns are worth a little more than the market price, but that cannot be true for Z < 0.1).

Table 7

Liquidity measures for 18 public petrochemical companies, calculated as the percentage of shares not associated with control, 2024

Company	LSEG liquidity (percent)	ZENO liquidity (percent)	UCO1 direct and indirect shares (percent)	Percent of ZENO liquidity to catch UCO1
Formosa Plastics Corp	66.5	76.2	2.1	2.7
Shell PLC	99.9	94.4	5.6	5.9
ExxonMobil Corp	99.9	79.9	9.9	12.4
Reliance Industries Ltd	50.3	50.4	10.9	21.7
Tongkun Group Co Ltd	58.5	71.4	19.3	27.0
LyondellBasell Industries NV	79.7	70.1	20.1	28.7
Braskem SA	55.1	49.5	22.9	46.4
Xinfengming Group Co Ltd	32.6	45.7	22.1	48.5
Hengyi Petrochemical Co Ltd	37.6	59.4	40.6	68.4
Jiangsu Eastern Shenghong Co Ltd	33.2	57.8	42.2	73.0
PTT Global Chemical PCL	47.7	54.8	45.2	82.4
Indorama Ventures PCL	33.7	35.3	64.7	Impossible
Saudi Basic Industries Corporation SJSC	30.0	30.0	70.0	Impossible
Hengli Petrochemical Co Ltd	21.0	27.2	29.8	Impossible
Westlake Corp	26.6	27.1	72.9	Impossible
Rongsheng Petrochemical Co Ltd	25.8	46.8	53.2	Impossible
China Petroleum and Chemical Corp	11.6	14.6	85.4	Impossible
PetroChina Co Ltd	5.4	6.8	93.2	Impossible

Note: "Impossible" means the percentage of liquid shares is below the percentage of shares held by UCO1.
Sources: London Stock Exchange Group (LSEG) data and ZENO-Indices.

To deepen the analysis, we have considered the case of an outside contender that would try to acquire the same percentage of shares as UCO1 (shown in the third column of table 7). This will obviously not give the contender a higher ZENO index than that enjoyed by UCO1. In fact, that contender (after it has purchased those shares) and the current UCO1 would enjoy the same Z1 (although lower than the level of control before the operation due to the increased competition for control).

The fourth column indicates to what extent it is possible for the contender to purchase that level of share. Sometimes it is not. In the case of PetroChina Co Ltd, for example, with a level of liquidity of 6.8 percent of the shares issued, a contender would not be able to purchase 93.2 percent of the shares,

the percentage held by UCO1. The situation is the same for all those marked "impossible." In the case of ExxonMobil, UCO1 holds 9.9 percent of the shares and is a passive fund. For LSEG, those shares are liquid (and so are the shares of the other major shareholders that are also passive funds or equivalent), and liquidity is therefore 99.9 percent. For ZENO, the shares held with control are not liquid at the prevailing market price and, once all shares associated with some level of control are removed, we calculate liquidity at 79.9 percent. ExxonMobil is therefore vulnerable, but not as much as suggested by the LSEG liquidity number. More generally, US companies can be a target for an outside contender that would want to control them. The higher the number in the fourth column, the more difficult (and costly) it would be for an outside contender to acquire a percentage of shares equivalent to those held by the current UCO1 (and this is even more true to exceed that number and gain higher control and become UCO1).

It would be very hard to acquire liquid shares and challenge UCO1 in Chinese companies. Take the example of Jiangsu Eastern; ZENO evaluates the liquidity at 57.8 percent (higher than that estimated by LSEG). As UCO1 holds 42.2 percent of the shares, a competing shareholder who would like to reach the same level of control as UCO1 would need to purchase 42.2 percent of the shares from those that are liquid (57.8 percent). That corresponds to a ratio of 73.0 percent (last column), a massive task for the contender.

In some cases, it would simply be impossible to acquire enough liquid shares to compete with UCO1. Of course, this would not prevent an outsider from acquiring a controlling block from UBO1 or from another existing UBO, but then a premium would have to be paid since that UBO enjoys some degree of control over the company that it would not be willing to part with at the prevailing market price.

VII KEY OBSERVATIONS AND THEIR IMPLICATIONS

Our analysis carries important implications for country- and regional-level strategies regarding ownership and control in the petrochemical industry, not only for the country where the companies are located but also to monitor the evolution of the control structure of companies located in other countries. This is not a call for horizontal integration or collusion, but a practical response to risks stemming from shareholding structures, including levels of liquidity that could enable hostile takeovers. As petrochemicals account for a growing share of the demand for oil, and as oil faces stiffer competition from renewables, policies that have long aimed at ensuring some degree of independence from an oil market should be complemented with national or regional strategies for the production of petrochemicals, given the sector's growing economic and strategic importance.

