

State-owned Enterprises in the global market: Varieties of government control and internationalization strategies

Stefano Clò ^{a,*}, Enrico Marvasi ^b, Giorgio Ricchiuti ^{a,c}

^a Università degli Studi di Firenze, Italy

^b Università degli Studi Roma Tre, Italy

^c Complexity Lab in Economics (CLE), Università Cattolica del Sacro Cuore, Milano, Italy

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ABSTRACT

We study the internationalization of State-owned Enterprises (SOEs) in the 21st century and its underlying firm-level and country-level drivers. Using a global database of more than 110,000 M&A (10% having a state-owned acquirer), we empirically investigate differences between private enterprises, traditional SOEs and contemporary reformed SOEs. We show that the intensity of government control is associated with diverging targeting strategies and internationalization patterns. Compared to traditional SOEs, reformed SOEs are more outward-oriented, tend to purchase better performing targets, concentrate their investments towards less risky countries that are geographically and culturally closer, with better institutional quality and a more central position in the trade network. Our findings are consistent with the view that reformed SOEs are increasingly adopting market-oriented strategies thus diverging from traditional SOEs (and converging towards the private model) in their objective functions.

1. Introduction

At the end of the twentieth century, trade liberalization brought the opportunity for **Privately-Owned Enterprises** (POEs) to internationalize their business through a wave of Foreign Direct Investments (FDI), specifically cross-border M&A. This process did not significantly involve **State-Owned Enterprises** (SOEs), whose lower propensity to expand internationally has been the result of various factors: lack of adequate market incentives, political capture and a different objective function.

Against this backdrop, the New Millennium has been characterized by a surge of SOEs in the global arena. While a comprehensive empirically-based understanding of this phenomenon is still lacking, various research studies show an international expansion of many government-controlled enterprises, which established themselves as world multinational corporations (Kowalski et al., 2013; Cuervo-Cazurra et al., 2014; Karolyi and Liao, 2017).

The present paper discusses the internationalization of SOEs in light of the major reforms they have undergone in the last decades. While continuing to maintain the residual right to appoint the relative majority of the board, many governments have partially divested from SOEs. Many SOEs have been corporatized, opened to private equity and listed in the stock markets. In these cases, governments continue to hold the ultimate control through a non-absolute majority

of shares or through pyramidal organizational structures (Bortolotti and Faccio, 2009; Fan et al., 2013; Pargendler et al., 2013). This partial privatization has reduced government holdings to a point where SOEs can no longer be considered as State-owned, according to the traditional definition. Instead, they have been increasingly referred to as mixed enterprises, reformed SOEs or **State-invested enterprises** (SIEs)¹ (Christiansen and Kim, 2014; Clò et al., 2020). According to Musacchio and Lazzarini (2018), reformed SOEs have been increasingly adopting market-oriented strategies, with a significant improvement in their financial accountability and economic performance.

Given this framework, our main research interest is to extend the traditional dichotomic comparison between public and private ownership by questioning whether reformed SOEs differ from traditional SOEs (and from their private counterparts) in their objective functions and market strategies. We address this issue by focusing on their M&A activity and, in particular, on their propensity to internationalize through cross-border deals. We analyze the firms' pattern of internationalization by inquiring whether POEs, traditional SOEs and SIEs differ with respect to the type of firms they target and the countries they choose for their foreign investments.

The fact that SOEs have embarked on a path of internationalization that historically has been associated with private companies leads us

* Corresponding author.

E-mail address: stefano.clo@unifi.it (S. Clò).

¹ Throughout the paper we use SIEs or reformed SOEs interchangeably.

to question whether some differences still persist in their investment strategies and ultimate goals. Our main thesis is that SOEs and POEs are still characterized by diverging objective functions, but we enrich this traditional view by arguing that the divergence between them depends on the intensity of SOEs' internal reforms.

We consider reformed SOEs to be more aligned to POEs in their investment strategies as regards both their propensity to internationalize and the type of country or enterprise towards which they direct their investments. Conversely, substantial differences may exist between reformed SOEs and traditional SOEs. We argue that while reformed SOEs are likely to adopt market-oriented strategies, traditional SOEs are still motivated by political and social objectives that can deviate from profit maximization. Accordingly, we expect contemporary reformed SOEs to be more likely to internationalize and direct their foreign investments towards more profitable target firms and less risky countries. On the contrary, we expect traditional SOEs to be more domestically oriented and, when they internationalize, more likely to undertake riskier investments aimed at achieving political goals, such as gaining control over strategic assets. Moreover, we also expect investment strategies to be related to a country's position in international trade. While from a theoretical perspective, foreign investments (M&A and FDIs) and trade flows may be either substitutes or complements, depending on the purpose of the investment, the empirical evidence leans towards complementarity, especially with firms increasingly involved in complex vertically fragmented activities. Similarly, investing in countries with a central position in global trade can be regarded as a relatively safer and more market-oriented option. Thus, the relationship between M&A and a country's relevance in world trade is expected to vary depending on the type of ownership of the investing firms.

To make our research questions and arguments operational, we summarize them into five hypotheses that can be empirically investigated. To this end, we adopt an empirical approach that relies on a novel database of more than 110,000 M&A over the period 2005–2012, 10% of which have a State-owned acquirer. These data are analyzed through a two-step approach. First, we use disaggregated firm-level data to analyze firms' propensity to internationalize and to assess whether POEs, traditional SOEs and contemporary reformed SOEs differ in their firm-targeting strategy. Second, we use country-level aggregated panel data to investigate whether divergent internationalization patterns across POEs and different types of SOEs can be traced back to country-specific characteristics, including institutional quality, degree of geographic and cultural proximity, the presence of strategic natural resources, and relevance in world trade.

Our results confirm our hypotheses regarding the different internationalization strategies adopted by traditional and reformed SOEs. In particular, the firm-level analysis highlights that SIEs have a higher propensity to internationalize through cross-border M&A. Like their private counterparts, they acquire profitable companies both in domestic and cross-border deals. Conversely, traditional SOEs perform more domestic M&A and acquire lower performing target firms. The country-level analysis also documents relevant differences. We find that both the geographical and cultural proximity hypotheses (the tendency to invest more in geographically or culturally close countries) hold for POEs and reformed SOEs, but not for traditional SOEs. Traditional SOEs are more likely to lean towards countries with a lower institutional quality or that are culturally and geographically distant, more peripheral in the world trade network and with a higher endowment of strategic natural resources. This paper contributes to the existing literature in several ways. First, we document the recent phenomenon of SOEs' internationalization through the empirical analysis of a large dataset composed of more than 110,000 M&A all over the world. Second, we theorize that acquiring firms adopt different internationalization patterns according to their ownership nature: public vs private. Moreover, we extend this conceptual framework by arguing that firms under government control differ in their internationalization strategies according to the intensity of the internal reforms they had undergone. In this respect

we introduce a distinction between traditional SOEs and contemporary SIEs. Compared to the former, the latter show a reformed ownership structure: they are mixed enterprises, usually listed on a stock market, where the government continues to be the top shareholder although it owns less than 50% of the shares of the controlled company. Third, we validate our conceptual framework through an extensive econometric analysis which is developed both at firm and at country level. Notably, systematic differences across POEs, traditional SOEs and contemporary SIEs are documented with respect to a plurality of variables, ranging from the target firms' economic performance to their main sector of activity; from the target countries' institutional quality to their endowment of strategic resources. The paper also extends previous literature by developing a network analysis which allows to compare internationalization and trade patterns. In fact, to appropriately consider the complexity of trade patterns, we construct the entire world trade network and calculate several centrality measures detecting key players (countries) within the network.² This approach enriches the analysis in at least two ways. First, it makes it possible to study the links across agents in relation to the whole network, since each country is analyzed through its interactions with others within the network. Second, it allows the construction of richer measures that look at the relationships between entities in a more in-depth way that also considers the context of all the other links between countries. Finally, consistently with our conceptual framework, the evidence of systematic differences in the internationalization patterns and targeting strategies of SOEs and SIEs demonstrates how differences in the intensity of government control (and in the resulting firm governance structure) are likely to affect the controlled firms' ultimate objectives, a variable which cannot be observed directly. Our evidence suggests that, while reformed SOEs adopt market-oriented strategies, making them relatively more aligned to POEs' profit maximization goal, traditional SOEs are still used by governments as a vehicle to pursue political goals. The fact that traditional SOEs undertake riskier and less market-oriented strategies suggests that their investment choices are driven by political motives, such as national security or the bail out of national companies in financial distress. The paper is organized as follows. In Section 2, we lay out our main hypotheses and research questions which we formulate according to the main relevant literature. In Section 3, we present the database and the main variables we analyze. In Section 4, the empirical strategy is introduced, and centrality measures based on the trade network are explained. Main results are discussed in Section 5. In Section 6 we present our conclusions and final considerations.

2. Literature review and hypotheses

In this section, we define our hypotheses on how differences in the acquiring firms' ownership nature affect their investment strategies and internationalization patterns. The hypotheses are related to the relevant literature and are organized into five broad areas which are presented below.

