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Are All State-Owned Enterprises Equal?

A Taxonomy of Economic Activities to Assess SOE Presence in the Economy

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Abstract

This paper proposes a sector taxonomy of the rationale for the presence of state-owned enterprises in specific industries. The taxonomy is conceptualized only on an efficiency-based rationale for state participation in different economic activities, abstracting it from social or political justification of state-owned enterprises, which can be subjective or conditioned to the country context. The taxonomy is leveraged on a standard industry classification, the Nomenclature of Economic Activities Revision 2 four-digit level sector classification, which is sufficiently disaggregated to resemble specific markets, and thus more appropriate for analyzing the presence of state-owned enterprises through the lens of industrial organization. The proposed taxonomy deploys a decision tree, based on efficiency-based criteria, to classify 563 disaggregated sectors into one of three groups: a "competitive" category, for which the presence of state-owned enterprises does not appear to be justified on grounds of economic efficiency/market failure; a "natural monopoly" category, which includes economic sectors whose market structure is characterized by economies of scale and subadditivity costs that could be corrected via the participation of state-owned enterprises; and a "partially contestable" category, which includes economic sectors characterized by some form of market power, externalities, or other market failures that could be addressed through state ownership. The application of the decision tree classifies 11 disaggregated sectors as natural monopolies, 45 as partially contestable, and the remaining 505 as competitive.

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I. Introduction

Understanding the rationale behind direct state participation in markets through state-owned enterprises (SOEs) is critical to the design of appropriate SOE reform policies. Not all SOEs are equal as they can participate in a diverse and wide range of economic activities in the economy. As evidenced in the novel WB Global Business of the State (BOS) database, there is a large heterogeneity in the sectors where the state intervenes as a market player. The economic costs and benefits from this intervention can also vary substantially depending on the type of economic activity where the SOEs operate.

This paper proposes how to classify economic activities where the state can be present as a market player based on their intrinsic characteristics and associated market failures.[1] Economic theory provides an efficiency-based rationale to identify instances (market failures) in which a non-profit-maximizing SOE would be able to pursue optimal policies (bringing benefits that improve overall welfare), provided that state capture[2] and other inefficiencies or distortions generated by public ownership (the costs) would not outweigh the benefits of SOE presence. Following the Industrial Organization (IO) literature that analyzes the exercise and control of market power (Tirole, 2014), this paper proposes how to classify the economic activities where the state can be present as a market player based on the intrinsic economic characteristics and market failures. In doing so, the paper contributes to filling the gap on how to connect IO research on the differences across markets and industry dynamics with the policy agenda related to the role of the state in markets.[3]

The comprehensive taxonomy presented in this paper rationalizes the potential presence of SOEs at the level of disaggregated economic sectors and by doing so avoids a "one-size-fits-all" approach to analyzing the economic footprint of the state in markets. An efficiency-based rationale for SOE presence suggests heterogeneity of the companies with state participation across sectors, as they may be characterized by different technological and market features. Economic theory can provide guidance to distinguish between those sectors in which markets are able to achieve an efficient market equilibrium, such that there is no economic rationale for SOE presence, and those in which the presence of an SOE might potentially bring economic benefits. While the economics literature has analyzed individual sectors to understand market failures, SOE performance, and reform potential, no systematic attempt has been carried out to analyze sectors based on standard industry classifications that are sufficiently disaggregated to resemble specific markets, and thus more appropriate for determining SOEs' potential impact on market efficiency. The analysis at the level of specific markets is justified on the basis of the industrial organization (IO) literature. The starting point of any competition analysis is the relevant market, which encompasses a product (service) dimension and a geographical dimension. The product dimension

[1] Although there can be social or political rationale to justify state participation in certain economic activities, this paper only focuses on the efficiency-based rationale of state presence in markets. This is because social or political justifications can be country specific as well as subject to the agenda or preferences of policy makers. To avoid this country specific approach and minimize subjectivity, we base our classification only on efficiency criteria that are based on economic theory and empirical evidence documented in the IO literature.

[2] Hellman and Kaufman (2001) define state capture as the efforts of firms to shape the "rules of the game" (laws, policies, and regulations of the state) to their own advantage by providing illicit and non-transparent private gains to public officials. In the case of SOEs, these gains take different forms. According to the OECD's 2017 Survey of anti-corruption and integrity in SOEs, the top ten corruption risks observed in companies with instances of corruption cases include: 1) violations of data protection and privacy, 2) stealing or thefts of goods from the company, 3) fraud, 4) receiving bribes, 5) favoritism (nepotism, cronyism and patronage), 6) non-declaration of conflict of interest, 7) procurement/contract violations (delivering sub-par goods/services, violating contract terms with suppliers), 8) illegal information brokering, 9) receiving kickbacks, and 10) interference in decision-making.