Although risks in the oil and petrochemical sectors are linked—major disruptions in oil supply would immediately affect petrochemical operations—the petrochemical industry faces its own resilience challenges, as its products are indispensable inputs for both industrial and agricultural economies.

We have observed earlier that governments have influenced firms through regulations and controlling stakes in petrochemical companies. As a result, governments are also in a position to compel important shareholders to do their bidding. The control structure of companies is therefore crucial, as is the

fact that the ownership and control structures matter greatly—particularly since these structures differ significantly from those in oil. This generates several important insights:

- Ownership patterns show that China and the broader Asian region have substantial control over the industry. Even absent geopolitical intent, any interruption in Chinese and other Asian exports would have severe consequences for the global supply chains.
- While the United States is somewhat protected against large geopolitical risks linked to petrochemicals, passive funds could divest for financial gains. Although our analysis shows that this risk might be overstated by the usual measures of liquidity, it is still quite relevant. Another angle is that passive funds may be more immune to incentives related to industrial policy than a corporate investor who is there for the long run with an industrial project.
- In our sample, Europe is represented by only two companies (a combined mere 4 percent of total revenue), one of which, Shell, has its main controlling entity in the United States. However, this assessment of the European position comes with a caveat: we looked only at companies classified as petrochemical producers. As stated, some large European companies, such as BASF, are not included because they are considered diversified even though they have significant petrochemical operations.[12]

What are the implications of these findings?

- The first angle is *leverage*. Effective control can be maintained—and in some cases optimized—by selectively divesting from companies where investors already hold ownership stakes large enough to secure a very high, or even total, degree of control. In such cases, marginal reductions in shareholding would not materially weaken UCO1's ability to influence strategic decisions. Resources freed through this process could then be redeployed for other strategic purposes, while enhancing flexibility and efficiency in the overall portfolio.
- A second policy lever comes from *liquidity*. When liquidity is high, external investors may be able to acquire a controlling stake at relatively low cost, increasing exposure to unwanted takeovers. Lower liquidity, by contrast, raises the barrier to entry and helps preserve national influence. Passive funds—whose investment mandates require broad sectoral exposure, including petrochemicals for diversification and risk management purposes—could help reduce liquidity by maintaining stable positions. However, this role is most effective when such funds operate alongside committed corporate investors, whose long-term involvement provides additional stability and alignment with strategic objectives.

These two levers can be activated through a mix of information, regulation, and public investment.

12 In the case of BASF, the revenue from petrochemical operations in 2024 was similar to that of PTT.

- On the information side, it is not completely clear that companies and investors are fully aware of how they can best leverage ownership into control across several companies (a general problem discussed in Ginglinger et al. 2018). In fact, even important shareholders are often not aware of the extent of their control and may find an assessment of their and other shareholders' control useful.
- From a regulatory perspective, one might limit the participation of selected investors (in passive funds) in some strategic sectors, including petrochemicals, while still broadening investor participation in these sectors. Such a policy might be adequate for the United States, where liquidity is a significant issue, but would be less effective for Europe or other regions where domestic production capacity and scale are already limited. In all cases, policies would benefit from relying on a control-based metric, such as the ZENO index, rather than simple ownership shares, as control indices provide a more accurate assessment of effective influence and decision-making power within firms.
- Public investment can also help minimize the liquidity problem, while fostering the development of local production. In the European Union, such investment could occur at the level of individual member states through state aid projects. These projects would need to be shown to address market failure. The pursuit of EU-level self-sufficiency/resilience would constitute such a market failure as individual companies' incentives to address these risks do not consider their wider economic repercussions. Since the objective pursuit is EU-wide, though, such projects would be better deployed through the Important Projects of Common European Interest (IPCEIs), which help coordinate the individual member states' projects into a more coherent whole. Although direct EU-level intervention could, in principle, be even more effective, attempts to centralize industrial policy have so far faced significant political resistance.

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APPENDIX A
DATA ASSUMPTIONS

This appendix explains how the 21 companies used in the paper were selected based on revenue.

Accessing the revenue of the petrochemical sector is difficult, because there exists no accurate revenue list of petrochemical companies, and assembling such a list, necessarily from the annual reports of companies, presents overwhelming challenges:

- Many companies active in the petrochemical sector do not segment their revenue in a way that allows the extraction of petrochemical revenue.
- The definition of what companies are included in the petrochemical segment is not homogeneous across all annual reports that do segment it.

Therefore, we use, as a best approximation, the ACS list of 50 top chemical companies, selecting only the 21 companies labeled *Petrochemicals*. Those companies are mostly, but not necessarily only, active in petrochemicals, and thus some of their listed revenue might capture nonpetrochemicals. Conversely, many companies labelled in the list as *Diversified* produce petrochemicals. However, because of the challenges in segmenting their petrochemical revenue, we elected not to include them.