Propensity to internationalize. The literature has advanced various arguments to explain why SOEs historically showed a lower propensity to internationalize. According to the 'social view' argument, SOEs were deliberately deviating from a profit maximization behavior, as they were called to pursue nationally-relevant social goals such as: territorial development and cohesion, employment support, income redistribution and inflation control through pricing mechanisms, and affordable access to services of general interest. The SOEs' focus on national priorities lowered their propensity to invest extensively abroad, thus dismissing potentially profitable opportunities stemming from

² This approach has been adopted to analyze financial investments (Garlaschelli et al., 2005), FDIs (De Masi et al., 2013; De Masi and Ricchiuti, 2018, 2020), or world trade (Fagiolo et al., 2009; De Benedictis and Tajoli, 2011, 2018).

internationalization. Furthermore, foreign direct investments were perceived to have a detrimental effect on the domestic balance of payments, on employment dynamics and, ultimately, on the support of the domestic economy. Other authors stressed the risk of political interference and the capture by private interests (Shleifer and Vishny, 1994; Mauro, 1995). According to this argument, governments use their controlled enterprises as a vehicle for pursuing private political rents. As a consequence, SOEs were deterred from venturing abroad, where politicians are less able to exert their political control and influence. Building on these arguments, our expectation is that traditional – unlisted and majority owned – SOEs mainly concentrate their investments within national borders. Conversely, we expect these arguments to be less relevant for reformed – listed and minority owned – SOEs, which we expect to be more aligned to POEs in their propensity to internationalize. We summarize this hypothesis as follows:

Hypothesis 1 (H1): *Compared to POEs, SOEs exhibit different internationalization patterns depending on the reforms they have undergone. In particular, reformed SIEs exhibit a greater propensity to internationalize compared to traditional SOEs.*

Target firms' performance. Internationalization through cross-border M&A can be described as a market-oriented strategy motivated by a genuine economic rationale. Cross-border acquisitions represent a fast way to enter new markets, to acquire new capabilities or distributional networks, to access strategic intangible assets such as patent-protected technologies, superior managerial skills and know-how (Deng, 2009; Wang and Boateng, 2007; Sun et al., 2012).

According to this conceptual framework, the internationalization pattern of both POEs and reformed SOEs should be driven by a market-oriented strategy, resulting in the targeting of well-performing firms. Conversely, traditional SOEs (which internalize political goals in their objective function) should acquire enterprises with an inferior economic performance, that private acquirers would not consider. This second argument is consistent with the evidence from large-scale government bail out operations targeting the banking sector and strategic enterprises in financial distress (Tagkalakis, 2013). These considerations lead to the following hypothesis:

Hypothesis 2 (H2): *Compared to POEs, traditional SOEs acquire lower performing and less technologically intensive target firms. This difference is more pronounced in domestic M&A than in cross-border M&A. Conversely, SIEs are more aligned to POEs in their firm targeting strategies, both domestically and internationally.*

Risk and institutions. Formal and informal institutions affect the risk associated with investments and thus are likely to influence both the propensity to internationalize and the choice of the country where firms direct their foreign investments. Moeller et al. (2004) find that a weak institutional environment in the target country increases agency problems and asymmetric information, resulting in a lower probability of cross-border M&A. By affecting the degree of reciprocal trust, social and cultural factors have also been identified as determinants of cross-border deals (Guiso et al., 2009; Bottazzi et al., 2012). Other studies have found that geographical, cultural and language proximity positively affect the intensity of cross-border M&A, as this lowers the non-monetary transaction costs associated with trans-border deals (Stulz and Williamson, 2003; Ahern et al., 2012; Di Giovanni, 2005; Erel et al., 2012). With reference to this literature, Mariotti and Marzano (2019) argue that institutional factors drive the internationalization pattern of SOEs'. Similarly, we argue that institutional factors affect the firms' propensity to internationalize depending on their ownership nature and, as regards government-controlled firms, depending on the intensity of the reforms they have undergone. Existing literature has widely argued that, compared to POEs, traditional SOEs are less risk-exposed, as they face softer budget constraints and a lower threat of takeover or bankruptcy (Vickers and Yarrow, 1991; La Porta et al., 1999). Accordingly, Knutsen et al. (2011) find that SOEs are more likely to make hazardous investments because, unlike private enterprises,

they invest more in countries with a poor rule of law and high corruption, suggesting that their strategies are less influenced by institutional risk factors. However, we expect this argument to be less relevant for contemporary reformed SOEs, as they are corporatized firms with a hard budget constraint and are more exposed to market incentives. Thus, we formulate the following hypothesis:

Hypothesis 3 (H3): *Compared to POEs, traditional SOEs undertake riskier internationalization patterns, resulting in cross-border M&A in countries with a lower institutional quality, and less geographical and cultural proximity. Conversely, SIEs and POEs do not show significant differences in their internationalization strategies with respect to these variables.*

Strategic resources. The emergence of SOEs in the global arena has raised various concerns, as governments can use them as a vehicle for pursuing non-commercial and political objectives (Cuervo-Cazurra et al., 2014); this may involve anti-competitive effects and generate economic distortions at the global level (Guriev et al., 2011; Kowalski et al., 2013). Some authors argue that SOEs pursue political goals such as national security and thus internationalize in order to access strategic natural or primary resources which are not available domestically (Butt et al., 2008; Bremmer, 2010; Bass and Chakrabarty, 2014; Jeong and Weiner, 2012). Focusing on the Chinese case, Ramasamy et al. (2012) find that SOEs mainly direct their cross-border M&A towards countries rich in natural resources. In light of this literature, we question whether SOEs and POEs aim their foreign investments towards countries which differ with respect to their endowment of natural and strategic resources. According to our conceptual framework, we expect this difference to be relevant mainly for traditional SOEs that can be used by governments as a vehicle for achieving politically relevant goals. We, thus, hypothesize the following:

Hypothesis 4 (H4): *Compared to POEs, cross-border M&A undertaken by traditional SOEs are more oriented towards the search for natural and strategic resources, with this goal being less relevant for SIEs.*

Trade network centrality. The decision to make foreign investments may depend on the trade patterns. FDIs and cross-border M&A represent a way to enter new markets or relocate certain tasks. Existing trade linkages matter as some countries are better positioned than others within the trade network, depending on the reasons for the investment.

Traditionally, foreign investments and exports have been seen as substitute ways to serve the market (Head and Ries, 2004). However, evidence and theory have shown that exports and FDIs can also be complements, even at the level of a single firm, which may undertake export-platform FDIs (Neary, 2009). Exports can be a safer way to test a market before establishing a foreign affiliate so that, empirically, investment abroad is positively correlated with export experience (Conconi et al., 2016).

Moreover, with production fragmentation and the emergence of Global Value Chains, the complementarity between trade and foreign investments has become even more relevant (Antras, 2020; Antras and Yeaple, 2014). Being positioned in central locations, with strong trade linkages with international markets, enhances such complementarities and is likely to provide more valuable opportunities (Ahmad et al., 2021; Han et al., 2016).

In light of the debate concerning the nature of the relation between foreign investments and trade (complementarity vs. substitutability), we investigate whether cross-border deals involve acquiring and targeting companies located in countries that hold more central positions in the world trade network. Centrality signals that a firm's strategy is less risky and more market oriented. We expect that countries with a higher degree of centrality, which also play an important role in supply chains, also tend to be more involved in cross-border deals (Criscuolo and Timmis, 2017). Moreover, we hypothesize that the sign and strength of this relationship might depend on the ownership nature of the acquiring company. For SIEs and POEs, we expect a positive relationship between deals and centrality in the network of target countries. On the contrary,

we expect a target country's position in international trade to be less relevant for typical SOEs.

The above reasoning leads us to the following hypothesis:

Hypothesis 5 (H5): *Countries with a higher degree of centrality in the trade network are more involved in cross-border deals, with this association being stronger for SIEs and POEs than for traditional SOEs.*

3. Data

We build a novel dataset of worldwide M&A deals by combining data from different sources: information on deals is sourced from Zephyr; Orbis provides firm-level information; data on country-level resources are taken from BP's Statistical Review of World Energy, the World Bank's Worldwide Governance Indicators and World Development Indicators; geographical and trade variables are from CEPII. We construct the dataset as follows.

We first extract from Zephyr,³ a database managed by the Bureau Van Dijk, the entire set of M&A that took place over the period 2005–2012. We consider only deals reporting non-missing observations on: the year of the deal; the deal type; the name of the target and acquiring companies involved in each deal and their respective identification numbers (IDs). Companies' IDs are then used to extract from the Orbis database (also managed by the Bureau Van Dijk) additional information on the target and acquirer firms involved in the selected deals. Orbis contains yearly information on the financial, accounting and corporate characteristics of a large number of international companies. From this data source, we retrieved information related to firms' profitability (as measured by the ROS indicator) in the year of the deal, their geographical location, year of incorporation, whether the firm is listed on a stock market, and its sector of activity. The sector of activity is used to gauge information on the technological level of firms. Based on the Eurostat classification (Statistics on high-tech industry and knowledge-intensive services), high-tech firms include those in high-tech knowledge-intensive services and high-technology manufacturing.⁴ Moreover, for the acquirer companies, we extract from Orbis information on their governance structure: their listing status, the percentage of shares owned by the top shareholder and their ownership nature. Our main explanatory variable refers to whether the acquirer is State-owned or not. A firm is considered an SOE when it is ultimately owned by a government or public authority.⁵

For companies that are under government control, we use information on the percentage of shares owned by the top shareholder to distinguish majority-owned SOEs and minority-owned SOEs. In the former case, the government owns the absolute majority of shares, while in the latter case the government is the top shareholder despite owning less than 50% of the controlled company's shares.

In addition to considering firm-level variables, we enrich our dataset by including variables which capture some features about the countries where the target and acquiring companies originate. According to our

³ Zephyr reports worldwide information on deals. We include acquisitions, mergers, joint ventures, IPO, minority stakes, institutional buy-outs and management buy-outs, while we disregarded data or rumors about potential and not completed deals.

⁴ The classification of NACE rev. 2 sectors by technological level is available from Eurostat at https://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf.