[3] There are two main waves of research in Industrial Organization. A key focus of the first wave of IO research was empirical industry research. This originated with Bain (1951, 1956) and dominated the 1960s. Much of this early inter-industry literature was concerned with the relationship between market structure, firm conduct, and market performance.IO research at the time shifted from case studies towards an inter-industry approach, as summarized by Schmalensee (1989). The first wave of IO research was later superseded by a second generation of theoretical IO. Tirole (1994) explains that this development was due to the fact that empirical inter-industry research fell short of establishing causal mechanisms. Empirical applications of this second wave are generally sector- and market-specific, not cross-sectoral, recognizing that industries are different and providing new knowledge to regulators to understand market power (Tirole, 2014).

considers the demand and supply sides of the market. From the demand side, products must be substitutable from the buyer's point of view, and from the supply side, sellers must be those that can or could easily produce the relevant product or close substitutes (OECD 1993). The location of buyers determines whether the market is local, regional, national, or international (OECD 1993). For the purposes of this paper, we have relied more heavily on the product (service) dimension of the market definition, however, the geographic aspect of the market should be taken into consideration when analyzing a specific country context, especially in the case of small, landlocked economies. A discussion on the level of disaggregation of industry classification and its relation to the definition of market is presented in section V.

This paper puts forward a "triage" of economic sectors to determine those without a specific economic rationale for SOE presence, those with a strong SOE rationale, and those with a weaker SOE rationale. The paper leverages the existing economic literature to categorize each economic sector into three groups: a "competitive" category, for which SOE presence does not appear to be justified on grounds of economic efficiency/market failure; a "natural monopoly" category, which includes economic sectors whose market structure is characterized by economies of scale and subadditivity costs that could be corrected via SOE participation; and a "partially contestable" category, a residual category which includes economic sectors characterized by some form of market power, externalities, or other market failures which could be addressed through state ownership.

The resulting taxonomy is the first comprehensive categorization to rationalize the presence of SOEs in 563 economic sectors, based on economic theory and the empirical literature of industrial organization, filling an important gap in the literature. There does not appear to have been any attempt in the literature to classify economic activities at such level of disaggregation on the basis of economic theory and evidence. Previous work has focused on studying specific sectors characterized by market failures and the potential efficiency gains from government interventions, but this work has failed to comprehensively analyze disaggregated sectors according to a single analytical framework. As a result, most of the classifications developed so far have focused on aggregate sectors or a limited number of subsectors.[4] This paper analyzes each of the 563 economic sectors of the Nomenclature of Economic Activities (NACE) Revision 2 classification of economic activities at the four-digit level, recognizing that only by appreciating the nuanced differences in economic activities across disaggregated sectors can granular SOE diagnostics and reform recommendations be made possible.[5]

State participation in the economy through the provision of goods and services may sometimes pursue public interest objectives in ways that private, profit-maximizing firms cannot, but it often implies significant costs as well. Unintended consequences may include crowding out private investment, allocating resources inefficiently, or introducing fiscal liabilities. These costs and benefits are not homogeneous across sectors, and policies that aim to improve this cost–benefit balance must be informed by a solid understanding of the objective, rationale, or motivation of state participation in a specific sector. The presence of SOEs is motivated by economic, social, or political considerations. These are the categories according to which the literature classifies justifications for state provision of goods and

[4] World Bank (1995) distinguishes broadly between "natural monopoly markets" and "competitive or potentially competitive sectors". Dall'Olio and Nelli (2017) extend this approach by categorizing aggregate sectors into four categories, based on a combined assessment of market structure characteristics and public policy objectives: finance, commercial sectors, strategic sectors (oil, mining), and utilities (gas, water, electricity). Nyman, Dauda and Koschorke (2018) analyze along similar lines the economic rationale for state presence of South Africa's state-owned enterprises across 40 vertically integrated markets. Dauda and Drozd (2020) present the economic rationale for state participation in 44 sectors captured in the 2018 vintage of the Product Market Regulation indicators.

[5] The Statistical Classification of Economic Activities in the European Community, referred to as the NACE classification, is the industry standard classification system used in the European Union to classify economic activities.

services through SOEs (Sorrentino, 2020).[6] That is, governments may want to establish SOEs to carry out countercyclical spending during recessions, to create jobs and provide job security, to distribute incomes and benefits, to open up opportunities for historically disadvantaged population groups, or to exercise strategic control in productive sectors or geographic regions a result of public policy objectives.