Regarding shareholding, 18 of the companies are publicly traded and three are privately held. The ownership structure of public companies is accurately available. Borealis, Chevron Phillips Chemicals, and Sibur are privately owned, and their shareholding structure is not fully available to our knowledge and thus has been inferred to the best of our ability from sources such as press releases, news, or older disclosures.

APPENDIX B

Table B.1

More Granular Information on the Control of the Top 21 Petrochemicals Companies

Company common name	Country of exchange	Country of headquarters	UCO1	Z1	UCO1 type	UCO1 country
Borealis		Austria	Oesterreichische Beteiligungs AG	0.71	Holding company	Austria
Braskem SA	Brazil	Brazil	Odebrecht SA	0.51	Holding company	Brazil
Chevron Phillips Chemical		United States	The Vanguard Group Inc	0.41	Investment advisor	United States
China Petroleum and Chemical Corp	China	China	Government of China	1.00	Government agency	China
ExxonMobil Corp	United States	United States	The Vanguard Group Inc	0.42	Investment advisor	United States
Formosa Plastics Corp	Taiwan	Taiwan	Chang Gung Medical Foundation	0.43	Corporation	Taiwan
Hengli Petrochemical Co Ltd	China	China	Hengli Group Ltd	0.68	Corporation	China
Hengyi Petrochemical Co Ltd	China	China	Zhejiang Hengyi Group Co Ltd	1.00	Corporation	China
Indorama Ventures PCL	Thailand	Thailand	Indorama Resources Ltd	1.00	Corporation	Thailand
Jiangsu Eastern Shenghong Co Ltd	China	China	Jiangsu Shenghong Science and Technology Corporation Co Ltd	1.00	Corporation	China
LyondellBasell Industries NV	United States	United States	LYB Holdco LLC	0.74	Holding company	Luxembourg
PetroChina Co Ltd	China	China	Government of China	1.00	Government agency	China
PTT Global Chemical PCL	Thailand	Thailand	Ministry of Finance Thailand	1.00	Government agency	Thailand
Reliance Industries Ltd	India	India	Srichakra Commercials LLP	0.38	Corporation	India

Rongsheng Petrochemical Co Ltd	China	China	Zhejiang Rongsheng Holding Group Co Ltd	1.00	Corporation	China
Saudi Basic Industries Corporation SJSC	Saudi Arabia	Saudi Arabia	Government of Saudi Arabia	1.00	Government agency	Saudi Arabia
Shell PLC	United Kingdom	United Kingdom	BlackRock	0.23	Investment advisor	United States
Sibur		Russia	Leonid Mikhelson	1.00	Individual investor	Russia
Tongkun Group Co Ltd	China	China	Tongkun Holdings Group Co Ltd	0.70	Corporation	China
Westlake Corp	United States	United States	TTWF LP	1.00	Corporation	United States
Xinfengming Group Co Ltd	China	China	Zhuang Kuilong	0.64	Individual investor	China

table continues

Table B.1 (contined)

More Granular Information on the Control of the Top 21 Petrochemicals Companies

Company common name	Country of exchange	Country of headquarters	UCO2	Z2	UCO2 type	UCO2 country
Borealis		Austria	Government of Abu Dhabi	0.29	Government agency	United Arab Emirates
Braskem SA	Brazil	Brazil	Government of Brazil	0.34	Government agency	Brazil
Chevron Phillips Chemical		United States	State Street Investment Management US	0.30	Investment advisor	United States
China Petroleum and Chemical Corp	China	China				
ExxonMobil Corp	United States	United States	State Street Investment Management US	0.22	Investment advisor	United States
Formosa Plastics Corp	Taiwan	Taiwan	Formosa Chemicals and Fibre Corp	0.34	Corporation	Taiwan
Hengli Petrochemical Co Ltd	China	China	Hengneng Investment Dalian Co Ltd	0.32	Corporation	China
Hengyi Petrochemical Co Ltd	China	China				
Indorama Ventures PCL	Thailand	Thailand				
Jiangsu Eastern Shenghong Co Ltd	China	China				
LyondellBasell Industries NV	United States	United States	The Vanguard Group Inc	0.23	Investment advisor	United States
PetroChina Co Ltd	China	China				
PTT Global Chemical PCL	Thailand	Thailand				
Reliance Industries Ltd	India	India	Karuna Commercials LLP	0.27	Corporation	India
Rongsheng Petrochemical Co Ltd	China	China				

Saudi Basic Industries Corporation SJSC	Saudi Arabia	Saudi Arabia				
Shell PLC	United Kingdom	United Kingdom				
Sibur		Russia				
Tongkun Group Co Ltd	China	China	Jiaxing Shenglong Investment Company Ltd	0.23	Corporation	China
Westlake Corp	United States	United States				
Xinfengming Group Co Ltd	China	China	Xinfengming Holdings Group Co Ltd	0.34	Corporation	China

Source: Authors' calculations using London Stock Exchange Group (LSEG) data, processed with Z-CAT software provided by ZENO-Indices.

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