⁵ The ownership of a company is determined by adopting the following procedure. We extracted information on the firm's top shareholder from Orbis. The former refers to the owner of the largest share of equity in the company, so we proceed in a recursive manner until the ultimate controller is identified, especially when such an entity is a governmental body. This criterion encompasses both enterprises under direct public control, where the government is the top shareholder, and indirect public control, where the government is the ultimate owner through a chain of upstream ownership relations while it does not figure as the SOE's top shareholder.

conceptual framework and hypotheses, these country-level variables can help explain differences in the internationalization pattern across POEs, traditional and reformed SOEs. For each country, the level of strategic resources is proxied by three variables: the amount of natural gas and oil reserves (data are sourced from the BP Statistical Review of World Energy), and the level of mineral rents (data are collected by the World Development Indicators managed by the World Bank⁶). Following a consolidated literature, to measure a country's institutional quality we rely on the World Bank's Worldwide Governance Indicators (WGI) database (Kaufmann and Kraay, 2008; Kaufmann et al., 2010). In light of our specific interest in the quality of the government controlling the SOEs, we decide to focus our attention on the Control of Corruption (CC) indicator, which captures 'the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as capture of the State by elites and private interests' (p. 223 Kaufmann et al., 2011). Bilateral trade flows between countries as well as geographical variables such as distance, common language and colonial ties are sourced from CEPII. Bilateral trade flows are taken from the BACI database provided by CEPII and based on raw data from UN-Comtrade. We aggregate trade data at the origin–destination country level and use it to build the World Trade Network (De Benedictis et al., 2014) on which we calculate centrality measures. The construction of the world trade network and the use of centrality measures is described in detail in the next subsection.

After cleaning the data (errors, misreporting, missing information), our final database is composed of a total of 110,064 deals that occurred worldwide over the period 2005–2012. Geographically, our database has a global coverage, including 130 acquirer countries and 164 target countries. Of the 110,064 deals in our dataset, 91.3% (100,480) involve POEs as acquirers and 8.7% (9,584) regard SOEs. Domestic deals are 73.3% (80,693), while cross-border deals are 26.7% (29,371). 92% of the cross-border deals (27,019) are executed by POEs and 8% (2,352) by SOEs.

We report in Table 1 the list of variables and their respective sources.

3.1. Network measures

Centrality is a key concept in the network analysis. By measuring the importance of each agent (a node) within the network, we find that it greatly differs conceptually and computationally from standard individual-level measures because it takes into account the entire structure of the network (see Newman, 2018). Following De Masi and Ricchiuti (2020), we use country-to-country bilateral trade flows to construct a yearly undirected trade network. The nodes i and j (countries) are linked when we observe a trade flow between them. In the case of international trade, weights are particularly meaningful. Specifically, in each year t , they are constructed as the ratio between bilateral trade (imports plus exports) and the total world trade. They capture the relevance that each country pair has within the world trade network:

$$\omega_{ij,t} = \frac{Imports_{ij,t} + Exports_{ij,t}}{Imports_{w,t} + Exports_{w,t}}$$

We consider several measures of centrality, including both local measures (degree of centrality, average degree of neighbors, clustering) and higher-order measures (eigenvector centrality). These measures

⁶ According to the World Bank, mineral rents are calculated as the difference between the value of production for a stock of minerals at world prices and their total costs of production. Minerals included in the calculation are tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate.

Table 1
List of variables and sources.

Variable	Description	Source
Deal-level variables		
Acquirer	Acquiring firm ID	Zephyr
Target	Target firm ID	Zephyr
Year	Year of the deal	Zephyr
Firm-level variables		
SOE	State or privately owned	Orbis
SOE minority-owned	State owns less than 50% of shares	Orbis
SOE majority-owned	State owns more than 50% of shares	Orbis
Listed	Listed or unlisted	Orbis
Profitability	Return on sales ebit	Orbis
Country	Country name	Orbis
Sector	NACE rev. 2 sector, 2-digit	Orbis
High-tech	H-tech manuf., H-tech know.-int. serv.	Eurostat
Country-to-country variables		
Cross-border	Domestic or cross-border	Zephyr
Distance	Distance between countries	CEPII
Colonial ties	Common colonial ties or not	CEPII
Bilateral trade	Imports and exports	CEPII
Country-level variables		
Oil reserves	Oil reserves, barrels	BP
Natural gas Reserves	Natural gas Reserves, cube meters	BP
Mineral rents	Mineral rents, % of GDP	World Bank
Control of corruption	Index of control of corruption	World Bank
Degree	Centrality in the world trade network	Own elaboration
Eigenvector	Centrality in the world trade network	Own elaboration
Clustering	Centrality in the world trade network	Own elaboration
Average neighbor degree	Centrality in the world trade network	Own elaboration

vary according to the network topology, and catch different nodes' attitudes.⁷

Degree centrality is the simplest centrality measure, and allows to detect a leader of the network. For each country, it is given by the ratio between its (unweighted) number of links and the maximum number of possible links. Therefore, it is defined as the fraction of countries that is connected to country i :

$$DC_i = \frac{k_i}{(N - 1)}$$

where k_i is number of links of country i and N is the total number of nodes.

The second measure employed is the **average neighbor degree**, which returns the average degree of the country's neighbor. Specifically, the index equal to:

$$AVND_i = \frac{1}{s_i} \sum_{j \in N(i)} \omega_{ij} k_j$$

where s_i is the weighted degree of node i , ω_{ij} is the weight defined above, k_j is the degree of node j and $N(i)$ are the neighbors of node i . Having a high *average* means that the country is linked to highly-connected countries.

The last local measure we consider is the **clustering coefficient**, which is a measure of the density of connections around a node. For unweighted graphs, the clustering of a node is the fraction of possible triangles through that node that exist, allowing us to detect the neighboring nodes which in turn are connected to each other. For weighted graphs, different algorithms may be used to define the clustering coefficient; we follow the library NetworkX implemented

⁷ It is worth noting that these measures are statistically highly correlated but the hubs identified could diverge significantly (Krackhardt, 1990). Indeed, the measures are constructed in a different way, even if the background meaning that they aim to calculate is the centrality of a node with respect to the network.

in Python employing the geometric average of the sub-graph hedge weights (ω_{ij} defined above).

We finally calculate a global measure of centrality, the eigenvector, whose value depends on the structure of the network as a whole.

Eigenvector centrality represents a generalization of the degree (Newman, 2018). It accounts for both the number of connections of each node and, recursively, the number of connections of neighbors. It catches the neighbors' centrality. Specifically, its value for country i is the i th element of the vector x defined by the system:

$$Ax = \lambda x$$

where A is the adjacency matrix of the network and λ the eigenvalue. If λ is the largest eigenvalue, there is a unique solution x . The neighbors' centrality are weighted using ω_{ij} . A higher eigenvector implies that the country is connected to many nodes that themselves have high eigenvector centrality scores.

For degree, clustering and eigenvector centrality, we expect the largest number of deals to be done in the hub countries of the trade network. This result would confirm a complementary relationship between M&A and trade. The sign of the Average Neighbor Degree, on the other hand, strictly depends on the network's topology. Given that the trade network is dense, and most countries are fully connected, we could expect a positive as well as a negative relationship with the number of deals.

4. Empirical strategy

To test our hypotheses, we develop the empirical strategy on two levels: firm and country. First, a firm-level analysis is developed to test hypotheses H1 and H2, on how differences in the acquirers' ownership nature (and, across government-controlled firms, in the intensity of their reforms) affect their internationalization propensity and targeting strategies. Regarding hypothesis H1, we assess whether the probability of making cross-border deals depends on the ownership structure of the acquiring firm. Notably, based on the information extracted from Orbis,

Table 2
Hypotheses and main variables.

	H1 Propensity to internationalize	H2 Target's performance	H3 Risk and institutions	H4 Strategic resources	H5 Trade network centrality
Dep. var.	Pr(cross-border)	Pr(h-tech domestic) Pr(h-tech foreign) domestic target ROS foreign target ROS	N deals by: listed acq. unlisted acq.	N deals by: listed acq. unlisted acq.	N deals by: listed acq. unlisted acq.
Main expl. var.	SOE acquirer SOE × minority SOE × listed	SOE acquirer SOE × minority SOE × listed	SOE acquirer SOE × contr. corr. SOE × distance SOE × colony SOE × com.lang.	SOE acquirer SOE × gas SOE × oil SOE × mineral	SOE acquirer SOE × acq. centrality SOE × tar. centrality
Data	deal-level cross-section	deal-level cross-section	bilateral country-level panel	bilateral country-level panel	bilateral country-level panel
Estimator	Probit	Probit, OLS	Poisson	Poisson	Poisson

we distinguish between a POE, a majority-owned SOE and a minority-owned SOE. As regards hypothesis H2, we investigate whether the characteristics of targeted firms, such as their economic performance and economic sector of activity, differ depending on the ownership nature of the acquirer and across domestic and cross-border deals. Second, we develop a country-level analysis to test hypotheses H3–H5. In particular, by investigating the geographical patterns of cross-border deals between each country pair, we study how the total number of deals by POEs, traditional SOEs and reformed SIEs depends on the characteristics of the countries involved, such as their institutional quality, geographical and cultural proximity (H3), the presence of strategic natural resources (H4) or their weight in the international trade network (H5). In the following subsections, we specify and discuss the empirical strategy adopted for each hypothesis. The firm-level and country-level empirical strategies are presented respectively in Sections 4.1 and 4.2. Moreover, Table 2 summarizes for each hypothesis the main variables of interest, the type of data and the estimator employed in the econometric analysis.

4.1. Firm-level analysis: Model specification

The firm-level analysis is aimed at understanding differences in cross-border M&A activity among enterprises depending on their ownership nature and other firm-specific features. To investigate how firms' characteristics affect the type of deals made as regards the propensity to operate at the international level and the market orientation, we first work on the full cross-section dataset of deals.