While social or political motivations for SOEs are country-specific and influenced by policy makers' preferences, justifications grounded in economic theory are more universal. Rationalizations of state presence based on socio-political considerations remain dependent on a country's specific context and political setting, complicating systematic cross-country analysis.[7] However, from an economic perspective, state direct participation in markets through SOEs can be one of multiple ways to address specific market failures, which can be objectively identified on the basis of the underlying characteristics of the specific markets.[8,9] As explained by Putniņš (2015), under the assumption that governments seek to maximize social welfare, the rationale for state ownership should be based on a three-step process: establishing the presence of a market failure, determining whether an SOE is the most desirable policy intervention to address that market failure, and assessing the costs and benefits of using SOEs to address the market failure for a specific market. Other ways to rationalize state participation in businesses include the analysis of the subsidiarity role of state, which establishes that if there are or could be private agents interested in performing an economic activity, then the state does not need to participate as a market player and should focus on supplying essential goods or services that cannot be provided by private agents.[10] The advantage of analyzing SOEs through the economic lens of market failures or subsidiarity is that this analysis relies on intrinsic sector characteristics which are common across most countries, hence the analysis can be more easily standardized.

Hence, by classifying sectors based on intrinsic market characteristics, this paper provides a novel tool for nuanced country-level analysis of state presence in the economy with a view to guiding policy makers in their decision of whether to intervene in a market or to divest an SOE. Whether assessing the overall footprint of SOEs in the economy or understanding potential distortions from state ownership in the corporate sector, simply adding up all SOEs into one figure is insufficient. It ignores the underlying motivations for a given SOE, as well as the varied costs and benefits from SOE participation in different sectors. By proposing an objective taxonomy, this paper provides a robust tool for analyzing SOE

[6] Cordella and Vagliasindi (2021) explain that different reasons explain the existence of SOEs, including political, social, and economic motivations. They suggest, however, that SOE performance should be measured against the objective for which they were created rather than the standard profit-maximizing measures of private firms. Heath and Norman (2004) identify five main categories of SOE responsibilities: macroeconomic, creation of good-quality jobs, redistribution, national interest, and addressing externalities.

[7] For example, some countries consider strategic those sectors related to national or subnational control of the territory (such as the military), while others use a broader definition that includes electricity, transport, water, hydrocarbons, mining, or financial activity. There are also differences in what constitutes a development objective in different contexts. Some governments may, for example, pursue state ownership in agriculture given its relevance in the economy, even though there are no objective market characteristics to indicate that the private sector would otherwise not enter and invest. See also World Bank (2011), where in the context of underdeveloped private capital markets and weak intellectual property systems, SOEs were rationalized on the basis whether they acted as venues for developing capital-intensive industries in the absence of the private sector.

[8] Market failures are cases where suppliers would provide goods and services in suboptimal quantities, resulting in an inefficient market equilibrium and social welfare loss.

[9] For example, the provision of insurance is hampered by adverse selection and moral hazard, two types of market failures that are intrinsic to and ubiquitous in insurance markets.

[10] In policy implementation, some governments have also developed frameworks to determine where SOEs operate in the economy based on economic and social considerations (Landa, 2016). The analysis of the subsidiarity role of the state is one of the principles to rationalize the role of SOEs in the economy. It establishes that when there is a private sector that is viable and supply goods and services and attend demand, the state should refrain from acting as market player in those activities, and if any intervention is needed it should be in the form of regulation. For instance, according to the Peruvian Constitution, the Government has to follow three criteria for assessing its participation (directly or indirectly) in business activities. First, the State participation in business activities should be authorized by a special law; second, the State participation in business activities should be subsidiary to private businesses such that the State intervention should not foreclose private businesses from the market, and finally the State participation in business activities can only by allowed for reasons of overriding public interest or manifest national benefit.

participation in different markets through an economic lens, abstracting from the political and social preferences of individual policy makers. This also allows to provide guidance on the different alternatives and tailored solutions for SOE reform beyond ownership transformation and which can be strongly related to the type of sectors where these companies operate.[11]

The proposed taxonomy is also critical to allow for cross-country comparison of the SOE footprint. Political economy and social objectives vary from country to country, and, as such, it is impossible to objectively justify the presence of the state in the market on the basis of those objectives. However, since economic market failures are uniquely identified based on the characteristics of the markets in which goods and services are produced and the technologies used, the proposed taxonomy allows analysts to compare SOEs' presence in the economy across countries according to a homogeneous classification system. This taxonomy is already feeding into the Businesses of the State Database of the World Bank Group which is described in a companion paper to this work (Dall'Olio et al., 2022).

The remainder of this paper is organized as follows. Section II provides a review of the economic literature on SOEs and market failures. Section III provides the conceptual framework according to which economic sectors are classified. Section IV analyzes the economic sectors, disaggregated to the level of the NACE four-digit classification, and classifies each of them into the three proposed categories. Section V presents a data driven exercise to validate the taxonomy classification. Section VI concludes.

II. Literature Review: SOE Participation and Market Failures

A systematic and comprehensive classification of the rationale for SOE presence in various economic sectors could usefully inform the analysis of SOEs from a policy perspective. As important is to have a harmonized definition on SOEs to allow cross-country comparison, it is relevant to have a unified conceptual framework to classify economic sectors based on the rationale for government presence in the provision of goods and services to inform assessments of SOEs, guide reform efforts in individual countries, and facilitate cross-country analysis of SOE presence in the economy.[12] Although several examples of sectoral analysis of SOEs can be found in the literature and efforts are being made by specific countries to provide a framework for analyzing the rationale behind SOE presence in various sectors of the economy,[13] a globally accepted approach guided by the economic literature has been missing. As a result, most SOE analysis remains either restricted to specific sectors (i.e., a number of studies cover universally accepted sectors in which SOEs are present across countries such as electricity and water

[11] Sanchez-Navarro, Goodwin, & Kikeri (2021) present a full description of the different alternatives for reform building on this taxonomy is presented in the CPSD SOE Knowledge note indicating the different menu of options of reform. For instance, it proposes management arrangements and concessions can be more suitable for natural monopoly sectors, whereas divestiture may be more suitable for large SOEs in competitive sectors that could be served by (or in competition with) the private sector.

[12] A caveat of previous academic literature and policy-related workstreams is the lack of a uniform definition of SOEs across countries and between economic activities, which hinders cross-country comparisons and analyses of SOE performance. To resolve this lack of harmonization, Dall'Olio et. al. (2022) building on the International Monetary Fund's Government Finance Statistics Manual (2014) proposes a corporation as an SOE based on the government's share of control for a corporation as well as the corporation's role in the market. That is, an entity is considered a State-Owned Enterprise if it satisfies the following conditions:

i. It is controlled by government units or by other public corporations, as proxied by a level of direct or indirect (i.e., through subsidiaries) participation of above 10% at each of the level;
ii. It is recognized by law as a legal entity separate from its owners;
iii. It can generate profit or other financial gain for its owners;
iv. It is set up for the purposes of engaging in market production (i.e., it provides goods and/or services in exchange of a price).

[13] For example, in the case of Peru, the Constitution in its article 60 of constitution establishes: "The government recognizes economic pluralism. The national economy is based on the coexistence of several forms of ownership and enterprise. Authorized solely by an express law, the government may subsidiarily engage in business activities. directly or indirectly, for reasons of overriding public interest or manifest national benefit. Business activity receives the same legal treatment, whether public or private."

supply)[14] or conducted from the perspective of a specific country (i.e., SOEs in China, given the significant role played by SOEs in Chinese markets).[15]

In theory, markets that function competitively will attain allocative (Pareto) efficiency in the absence of any policy-related distortion. However, for markets in which certain environment or product characteristics generate a market failure, competitive allocation (in the absence of policy intervention) would not maximize social welfare (or, therefore, achieve Pareto efficiency). These market failures include primarily market power (arising from technological/cost structure characteristics),[16] externalities or public goods, and information frictions. In the presence of market failure, state participation in the economy via an SOE could be justified as a tool to bring back allocative efficiency (OECD 2017). In many countries, SOEs are also viewed as a tool to build capabilities in products or services. Such policy can be framed as responses to externalities and coordination failures (Hausmann and Rodrik 2003; Mazzucato 2013; Antonelli et. al. 2014; Castelnovo and Florio 2020). While potentially valid on grounds of economic efficiency, these justifications are outside the scope of this paper as they are difficult to generalize across countries and frequently relate also to spillovers *across* and not *within* sectors. At the same time, an important subcategory of these justifications – knowledge spillovers – are captured insofar as research and development sectors have been classified as sectors with an economic rationale for state presence.