Propensity to internationalize (H1). Hypothesis H1 is addressed in the following way. Differences in firms' propensity to internationalize is investigated through the following probit baseline specification:

$$Pr(Y = 1) = \Phi(\alpha + \beta SOE + \gamma' X + \delta_t + \delta_{ci} + \delta_{cj} + \delta_{si} + \delta_{sj}) \quad (1)$$

where the variable Y indicates whether the deal is domestic ($Y = 0$) or cross-border ($Y = 1$); Φ is the cumulative standard normal distribution function; α is the constant term; SOE is a dummy variable equal to 1 when the acquirer is a State-owned enterprise and 0 otherwise; and β is the main parameter of interest, capturing whether the (conditional) probability of making cross-border deals depends on the ownership nature of the acquirer. A positive (negative) value of β indicates that SOEs display a higher (lower) propensity to internationalize compared to POEs, conditional on controls. The vector X denotes a set of control variables of the acquiring firm, including their listing status, the institutional quality of the country where they are located and the percentage of shares owned by the top shareholder. Fixed-effects are added to control for potential confounding factors and for correlated unobserved heterogeneity. Year fixed-effects δ_t capture time-dependent common

shocks including yearly macroeconomic exogenous shocks, while the other parameters control for time-invariant differences across the acquirer i and the target j involved in the M&A. These include, respectively, their country c (δ_{ci} and δ_{cj}) and sector of activity s (δ_{si} and δ_{sj}).

The initial baseline model specified in Eq. (1) allows to verify the first part of hypothesis H1, that is to assess whether, at firm level, the probability of internationalizing through M&A depends on the acquirer's ownership nature (private vs. SOE), when controlling for specific firm and country level variables of both the acquirer and target company. Next, we focus on the second part of hypothesis H1 and further investigate whether SOEs exhibit different internationalization patterns depending on the intensity of reforms they have undergone. For this purpose, we distinguish between majority-owned and minority-owned SOEs as well as listed SOEs and unlisted SOEs. In particular, we extend the baseline model by adding a dichotomic variable, *Firm type* and by interacting it with the ownership variable as follows:

$$Pr(Y = 1) = \Phi(\alpha + \beta_1 SOE + \beta_2 SOE \times Firm\ type + \gamma' X + \delta_t + \delta_{ci} + \delta_{cj} + \delta_{si} + \delta_{sj}) \quad (2)$$

where *Firm type* captures different types of firms according to the specification. We check our results with (i) *Firm type* being a dummy for majority vs. minority owned firms; (ii) *Firm type* being a dummy for listed vs. unlisted firms. In these specifications, the coefficients of interest are those of interaction terms ($SOE \times Firm\ type$) that allow us to verify whether propensity to internationalize differs across traditional and reformed SOEs, conditional on the control variables X (including the non-interacted *Firm type*).

Target's performance (H2). We next verify hypothesis H2 by inspecting the characteristics of the firms targeted by different types of acquirers (POEs, traditional SOEs and reformed SIEs) in their domestic and cross-border M&A. We consider two main proxies for the acquirer's targeting strategy: the technological intensity of the targeted firm's sector (whether it operates in a high-tech sector) and the firm's profitability, measured by the ROS index. The former is a proxy for the acquirer's strategic interest in a market. Similarly, the latter is a proxy for the acquirer's profit orientation. Domestic and cross-border deals are considered separately: we first test whether the probability of acquiring domestic/foreign firms operating in high-tech sectors depends on the type of acquirer.⁸ For this purpose, we employ the same probit model specification discussed above in Eq. (2), with *High-tech* being our binary dependent variable of interest (equal to 1 when the

⁸ Furthermore, we also check the probability of acquiring listed targets (not reported for space reasons). Results available upon request.

target enterprise operates in a high-tech sector, according to the Eurostat definition). Moreover, SOEs' market orientation is investigated by looking at a target's profitability, again distinguishing domestic deals from cross-border deals. As in this case the ROS index is a continuous variable, we turn to an OLS estimator (rather than probit).

4.2. Country-level analysis

To address hypotheses H3–H5, which question whether different internationalization patterns across SOEs and POEs are associated with country-specific characteristics, we aggregate deals at country-level. The dependent variable is the number of country-to-country deals having either a private or State-owned acquirer (accordingly, the dataset is aggregated at the country-pair level, separately for POEs and SOEs). Our explanatory variables refer to country-specific characteristics and they include their institutional quality, their geographical and cultural proximity (H3) or the presence of strategic natural resources (H4). Moreover, we analyze how the number of deals relates to the international trade network (H5). Working with a count dependent variable which contains only integer values, we adopt a Poisson estimator. Although our dependent variable shows a departure from the assumption of equi-dispersion (i.e. mean and variance can be different), the Poisson regression still presents several advantages compared to alternative estimators (e.g. negative binomial): it provides consistent estimates of the coefficients of interest even when the underlying distribution of the dependent variable is not Poisson but the conditional mean is correctly specified (Gourieroux et al., 1984; Wooldridge, 1999). Moreover, the Poisson regression model is robust to a number of misspecifications such as overdispersion (it can be accommodated by using robust standard errors), the presence of an excessive number of zeros, to dependence over time as well as cross-sectional dependence (Bertanha and Moser, 2016). We use standard errors clustered at the origin country. We adopt the following specification to analyze how the number of bilateral deals between countries depends on country-specific characteristics and whether the ownership nature of the acquiring firm affects this relationship:

$$E[Y_{ij}^L] = \exp(\alpha + \beta_1 SOE_i + \beta_2 SOE_i \times x_h + \gamma'_1 X_i + \gamma'_2 X_j + \gamma'_3 X_{ij} + \delta_{ci} + \delta_{cj} + \delta_i) \quad (3)$$

where $E[Y_{ij}^L]$ denotes the (conditional) expected value of Y_{ij}^L that is the number of M&A deals between the home country i and the host country j made either by listed acquirers ($L = 1$) or by unlisted acquirers ($L = 0$).⁹ Vectors X_i and X_j include a set of country-level time-variant control variables respectively for home country i and host country j , while vector X_{ij} denotes bilateral country-to-country variables. The specific content of X_i , X_j , X_{ij} is related to the hypothesis that is being investigated; further detail is provided below. Concerning the coefficients of interest, β_1 captures the baseline difference in the number of bilateral deals between SOEs and POEs (both being either listed or unlisted), while the β_2 coefficient of the interaction term ($SOE_i \times x_h$) captures how the association between the number of deals and the variable $x_h \in \{X_i, X_j, X_{ij}\}$ differs for SOEs as compared to POEs. We check several specifications with the x_h variable and its interaction term defined as follows.

Risk and institutions (H3). In order to test hypothesis H3, we check whether SOEs' and POEs' cross-border M&A differ with respect to countries' bilateral distance and institutional quality. According to their differing objectives and ownership nature, SOEs and

⁹ In order to investigate differences between reformed and traditional SOEs we prefer to separately consider two alternative dependent variables (the total amount of deals performed either by listed or unlisted acquirers) rather than using among the regressors a triple interaction term (between the SOE dummy, the *listed* dummy and the country variable of interest x_h). In this way, results are easier to interpret.

POEs may react differently to risk factors as proxied by geographical variables. We proxy institutional quality by the WGI Control of Corruption (CC) indicator, $X_j = CC_j$. Geographical and cultural factors are measured with time invariant country-pair variables commonly used in gravity models such as geographical distance, colonial ties and common language, all captured by the vector $X_{ij} = \{Distance_{ij}, Colony_{ij}, CommonLanguage_{ij}\}$. The interaction term $SOE_i \times CC_j$ measures whether, compared to private firms, State-owned acquirers direct their investments towards countries with a better or worse institutional quality proxied by the World Bank's control of corruption indicator. The interaction terms $SOE_i \times Distance_{ij}$, $SOE_i \times Colony_{ij}$ and $SOE_i \times CommonLanguage_{ij}$ are gravity variables introduced to test the geographical and cultural proximity hypotheses; i.e. whether SOEs tend to value geographical or cultural factors more or less than POEs.¹⁰ Furthermore, we distinguish among types of government control by comparing the total amount of deals completed by listed SOEs and unlisted SOEs in each country-pair. This approach is aimed at verifying whether traditional SOEs carry out cross-border M&A in riskier countries compared to POEs and reformed SIEs.

Strategic resources (H4). To test hypothesis H4, according to which SOEs respond also to non-economic strategic incentives related to political power and access to natural resources, we focus on the amount of gas reserves, oil reserves and mineral rents. Thus, we set $X_j = \{Gas_j, Oil_j, Mineral_j\}$ and introduce the following interaction terms: $SOE_i \times Gas_j$, $SOE_i \times Oil_j$ and $SOE_i \times Mineral_j$.¹¹ They measure whether, compared to private enterprises, SOEs tend to direct more cross-border investments towards countries with an abundance of natural resources. As above, the dependent variable is the total number of deals done by both listed and unlisted acquirers, which allows us to check the differences across traditional and reformed SOEs in terms of the internationalization of political goals in their objective function and investment strategy.

Trade network centrality (H5). Lastly, to verify hypothesis H5, we calculate several network centrality measures for both home and host countries: eigenvector centrality, degree centrality, clustering coefficient and the average neighbor degree, i.e. we set $X_i = \{Eigenvector_i, Degree_i, Cluster_i, AvNDegree_i\}$ and $X_j = \{Eigenvector_j, Degree_j, Cluster_j, AvNDegree_j\}$. Subsequently, the interaction terms $SOE_i \times Eigenvector_i$ and $SOE_i \times Eigenvector_j$ (as well as with the other centrality measures) are introduced to analyze whether home/host country trade network centrality can explain the number of deals carried out by SOEs and POEs. The aim is to verify whether SOEs behave differently than private companies. Deals may be carried out to seek synergies with existing international trade linkages or, on the contrary, they might seek peripheral countries, for instance to open new linkages.