Both economic theory and the empirical literature have shown, however, the pitfalls of SOE participation in markets, including poor financial performance, risks of political capture, direct and contingent fiscal liabilities, and distortionary effects on other companies, sectors, and the overall economy. The economic literature has explored widely whether, *ceteris paribus*, SOE performance could be comparable to that of private sector firms. Economic theory posits that SOEs underperform private sector companies due to agency problems (Dharwadkar, George, and Brandes 2000; La Porta and Lopez-de-Silanes 1999), soft budget constraints (Kornai 1979; Kornai et al. 2003), clientelism (Shleifer and Vishny, 1994; Kopecký and Spirova 2011; Wang and Wang 2013; Liu and Zhang 2018; Jian et al. 2020; Szarzec et al. 2020), and mixed political and business objectives (Bai and Xu 2005; García-Canal and Guillén 2008; Shirley and Nellis 1991; Stan, Peng, and Bruton 2014), among others. This is confirmed by a number of empirical papers that have shown SOE performance to be consistently poorer than that of private sector enterprises.[17] Interestingly,

[14] Andrés, Guasch, and Azumendi (2011) analyze the governance structure and performance outcomes of SOEs in water and electricity sectors in Latin America. Gassner, Popov, and Pushak (2009) study the economic implications of SOE privatization in the water and electricity sectors of all regions in which the World Bank provides development assistance. See (2014) studies the performance of SOEs in the water sector for countries in Southeast Asia. Matuszak and Kabacinski (2021) analyze the financial performance of SOEs in the electricity sector for countries of the European Union.

[15] Bai, Hsieh, and Song (2016); Cong et. al. (2019); Huang, Pagano, and Panizza (2020); Song, Storesletten, and Zilibotti (2011); and Dollar and Wei (2007), among others, have used China as a case study to analyze SOE performance.

[16] The rest of this paper will refer to market power only as the pricing power that is derived from cost-structure (e.g., economies of scale, subadditivity of costs) and other inherent market features. That is, it refers to 'naturally arising' market power, as opposed to market power derived from legal instruments (e.g., statutory monopoly rights, regulatory protection), or firm behavior (e.g., collusion or abuse of market dominance). Evidently, exclusivity rights granted by the government may confer market power to a specific firm. But this taxonomy builds on the concept of 'market power' as a market failure in the spirit of industrial organization literature where it is understood as being derived from the cost-structure.

[17] Wang and Shailer (2018) conduct a meta-analysis and confirm that, compared to private ownership, government ownership is associated with inferior firm performance. Goldeng, Grünfeld, and Benito (2008) use returns on assets, as well as costs relative to sales revenue, to study firm performance in various markets where SOEs and privately owned companies compete, finding that SOEs generally perform worse than private firms. Dewenter and Malatesta (2001), in a global study of very large firms across sectors, find that the SOEs in that group are significantly less profitable, more highly leveraged, and more labor-intensive than private sector comparators. Drawing on empirical evidence for South Asia, Melecky and Sharma (2019) show that SOEs are more likely to be financially distressed than their domestic and foreign private counterparts.

findings pertaining to poor SOE performance are valid across sectors. Finally, SOE performance is linked with economy-wide performance, growth, the government's fiscal position,[18] and productivity trends.[19]

III. Framework to Classify Economic Activities Based on an Efficiency Rationale for State Participation

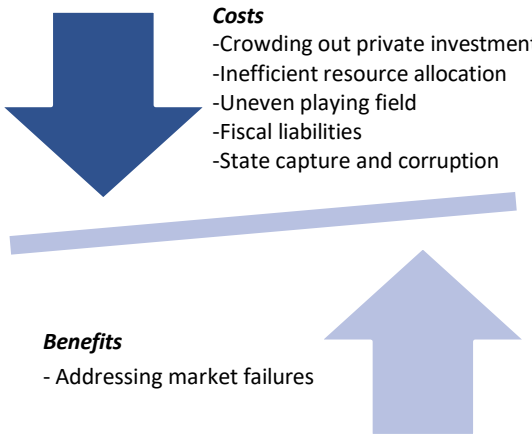
The conceptual framework put forward by this paper stems from the simple consideration that, given the pitfalls connected to SOEs, these should be present only in sectors for which a strong economic rationale for state participation exists. Gaining an understanding of the pros and cons of government intervention in individual sectors through an SOE, rather than letting private enterprises compete, is critical for informed policy making. SOE participation is just one of several alternative ways in which a government can intervene to correct a market failure; often, SOEs are not the best alternative. Market failures can be addressed through other forms (and perhaps less distortive and costly) of state intervention, ranging from information provision to regulation to direct state provision of the good or service, and do not themselves justify state participation *per se*. In the absence of a market failure (for example, in the manufacturing of food products or textiles), only the distortionary effects of SOE participation could arise, while the SOE's presence could not be justified by the aim of improving social welfare. While there are other important factors that shape SOE performance beyond the intrinsic market characteristics of the sector in which the company operates –for example, the level of independence of management, the quality and capacity of state supervisory mechanisms, regulatory regimes governing SOEs—they fall beyond the scope of this paper.

The proposed taxonomy is centered around the assumption that the presence and degree of market failures that could be corrected through an SOE can help differentiate among economic sectors. By distinguishing between economic sectors according to the presence (or absence) of specific market failures connected to the process of producing its goods or services, their intensity, and the appropriateness of an SOE as a (potential) corrective measure, one could explore the justification for the presence of SOEs and, as a result, be alerted to the risks of distortive consequences or unintended consequences of SOE presence. A natural conclusion is that sectors with little or no economic rationale should be the first to be considered for SOE divestiture/privatization, given that the well-documented performance gap and distortionary effects of SOEs (the "cons") cannot be compensated for by a specific economic benefit (the "pros") (Figure 1).

[18] SOEs may operate with a surplus or with systematic losses that impact the government's budget or balance sheets through numerous transmission channels: taxes and dividends on the revenue side, subsidies and transfers on the expenditure side, government loans to SOEs generating interest receipts, government takeover of SOE debt, and valuation effects, which tend to be correlated with SOE performance (Soler and Sy 2021).

[19] For example, Szarzec, Dombi, and Matuszak (2021) analyze a micro-level data set on the aggregate economic weight of SOEs in European countries according to leading business indicators, and on that basis assess the overall growth effects of SOEs and their relationship with governmental institutional quality, finding that better institutions entail a more favorable growth effect of SOEs. Böwer (2017) argues that the negative productivity aspects of SOEs in general could spill over to affect the economy at large. Mattera and Silva (2018) focus on firms in the steel sector across countries, finding not only that SOEs are associated with poorer economic performance and higher levels of indebtedness than private enterprises, but also that they have contributed to increasing overcapacity. Ehrlich et al. (1994) and Karpoff (2001) corroborate the exposition above by showing that direct government participation in markets, through SOEs, should be reduced, as private companies are higher performers in terms of productivity growth and managerial efficiency. Similarly, Boeing et al. (2016) and Wei et al. (2017) find that private firms benefit the most and carry out more research and development investments relative to SOEs, providing empirical evidence that SOEs underperform private companies with regard to productive investments. Harrison et al. (2019) document that SOEs and recently privatized SOEs in China perform less well than private companies in terms of profitability.

Figure 1 . Benefits and costs of SOEs[20]



Source: Authors' elaboration

The taxonomy builds on an analysis of the intrinsic features of economic activity that could lead to market failures, independent of the specific country and policy context. The conceptual framework applies a sectoral lens to various economic activities to assess the economic rationale for SOE participation as a tool to address a sector-specific market failure. The conceptual framework is grounded in economic theory—that is, on supply-side and demand-side characteristics, such as the cost structure of production and the rivalry and excludability of consumption. Since these are intrinsic characteristics of the demand and supply side, they are independent of the specific economic context. As such, the taxonomy can be applied across countries. Indeed, the analysis abstracts from the specific policy environment, which could, for example, generate market power in an otherwise potentially competitive sector.

Based on the economic rationale for state intervention, the proposed taxonomy categorizes sectors into three groups. The proposed classification distinguishes *competitive sectors* for which there is no economic rationale for SOE presence; *natural monopoly sectors*, where SOEs could be a well-suited tool to correct a strong market failure; and *partially contestable sectors* characterized by some weaker form of market failure which could potentially be addressed via an SOE. The rationale for the categorization is the following:

1) **Competitive Sectors**: These are sectors in which it is economically viable for multiple firms to compete to provide the good or service in question. Inherent market features, such as cost structure, technology, or demand characteristics, make entry into these sectors largely unproblematic. Furthermore, firms in competitive sectors are typically engaged in the provision of goods or services, the consumption of which is either rivalrous or excludable. Given the competitive nature of these markets, private sector firms competing in them tend to achieve economic efficiency. As such, no strong economic rationale for an SOE can be identified. At the same time, according to the theoretical and empirical literature, there are various inefficiencies associated with provision by the state, in that SOEs are less efficient than private companies under a competitive setting (Boardman and Vining 1989; Vining and Boardman 1992; Ohlsson 1996; Shleifer 1998; Domberger et al. 2002; Goldeng et al. 2008; Stiglitz 2008). These additional costs usually arise from agency costs (Jensen and Meckling 1976; Vogelsang 1983; McCubbins et al. 1987; Estrin and Perotin 1991; Bai and Wang 1998; Majumdar 1998; Dong and Putterman 2003; Lin and Li 2008; and others), imperfect information (Putniņš 2015), and