5. Results

5.1. Firm-level analysis

Descriptive statistics show that the share of cross-border deals (about 24%–27%) is similar for both POEs and SOEs. A stark difference, however, emerges when we consider minority-owned State-invested enterprises (SIEs, below 50% of the shares) and majority-owned State enterprises (above 50% of the shares), or listed and unlisted SOEs. In Table 3, we see that for SIEs and listed firms, about 34% of the deals are

¹⁰ These gravity variables also capture some aspects of the country's role in international trade, which we embed in hypothesis H5 through trade network centrality. Note that centrality is a broader concept that cannot be reduced to bilateral or dyadic variables since, as explained in the previous section, it considers the entire structure of world trade, also accounting for indirect trade relations.

¹¹ To capture other time-variant country characteristics we also control for GDP per capita.

Table 3
Share of domestic and cross-border deals by type of firm.

	Domestic	Cross-border	Total	N
POE	73.1	26.9	100	100,480
SOE	75.5	24.5	100	9,584
<i>of which:</i>				
Minority-owned	66.3	33.7	100	3,707
Majority-owned	81.2	18.8	100	5,877
Listed	66.1	33.8	100	3,705
Unlisted	81.3	18.7	100	5,879
All deals	73.3	26.7	100	110,064

cross-border, suggesting a greater propensity to internationalize, while majority-owned and unlisted SOEs tend to operate domestically.¹²

These differences in unconditional means are further investigated empirically.

Propensity to internationalize (H1). Table 4 reports the estimates for the models specified in Eqs. (1) and (2) to test hypothesis H1 regarding differences in SOEs, SIEs and POEs internationalization propensity. The positive and highly statistically significant coefficient of the *SOE* variable (Column 1) indicates that the probability of observing a cross-border deal increases when the acquirer is controlled by a government. This first evidence implies that, at firm level, the propensity to internationalize through cross-border M&A depends on the acquirer's ownership nature and confirms the non-negligible role that SOEs have been playing since the new century in the market for corporate control (Cuervo-Cazurra et al., 2014; Karolyi and Liao, 2017).

Results reported in Columns 2–3 of Table 4 show that the propensity to internationalize varies across different types of SOEs, depending on the intensity of the governance reforms they have undergone. In particular, we observe that the previous result regarding SOEs' higher internationalization is entirely driven by contemporary reformed SOEs, which are proxied by both minority-owned and listed SIEs. Conversely, traditional (unlisted and majority-owned) SOEs are less internationalized compared to both POEs and contemporary SOEs.

These results suggest that the intensity of government control is likely to affect the operational objectives that SOEs' managers are instructed to achieve. Indeed, compared to traditional SOEs, listed and minority-owned SIEs show a higher entrepreneurial attitude towards internationalization through cross-border deals. Our findings confirm hypothesis H1 about a shift towards characteristically private-sector models of corporate structure and profit orientation on behalf of reformed SIEs operating in deregulated and globalized markets (Clò et al., 2017; Musacchio and Lazzarini, 2018). This suggests that the long-term objectives and market strategies of contemporary reformed (listed and minority-owned) SIEs are unlikely to differ significantly from those of their private peers. Conversely, majority-owned SOEs and unlisted SOEs are still more inclined to acquire firms within their domestic borders. This evidence is in line with the traditional social view about public ownership according to which SOEs are called to pursue a social welfare objective, inducing them to undertake domestic investments with a positive repercussion on the national economy.¹³

¹² Summary statistics as well as the sector and country distributions of deals are reported in the Appendix in Tables 10–12. All the results presented in this and the next section are robust to the exclusion of China, whose SOEs have a particularly important role in the domestic economy as well as abroad. In our dataset, China accounts for a small fraction of deals and it is not driving our results. All the other figures reported in the text as well as further descriptive evidence and econometric results are available upon request.

¹³ Another insight emerges when distinguishing SOEs according to their economic sector of activity. Additional econometric analyses show that the

Table 4
Firm-level analysis: Propensity to internationalize (H1).

	(1)	(2)	(3)
Listed	0.386*** (0.011)	0.382*** (0.011)	0.375*** (0.011)
SOEs	0.115*** (0.019)		
Minority SOEs		0.136*** (0.023)	
Majority SOEs		0.017 (0.026)	
Unlisted SOEs			0.035 (0.026)
Listed SOEs			0.580*** (0.028)
Constant	6.682*** (0.330)	6.695*** (0.330)	6.714*** (0.330)
Observations	109,096	109,096	109,096
Year sector and country FE	Yes	Yes	Yes
R2	0.157	0.157	0.157

Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Target firm performance (H2). We now turn to verify hypothesis H2 by exploring differences in the market orientation of POEs and SOEs. To this end, one important dimension regards the propensity to acquire domestic and foreign technology. In Table 5, we present the results of probit regressions of the probability to acquire high-tech targets. Columns 1 and 2 show that SOEs behave differently than POEs and that they follow different strategies at home and abroad. SOEs are more likely to acquire high-tech domestic firms and less likely to acquire high-tech foreign firms as compared to POEs. In columns 3–4 and 5–6, we see that these results do not apply uniformly to all types of SOEs, but are largely driven by majority-owned and unlisted SOEs. Thus, traditional SOEs focus more on the domestic economy, where they invest in technology. On the contrary, reformed SOEs, especially when listed, seem to adopt strategies that are more in line with private firms.

We further analyze the strategies adopted by different types of acquirers by comparing the profitability of the target enterprises they acquire in both domestic and cross-border M&A. Results reported in columns 1–2 of Table 6 show that, on average, SOEs purchase better performing enterprises only in case of cross-border M&A, while no significant difference emerges in case of domestic deals. Columns 3–6 of Table 6 show significant differences among different types of SOEs. The hypothesis that contemporary reformed SOEs develop market-oriented strategies is confirmed by the evidence that both listed SOEs and minority-SOEs purchase well-performing enterprises, with a higher ROS compared to the target enterprises purchased by private acquirers. This result holds when looking at both domestic and cross-border M&A,

propensity to internationalize increases for both State-owned and private enterprises operating in high-tech sectors, while when looking at the financial sector, the probability to internationalize increases only in case of private ownership. This result can be interpreted by looking at the descriptive statistics. In case of public ownership, the financial sector is covered mainly by traditional SOEs, which focus their M&A within national borders, while contemporary reformed SOEs are relatively more present in high-tech sectors. Another confirmation about the diverging strategies across traditional and contemporary SOEs emerges from the evidence of their different internationalization patterns before and after the 2008 financial crisis. Indeed, after the economic recession, traditional SOEs have redirected their investments and financial capital within domestic borders more than contemporary SOEs (Figures are available upon request). This suggests that, while listed and minority-owned SOEs adopt a market-oriented strategy, traditional SOEs still represent a vehicle that governments use to implement national industrial policies and to pursue political objectives. These results are not reported in the paper but are available from the authors upon request.

Table 5
Firm-level analysis: Probability of acquiring domestic and foreign high-tech firms (H2).

	(1) Domestic	(2) Cross-border	(3) Domestic	(4) Cross-border	(5) Domestic	(6) Cross-border
Listed	−0.243*** (0.013)	−0.149*** (0.020)	−0.241*** (0.013)	−0.148*** (0.020)	−0.230*** (0.013)	−0.175*** (0.020)
SOEs	0.096*** (0.021)	−0.128*** (0.036)				
Min.-owned SOEs			0.006 (0.036)	−0.144*** (0.046)		
Maj.-owned SOEs			0.142*** (0.026)	−0.107** (0.051)		
Listed SOEs					−0.027 (0.036)	0.076 (0.047)
Unlisted SOEs					0.160*** (0.025)	−0.362*** (0.053)
Constant	−4.292*** (0.510)	−4.606*** (0.535)	−4.296*** (0.511)	−4.606*** (0.535)	−4.321*** (0.510)	−4.541*** (0.535)
Observations	79,888	29,093	79,888	29,093	79,888	29,093
Year sector and country FE	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.188	0.186	0.188	0.186	0.188	0.187

Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6
Firm-level analysis: ROS of the Target Enterprise (H2).