[20] The potential benefits refer to a simplified view abstracting the potential intended benefits that governments could foresee when deciding to create an SOE.

rent-seeking behavior (Datta-Chaudhuri 1990; Tullock, Seldon, and Brady 2002; Dal Bó 2006; Estache and Wren-Lewis 2009; and others). In competitive markets, therefore, state provision would most likely generate a government failure that harms social welfare (Le Grand 1991). This is the reason why, in the proposed taxonomy, competitive sectors are color-coded in red: given the higher risks of introducing market distortions and the absence of clearly defined economic benefits, the cost-benefit analysis of the SOE presence in those sectors will necessarily be negative.

2) **Natural Monopoly Sectors**: The economics literature identifies sectors in which it is more efficient for one operator to provide the good or service in question, as compared to many producers. Typical examples are network industries (such as electricity transmission) that are characterized by subadditivity[21] in costs and economies of scale. Under such circumstances, while provision by a single market player is the least costly (most efficient) form of production, allocative efficiency cannot be achieved through profit maximization, as the price that maximizes social welfare is below the average cost. For this reason, the government might want to control the market power of the monopolist, either through regulation or direct provision. If ownership is chosen, the government will be forced to cover the SOE's losses with some form of tax revenue or subsidy as a trade-off to maximizing social welfare (Putniņš, 2015).[22] While, over time, technological developments have restricted the set of industries that fall into this category, activities in this category nevertheless have the strongest rationale for state provision. These sectors are color-coded in green since the cost-benefit analysis of SOE presence in these markets might yield a positive result, given that the benefits might exceed the costs associated with an SOE (i.e., inefficiency, market capture, etc.) and unregulated monopolies will not provide socially optimal quantities if they seek to maximize profits. The categorization does not imply a direct "justification" of SOE in those sectors, since SOE is - as discussed above - just one of the potential alternatives, and not necessarily the optimal one, to correct market failures.

3) **Partially Contestable Sectors**: we propose a residual category covering sectors in which is it economically viable for more than one firm to operate but the sectors are characterized by some form of market failure that could potentially be corrected through government ownership. The name of the category is emblematic of one such market failure which is the under-provision of goods and services caused by market power. Also in this case, the color coding is to signal that, taken ex-ante, the cost-benefit analysis of SOE presence might result in an efficiency-based justification for SOE, although weaker than the natural monopoly rationale presented above. Based on a comprehensive literature review, three typologies of market failures can be identified which could be associated with the sectors color-coded in yellow below:

i. **Market power generated by structural barriers to competition**: Barriers to competition, such as high exogenous setup costs or other entry barriers, will naturally limit the number of players in the market. As a result of the initial fixed costs, entry of firms occurs until the profits of entrants cover the initial setup costs, breaking the free entry assumption that holds under perfect competition and generating a social welfare loss. Theoretical and empirical evidence suggests that, if the size of the market (demand) is low relative to the setup costs, so that the scale economies generated by the fixed costs are significant, then concentration will be high. On the contrary, as market size expands relative to initial costs, economies of scale will reduce, and concentration decrease (Sutton 1991). Scherer (1996) explains that the

[21] Subadditivity means that the cost function for a single-product firm is characterized by declining average total costs over the relevant range of industry output such that it is less costly to supply the output with a single firm rather than split it among two companies or competing firms (Joskow, 2007). Cost subadditivity implies that the cost of a combined business operation is less than the sum of the cost of two separate businesses (Anand and Kim 2018).

[22] Although for an efficient and optimal result, even an SOE might require additional regulation and enforcement to avoid potential abuse of dominance.

petroleum refining industry is characterized by economies of scale to a degree determined by a country's market size and leading to concentration. Baumol, Panzar, and Willig (1982) explain that, even under scenarios in which technology may imply the presence of a single-player market (such as the airline industry), entry and exit of firms can result in a more competitive structure and less market concentration relative to a monopoly (for example, an oligopolistic structure). However, the resulting oligopolistic market structure may still lead to inefficient outcomes, such as persistent overcharges or excess capacity. In such circumstances, direct participation in markets through SOEs can be a means to control the market power of other suppliers.[23]