	(1) Domestic	(2) Cross border	(3) Domestic	(4) Cross border	(5) Domestic	(6) Cross border
Listed	1.862*** (0.355)	0.846* (0.505)	1.820*** (0.356)	0.648 (0.455)	1.649*** (0.372)	1.039** (0.517)
SOEs	−0.409 (0.483)	2.766*** (0.911)				
Minority-owned SOEs			0.881 (0.827)	2.143* (1.149)		
Majority-owned SOEs			−1.023* (0.561)	3.462*** (1.202)		
Unlisted SOEs					−1.032* (0.562)	4.248*** (1.236)
Listed SOEs					2.483*** (0.783)	2.433* (1.261)
Constant	102.381*** (16.270)	79.763*** (16.288)	102.208*** (16.264)	79.536*** (16.260)	102.463*** (16.279)	79.704*** (16.285)
Observations	29,524	11,681	29,524	11,775	29,524	11,681
Year, Sector, Country FE	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.073	0.104	0.073	0.104	0.073	0.104

Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

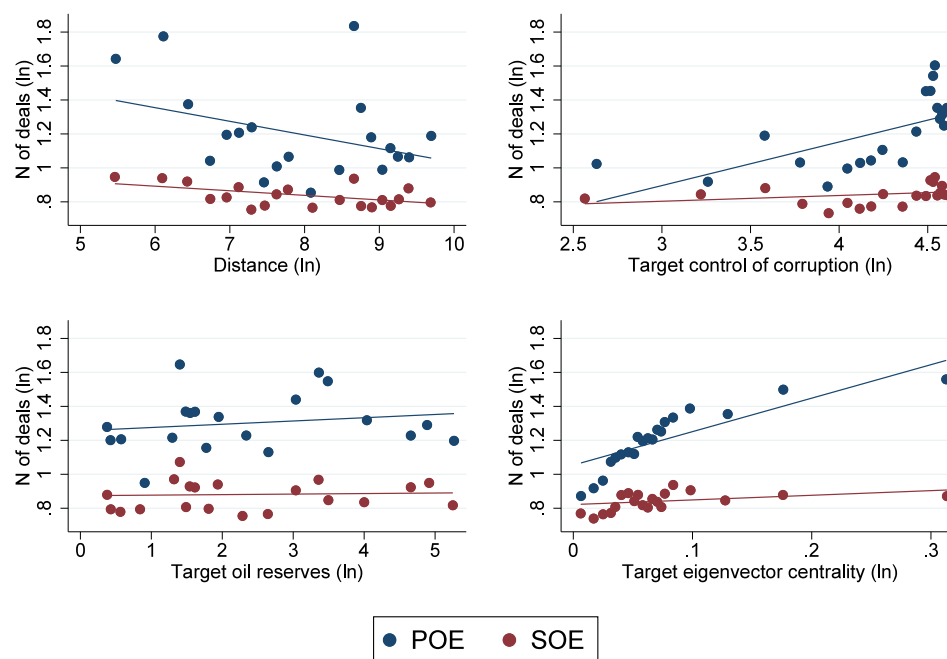
with the ROS being on average higher in case of trans-border deals. This suggests that internationalization is motivated by rent-seeking opportunities.

A different picture emerges when we focus on traditional SOEs, as the profitability of the target companies they acquire differs significantly across domestic or foreign deals. In case of domestic M&A, unlisted and majority-owned SOEs purchase poorly performing enterprises, with a lower ROS than the target enterprises purchased by both POEs and SIEs (Tagkalakis 2013; Clò et al., 2017). The internalization of political objectives brings traditional SOEs to target enterprises facing financial distress, or whose performance is inferior, that private acquirers do not consider in their acquiring strategy. The fact that this result holds only for domestic deals suggests that traditional SOEs mainly pursue a socio-political goal which deviates from profit maximization only when they operate within domestic borders. Conversely, when they decide to go abroad, their strategies can be driven by profit-seeking opportunities (acquisition of profit or its underlying determinants, such as skills, know-how etc.). Indeed, in their cross-border deals, unlisted SOEs and majority-owned SOEs purchase well-performing firms, with a higher profitability compared to private and other public acquirers. All in all, these results confirm hypothesis H2.

5.2. Country-level analysis

We now investigate whether different internationalization patterns across POEs and different types of SOEs can be traced back to country-specific characteristics. Cross-border deals are geographically concentrated: the top 15 origins account for more than 70%–80% of deals, while the top 15 destinations account for 60%–70% of deals.¹⁴ A large fraction of deals regards the United States and the United Kingdom. Deals by POEs are usually focused on rich western countries, while those by SOEs are more geographically differentiated. In general, however, the geographical distribution of cross-border deals largely overlaps between origin and destination as well as between POEs and SOEs (correlations and rank-correlations are all very high, in most cases above 80%–90%). To investigate geographical patterns further, we also look at origin–destination combinations. For clarity, we consider aggregates and look at cross-border deals between North America and Western Europe and the rest of the world. POE distribution is skewed towards North America and Western Europe and includes deals within these two macro-areas. By contrast, SOE deals are much more evenly distributed. The geographical distribution of cross-border deals is correlated with country characteristics. We summarize the main ones in

¹⁴ See the Appendix for details. Further evidence and results available on request.



Data grouped into 20 equal-sized bins.

Fig. 1. Country-to-country deals and target characteristics.

Fig. 1. The country-to-country number of deals is negatively correlated with the geographical distance, with SOE deals being less affected. The institutional quality of the destination country is positively correlated with the number of deals, yet this almost exclusively applies to POEs while SOEs seem not to take it into consideration. Natural resources such as oil reserves tend to be only slightly positively associated with cross-border deals, without statistically significant differences between POEs and SOEs (a similar result applies to gas reserves).¹⁵ Lastly, country centrality in the world trade network is positively correlated with the number of deals; this especially applies to POEs, while SOEs seem much less affected.

In what follows, we present and discuss the results of the econometric analysis of the cross-border M&A carried out by different types of acquirers.

Risk and institutions (H3). In the first specification of the model, we address hypothesis H3 by estimating Eq. (3). We assess to which extent SOEs' and POEs' cross-border M&A are driven by country formal and informal institutional factors, which ultimately affect the riskiness of foreign investments. Table 7 shows that the coefficient of the SOEs tends to be negative and statistically significant, indicating that the number of cross-border M&A for SOEs is lower than for private firms (for both listed and unlisted acquirers). This result is reasonable since SOEs are more limited in number and overall engage in fewer cross-border M&A. The quality of a country's institutions is proxied by the World Bank's Control of Corruption (CC) indicator, whose coefficient is positive and significant (Columns 1–2 Table 7). This implies that for both listed and unlisted private acquirers the number of cross-border M&A increases in line with the institutional quality of the host country. Conversely, we observe that the interaction between the SOE_i and CC_j variables has a negative coefficient, implying that for the public ownership case the number of cross-border M&A decreases with the institutional quality of the host country where the target enterprise is located. Thus, compared to private acquirers, SOEs direct their

¹⁵ In terms of natural resources, Saudi Arabia, Canada and Venezuela are the top three target countries for oil reserves; Russia, Iran and Qatar are the top three for natural gas reserves.

investment towards riskier countries with a lower institutional quality. This result is stronger for unlisted SOEs than listed SOEs, implying that on average traditional SOEs direct their investments towards riskier countries. The relevance of informal institutions in explaining the firms' internationalization pattern is proxied by the $Distance_{ij}$ variable (geographical distance between the home and host countries) and by the $Colony_{ij}$ variable, which indicates whether the countries involved in a deal have been in a colonial relationship. According to previous literature (Guiso et al., 2009; Bottazzi et al., 2012; Ahern et al., 2012; Erel et al., 2012), these variables represent a proxy for non-monetary transaction costs and barriers which can emerge due to differences in language, ethnicity, and religion.

Results reported in Columns 3–6 of Table 7 show that the geographical proximity hypothesis is confirmed for private acquirers (regardless of their listing status or sector of activity) and for listed SOEs only. Indeed, for them, both coefficients of the $Distance_{ij}$ variable and of the $SOEs \times Distance_{ij}$ interaction term are negative and significant (Column 3), indicating that cross-border M&A are more intense among geographically closer countries while they tend to decline as the distance between the home and host countries involved in the M&A increases. Conversely, this result does not hold for traditional unlisted SOEs. Indeed, the coefficient of the $SOE_i \times Distance_{ij}$ interaction term is not significant (Column 4), implying that, differently from POEs and listed SOEs, the number of M&A deals does not depend on the geographical distance between home and host countries.

The $Colony_{ij}$ variable shows a positive and significant coefficient for private acquirers (notwithstanding their listing status) and for listed SOEs only. In these cases cross-border M&A are more intense among countries that have been in a colonial relationship. Conversely, the cultural proximity hypothesis does not hold in the case of cross-border M&A carried out by unlisted SOEs. In this case, the $SOE_i \times Colony_{ij}$ is not significant. This result indicates that, differently from POEs and listed SOEs, unlisted SOEs do not direct their investments towards culturally closer countries. Overall, these results indicate that both formal and informal institutional factors are likely to affect the internationalization pattern of SOEs, SIEs and POEs. Indeed, when they decide to internationalize, unlisted SOEs are more likely to undertake riskier investments than POEs (and listed SOEs), by directing their cross-border M&A towards countries with a lower institutional quality and

Table 7
Country-level analysis: Risk and institutions (H3).

	(1) Listed	(2) Unlisted	(3) Listed	(4) Unlisted	(5) Listed	(6) Unlisted
SOEs	−0.308 (0.372)	0.571 (0.453)	−1.153*** (0.357)	−2.724*** (0.373)	−2.367*** (0.0559)	−2.577*** (0.0634)
Host CC	0.340*** (0.0559)	0.425*** (0.0800)				
SOEs * Host CC	−0.470*** (0.0896)	−0.741*** (0.110)				
Distance			−0.454*** (0.0279)	−0.569*** (0.0260)		
SOEs * Dist			−0.148*** (0.0451)	0.0202 (0.0470)		
Colony					0.516*** (0.127)	1.184*** (0.172)
SOEs * Colony					1.237*** (0.191)	0.225 (0.243)
Constant	−11.36*** (0.748)	−15.10*** (0.767)	−5.796*** (0.733)	−7.602*** (0.696)	−10.17*** (0.740)	−13.66*** (0.711)
Observations	36,596	36,596	36,596	36,596	36,596	36,596
Country, Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Listed and unlisted refer to acquirers; CC stands for Control of Corruption; other controls include home GDP per capita, Home CC, Home Oil and Gas Reserves and Home Eigenvector (not reported for space reasons); clustered standard errors at the acquiring country level in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

characterized by lower geographical and cultural proximity. This result is consistent with our a priori hypothesis and with previous research studies demonstrating that, when backed by a government shareholder, traditional SOEs' strategies are less influenced by institutional risk factors. Overall, these results are consistent with hypothesis H3.

Strategic resources (H4). In order to address hypothesis H4, we further investigate the different internationalization strategies adopted by SOEs and POEs by looking at the natural resource endowment of the countries where foreign investments are directed. This is measured by three variables: the amount of oil reserves, gas reserves and mineral rents. Results reported in Table 8 show significant differences across listed and unlisted SOEs. The coefficients of the three interaction terms (between the SOE variable and the natural resources variables) are positive and significant only in the case of unlisted SOEs (Columns 2, 4, 6), indicating that, compared to POEs, unlisted SOEs are more likely to direct their foreign investments towards countries with higher endowments of primary energy resources. Conversely, when looking at the deals made by listed companies, the coefficient of their interaction terms are either not significant or negative and significant (Columns 1, 3, 5), implying that listed SOEs do not differ significantly from POEs in their targeting strategy. When read together, these results suggest that, in accordance with previous literature (Kowalski et al., 2013; Bremmer, 2010; Bass and Chakrabarty, 2014), SOEs are used by governments as a vehicle to pursue political goals such as national security, since they internationalize to ensure access to energy resources and raw materials. Nevertheless, this result holds only when considering traditional unlisted SOEs which are under government control, while it is not confirmed in case of reformed listed SOEs. Overall, these results are consistent with hypothesis H4.

Trade network centrality (H5). Finally, we test hypothesis H5. Results on the firms' centrality within the trade network are reported in Table 9. In this case, we question whether SIEs, SOEs or POEs direct their cross-border investments towards host countries that are more or less relevant in the international trade network. As anticipated, we use different centrality measures which, while referring to the same concept, are constructed differently so as to capture distinct aspects of the network topology. The centrality measures allow to capture elements pertaining to network topology, i.e. how countries are connected to each other. In the table we report the correlation between the centrality measures, for both the country of origin and the country of destination, and we focus on the interaction between SOE status and centrality of the host country.

It emerges that *Degree*, *Clustering* and *Eigenvector* present similar patterns. A greater centrality within the trade network, at home as well as in the host country, is positively and significantly correlated with the number of deals between countries i and country j . And this result holds for both listed and unlisted companies. However, the interaction between *SOEs* and host's centrality shows us that the relationship is still positive for SOEs but at a lower scale. This suggests that SOEs direct their investments towards countries which are less central within the trade network. This result is confirmed for the three centrality measures when the acquirer is unlisted. On the other hand, this result is statistically significant only for listed firms when the *Degree* is considered. For *Clustering* and *Eigenvector* centrality, there is no difference between POEs and SIEs. The *AverageNeighborDegree* of countries of origin presents a positive significant correlation with the number of done deals. By linking this result with that of *Degree* centrality, we can state that countries with higher connections and whose neighbors have (on average) higher connections do the most deals. However, as regards host countries, the *AverageNeighborDegree* is significant only for unlisted firms but with a negative sign. Host countries with the most deals are those that have a higher degree but whose neighbors (on average) have a lower degree. On the other hand, unlisted SOEs make deals with countries that are less connected within the network but whose neighbors are well connected.

Overall, the positive correlations highlight the complementarity between trade and foreign direct investment. The number of deals is greater for the more central countries because companies try to position themselves, within the trade network, in the most relevant nodes. These nodes allow firms to access the most important markets and represent gates to the most significant trade flows (both elements are captured precisely by the network measures). There is a positive interplay between M&A and trade: a clear indication of complementarity between the two phenomena. From this perspective, we can conclude that our analysis reinforces the belief that FDI and international trade are complements and not substitutes. While this result is clear for both SIEs and POEs, it is less strong for traditional SOEs, which are more likely to seek more peripheral markets, again suggesting that their strategies are not necessarily market oriented. This result confirms hypothesis H5.

6. Discussion and conclusions

A feature of the contemporary economy is the emergence of State-owned enterprises (SOEs) as pivotal players in the global arena. Their

Table 8
Country-level analysis: Strategic resources (H4).

	(1) Listed	(2) Unlisted	(3) Listed	(4) Unlisted	(5) Listed	(6) Unlisted
SOEs	-2.239*** (0.0577)	-2.640*** (0.0720)	-2.285*** (0.0625)	-2.676*** (0.0767)	-2.335*** (0.0559)	-2.601*** (0.0641)
Host Oil Reserves	0.300*** (0.0333)	0.270*** (0.0331)				
SOEs * Host Oil Reserves	-0.0592** (0.0242)	0.0574* (0.0301)				
Host Gas Reserves			0.514*** (0.0313)	0.388*** (0.0337)		
SOEs * Gas Reserves			-0.0523 (0.0564)	0.183*** (0.0660)		
Host Mineral Rents					-0.00777 (0.00789)	-0.0253*** (0.00899)
SOEs * Host Mineral rents					0.0205 (0.0146)	0.0436*** (0.0140)
Constant	-10.54*** (0.733)	-13.97*** (0.709)	-10.52*** (0.730)	-13.91*** (0.706)	-10.14*** (0.741)	-13.55*** (0.718)
Observations	36,596	36,596	36,596	36,596	36,568	36,568
Country, Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Listed and unlisted refer to acquirers; other controls include home GDP per capita, Home CC, Home Oil and Gas Reserves and Home Eigenvector (not reported for space reasons); clustered standard errors at the acquiring country level in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 9
Country-level analysis: Centrality within the trade network (H5).

VARIABLES	(1) Listed	(2) Unlisted	(3) Listed	(4) Unlisted	(5) Listed	(6) Unlisted	(7) Listed	(8) Unlisted
SOEs	-2.257*** (0.0754)	-2.356*** (0.0829)	3.787*** (0.903)	5.960*** (1.039)	-2.253 (2.202)	-7.731*** (2.589)	-2.240*** (0.0843)	-2.310*** (0.0931)
Home Eigenvector	3.460*** (0.467)	4.386*** (0.385)						
Host Eigenvector	5.395*** (0.349)	5.103*** (0.312)						
SOEs * Host Eigen	-0.672 (0.574)	-2.513*** (0.633)						
Home Degree			14.74*** (1.127)	16.03*** (1.297)				
Host Degree			14.40*** (1.214)	15.88*** (1.072)				
SOEs * Host Degree			-9.115*** (1.376)	-12.76*** (1.586)				
Home AvND					1.418*** (0.313)	2.961*** (0.295)		
Host AvND					0.272 (0.309)	-0.850** (0.350)		
SOEs * Host AvND					-0.0126 (0.425)	0.993** (0.502)		
Home Cluster							59.95*** (16.88)	77.93*** (14.34)
Host Cluster							159.0*** (15.10)	171.0*** (12.59)
SOEs * Host Cluster							-26.97 (21.21)	-92.74*** (22.75)
Constant	-10.79*** (0.744)	-14.34*** (0.720)	-30.20*** (1.688)	-35.52*** (1.639)	-17.54*** (2.654)	-21.09*** (2.524)	-10.09*** (0.680)	-13.32*** (0.674)
Observations	36,596	36,596	36,596	36,596	36,596	36,596	36,596	36,596
Country, Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Listed and unlisted refer to acquirers; other controls include home GDP per capita, Home CC, Home Oil and Gas Reserves and Home Eigenvector (not reported for space reasons); clustered standard errors at the acquiring country level in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

internationalization seems to contradict the widespread belief that SOEs act mainly within domestic borders to achieve politically-relevant goals. Therefore, one can question why SOEs internationalize and, once they move beyond national borders, whether they are still mandated by their controlling governments to pursue social and politically relevant goals or, rather, if they behave similarly to private enterprises, whose strategies and investments are aimed at maximizing profits and the shareholders' value. These questions mainly motivated our research.

In our view, the phenomenon of SOE internationalization cannot be fully understood unless we explicitly consider the reforms that, over the last decades, brought about a deep transformation of SOEs, thus affecting their internal governance, as well as their ultimate goals

and strategies. Many SOEs have been corporatized, opened to private equity and listed on stock markets. Firms that have undergone this partial privatization process can no longer be considered State-owned, according to the traditional definition. The dichotomy between public and private ownership – we argue – has been overcome by a diverse scenario, characterized by a plurality of State-owned enterprises, which diverge in their objective functions (oriented towards either profit or socio-political goals) and investment choices depending on the intensity of the internal reforms they have undergone.

Our main thesis is that reformed SOEs (those that have been partially privatized, opened to private equity or listed on the stock market) greatly differ from traditional SOEs in their ultimate goals: the former

Table 10
Summary statistics on the whole deal-level dataset.

	Mean	SD	Min	Max	N
POE	0.91	0.28	0.00	1.00	110,064
SOE	0.09	0.28	0.00	1.00	110,064
SOE minority	0.03	0.18	0.00	1.00	110,064
SOE majority	0.05	0.22	0.00	1.00	110,064
Listed	0.37	0.48	0.00	1.00	110,064
High-tech	0.17	0.38	0.00	1.00	110,064
Finance	0.43	0.49	0.00	1.00	110,064
ROS ebit	6.45	22.89	-100.00	100.00	41,595
Target listed	0.25	0.43	0.00	1.00	110,064
Target high-tech	0.29	0.45	0.00	1.00	110,064
Cross-border	0.27	0.44	0.00	1.00	110,064
Distance (km)	1,705.93	2,973.48	2.74	19,586.18	110,044
Colonial ties	0.01	0.09	0.00	1.00	110,044
Oil reserves (bbl)	21.18	38.30	0.00	297.57	110,064
Gas Reserves (tcm)	4.30	8.53	0.00	34.64	110,064
Mineral rents	0.50	1.34	0.00	23.68	109,891
Control of corruption	81.55	23.12	2.39	100.00	110,064
GDP per capita	39,915.17	17,998.60	168.21	157,100.41	109,883
Degree	0.97	0.04	0.40	1.00	109,639
Eigenvector	0.09	0.07	0.00	0.62	109,639
Clustering	0.00	0.00	0.00	0.01	109,639
Av. neighb. degree	182.85	22.09	65.82	217.12	109,639
Target oil reserves (bbl)	20.72	39.34	0.00	297.57	110,064
Target gas Reserves (tcm)	4.14	8.70	0.00	34.64	110,064
Target mineral rents	0.60	1.51	0.00	43.71	109,823
Target control of corr.	79.17	24.61	1.90	100.00	110,064
Target GDP per capita	37,362.43	18,561.43	190.39	148,297.39	109,806
Target degree	0.97	0.05	0.40	1.00	109,723
Target eigenvector	0.09	0.08	0.00	0.62	109,723
Target clustering	0.00	0.00	0.00	0.01	109,723
Target av. n. degree	181.56	22.73	65.82	217.12	109,723

Table 11
Distribution of cross-border deals by country.

Rank	POE			SOE		
	Country	N deals (%)	Cum. (%)	Country	N deals (%)	Cum. (%)
Origin						
1	USA	27.6	27.6	NOR	8.4	8.4
2	GBR	14.9	42.5	GBR	8.0	16.4
3	FRA	6.1	48.5	USA	7.7	24.1
4	NLD	4.9	53.4	FRA	6.3	30.4
5	CHE	4.6	58.0	SGP	5.4	35.8
6	SWE	3.5	61.5	CHE	5.3	41.1
7	CAN	3.2	64.7	CHN	4.5	45.6
8	ESP	2.3	67.0	RUS	4.3	49.9
9	AUS	2.2	69.1	NLD	3.9	53.8
10	JPN	2.1	71.2	JPN	3.7	57.5
11	DEU	1.8	73.0	ARE	3.3	60.8
12	SGP	1.7	74.7	BEL	3.0	63.8
13	BEL	1.7	76.4	SWE	2.8	66.5
14	ITA	1.7	78.1	FIN	2.7	69.3
15	LUX	1.6	79.7	KWT	2.0	71.3
	Others (104)	20.3	100	Others (81)	28.7	100
	Total	100		Total	100	
Destination						
1	GBR	13.1	13.1	GBR	9.8	9.8
2	USA	9.8	22.9	USA	7.0	16.8
3	DEU	6.4	29.3	RUS	4.7	21.4
4	FRA	4.6	33.9	DEU	4.2	25.6
5	CAN	4.2	38.1	NLD	3.7	29.4
6	ITA	4.1	42.2	SWE	3.7	33.1
7	NLD	3.5	45.7	FRA	3.7	36.8
8	AUS	3.4	49.1	AUS	3.6	40.4
9	IND	3.3	52.4	CHN	3.2	43.7
10	CHN	3.1	55.5	CAN	3.2	46.9
11	SWE	2.8	58.3	ITA	3.2	50.1
12	ESP	2.8	61.1	IND	2.8	53.0
13	JPN	2.3	63.4	ESP	2.3	55.2
14	RUS	2.2	65.6	BRA	1.8	57.1
15	BEL	2.1	67.8	UKR	1.5	58.6
	Others (159)	32.2	100	Others (126)	41.4	100
	Total	100		Total	100	

Table 12
Distribution of cross-border deals by sector.

Rank	POE			SOE		
	Sector	N deals (%)	Cum. (%)	Sector	N deals (%)	Cum. (%)
Origin						
1	Finance	44.3	44.3	Finance	45.6	45.6
2	Manufacturing	22.9	67.2	Manufacturing	15.1	60.7
3	ICT	9.1	76.3	ICT	7.7	68.3
4	Scientific	6.8	83.1	Elec. and gas	6.9	75.2
5	Wholesale and retail	5.0	88.1	Transportation	6.0	81.2
6	Administration	2.3	90.4	Mining	5.2	86.4
7	Mining	2.3	92.7	Scientific	4.8	91.2
8	Transportation	1.9	94.6	Wholesale and retail	2.3	93.5
9	Construction	1.6	96.1	Defense	2.0	95.5
10	Real estate	0.7	96.8	Construction	2.0	97.4
11	Hotels and rest.	0.6	97.4	Administration	0.7	98.1
12	Elec. and gas	0.6	98.0	Water, waste	0.5	98.6
13	Water, waste	0.4	98.4	Hotels and rest.	0.5	99.1
14	Agriculture	0.4	98.8	Real estate	0.3	99.4
15	Health	0.3	99.1	Agriculture	0.3	99.7
16–19	Others	0.9	100	Others	0.3	100
	Total	100		Total	100	
Destination						
1	Manufacturing	31.6	31.6	Manufacturing	22.2	22.2
2	ICT	14.2	45.8	Finance	19.6	41.8
3	Finance	10.6	56.4	ICT	11.1	52.9
4	Scientific	10.2	66.6	Scientific	8.9	61.8
5	Wholesale and retail	9.3	76.0	Elec. and gas	8.6	70.4
6	Mining	6.6	82.5	Mining	7.5	77.9
7	Administration	3.5	86.0	Transportation	7.2	85.1
8	Construction	3.2	89.3	Wholesale and retail	5.1	90.2
9	Transportation	3.1	92.4	Construction	3.7	93.9
10	Elec. and gas	1.6	94.0	Administration	1.4	95.3
11	Hotels and rest.	1.3	95.3	Hotels and rest.	1.1	96.4
12	Real estate	1.1	96.4	Water, waste	0.9	97.3
13	Health	0.8	97.2	Real estate	0.7	98.0
14	Water, waste	0.7	97.9	Agriculture	0.6	98.6
15	Arts	0.7	98.6	Health	0.5	99.0
16–19	Others	1.4	100	Others	1.0	100
	Total	100		Total	100	

are market oriented, while the latter continue to pursue politically relevant goals. We cannot directly observe firms' objective functions, but we contend that significant differences between reformed and traditional SOEs in terms of the goals they aim to achieve can be extrapolated by comparing their investment choices with a set of directly observable variables.

To address this thesis, we investigated whether firms' internationalization pattern varies according to their ownership nature and, in case of public ownership, to the intensity of the reforms they underwent. For this purpose, we analyzed a dataset of more than 110,000 M&A that took place worldwide during the period 2005–2012. First, we divided them according to the type of acquirer: private enterprise, traditional (unlisted or majority-owned) SOE or reformed (listed or minority-owned) SOE. Overall, SOEs account for almost 10% of the deals which compose our database. We, then, investigated whether private enterprises, traditional SOEs and reformed SOEs differ with respect to the firms and countries they choose for their foreign investments.

Notably, we compared them with respect to a plurality of issues: their propensity to internationalize; the profitability of the enterprises they target in their domestic and cross-border M&A; the attempt to access strategic natural resources; the risk associated with their investments, which we proxy by looking at institutional factors and trade network centrality of the countries where acquirers make their foreign investments.

Our analysis highlights significant differences between the strategies of POEs, traditional SOEs and SIEs. Compared to traditional SOEs, reformed SOEs show a higher propensity to internationalize, they purchase better-performing targets, they direct their investments towards countries which are closer both culturally and geographically, with better institutional quality and a more central position in the trade

network. Together, all these factors contribute to lowering the risk associated with their decision to internationalize. We have also found that reformed SOEs are well aligned with private enterprises in their internationalization pattern and strategies. Together, all these findings are consistent with our premise that reformed SOEs are increasingly adopting market-oriented strategies, thus differing from traditional SOEs in their objective functions. Conversely, we have found that the behavior of traditional SOEs differs from that of private enterprises and reformed SOEs. First, they are less internationalized. Their activity is mainly focused within domestic borders, where they direct their investments towards bad performing targets. This evidence is consistent with the argument that traditional SOEs are still called to pursue political goals (i.e. the bail out of firms in financial distress). Moreover, we have found that, when they decide to go abroad, their internationalization pattern differs from that adopted by their private and reformed SOE peers. In particular, they are more inclined to target countries with a higher endowment of strategic natural resources. They direct their investments towards riskier countries (geographically and culturally distant, with lower institutional quality and which are less central in the trade network), a factor that can be explained in light of the political protection they still enjoy.

We finally discuss some implications and limitations of our analysis. Our findings contribute to evaluate the widespread political concern that accompanies the SOEs international expansion. Our findings implies that the rising role of reformed SOEs in the global market place, which adopt market-oriented strategies and behave similarly to private enterprises, is not likely to result in anti-competitive effects, market efficiency disruption and economic distortions. Conversely, such a concern should not be over-looked when considering the international expansion of traditional SOEs, particularly when they are backed by

non-democratic governments. In this latter case, the ultimate motive behind the SOEs? internationalization is plausibly not economic but political. They do not direct their investments abroad to maximize profits and growth opportunities, but rather to achieve political goals. With respect to this issue, however, our analysis presents some evident limitations that can only be overcome by future research. We have shown that traditional SOEs have not only pursued strictly economic objectives but have made choices guided by other motivations. Unfortunately, we were not able to clearly highlight and classify these motivations. Our findings suggest that SOEs can be used by low institutional quality governments as a foreign policy vehicle aimed at exerting their political power and influence in the global arena. However, our focus on the cross-border M&As' dynamics does not allow us to assess the extent of the related geopolitical implications. This goes beyond the objective and the scope of this paper and requires further analysis, especially in light of the recent pandemic and Ukrainian crises that are deeply affecting the economic and political equilibria in the international scenario.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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Appendix

See Tables 10–12.

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