ii. **Under-provision in the presence of positive externalities**[24] **or uncertainty**: Some economic sectors produce goods or services that generate positive externalities to other sectors and/or economic actors. A profit-maximizing agent will underinvest in those goods and services, as this agent will not internalize the additional welfare benefit associated with the production of its good. As explained by Sorrentino (2020), in such instances, direct state participation can often be proposed as a solution to address the risk of under-provision. In addition, Putniņš (2015) posits that state participation is the most appropriate government intervention when it is difficult to correct the positive externality with subsidies or difficult to measure the quality or quantity of a good, making government-funded private sector contracting inefficient. Examples of activities associated with positive externalities are research and development, disease and pest control, firefighting, or security services. In agriculture, for instance, empirical evidence shows that there are considerable externalities from reducing and controlling pests (Grogan and Goodhue 2012; Carlson 1989). Similarly, sectors characterized by information frictions and uncertainty can be affected by under-provision due to externalities. In the case of mining, for instance, uncertainty about deposits may lead to suboptimal investment and trade decisions over time. There are also goods and services sold in a market that have positive externalities linked to public goods. By definition, pure public goods are not sold in a market; since they are non-excludable and non-rivalrous, buyers would not be willing to pay for them. Military equipment can be sold, but its production is linked to the public good of national security. Fire-fighting services can be sold but the positive externalities are linked to the public good of non-rivalrous and non-excludable fire protection. However, not all positive externalities are linked to public goods nor motivate SOE participation (e.g., positive externalities of construction/renovation of a specific building increase the value of adjacent buildings; pharmaceutical companies may save lives but do not obtain the full economic benefit of their product).

iii. **Risks connected to large/irreversible negative externalities**: While economic activities should be regulated to control for negative externalities (such as pollution), there are cases in which the corrective taxes are not sufficient to repristinate economic efficiency.[25] Using a tax system to correct a negative externality is conditioned on the fact that the government can precisely estimate the magnitude of such a tax (Putniņš, 2015). This is a more difficult exercise when the negative externality can be catastrophic. As explained by Sorrentino (2020), one of the responsibilities of SOEs is to control potentially harmful externalities in industries like uranium processing and nuclear energy generation. Hence, the rationale for

[23] At the same time, there is no economic justification for granting this SOE the exclusive right to provide the good or service.

[24] As a market failure, the positive externalities account to an important extent for the under-provision of public goods. As the latter are non-rival and non-excludable, they are by definition associated with benefits that are not priced by the market for that particular good and service.

[25] Other mechanisms to mitigate negative externalities include subsidies (e.g., to farmers to avoid polluting practices), quota (permit) systems, and performance standards, among others.

government intervention through direct provision in cases where large negative externalities exist stems from the fact that a non-profit-maximizing agent such as an SOE may be better placed to minimize the risks stemming from these harmful externalities than a private economic agent, which might undertake higher risks to pursue profits without internalizing the negative consequences of those risks.

IV. Classification of Disaggregated Economic Activities

This taxonomy uses an internationally recognized classification scheme to categorize disaggregated economic activities into the three categories described above (natural monopoly, partially contestable, or competitive). Since the objective of the proposed taxonomy is to allow for an exhaustive, granular classification and thus support cross-country comparisons, the taxonomy leverages the NACE Revision 2, an internationally validated classification of economic activities. For the purposes of this paper, we refer to the NACE sections as "industries," to the divisions as "sectors," and to the classes as "disaggregated sectors."

Of the 615 disaggregated sectors at the four-digit level, 52 activities are excluded from the taxonomy (Table 1). Some industries are excluded altogether (such as Public Administration and Defense, Education, Human Health and Social Work, Activities of Households as Employers, and Activities of Extraterritorial Organizations). In addition, some disaggregated sectors in Finance and Insurance (2 activities), Arts, Entertainment, and Recreation (8 activities), and Other Services (6 activities) are not considered. Some of these sectors either provide public goods of strategic interest that cannot be sold commercially (Public Sector, Defense, and International Organizations), or the entities that provide these services are either not capable of generating profits or their purpose is not market production (Other Services). The rationale for their exclusion is that the entities providing such goods and services do not satisfy the definition of an SOE adopted by the paper. For industries in Health and Education, and some disaggregated sectors under Arts, Entertainment and Recreation, the operating models differ so much across countries that cross-country comparisons are of little use and risk distorting those cross-country comparisons, as for example one could end up contrasting a "public good" approach for some countries, in which services are provided at zero or symbolic costs, with a "private," profit-maximizing modality.[26] This is in line with recent work on SOEs (Szarzec, Dombi, and Matuszak, 2021), in which the education, health and public administration are excluded from the analysis of the effect of SOEs on economic growth, on the premise that companies in these sectors cannot always be privatized.

Table 1. NACE Revision 2 –Aggregate Industry Classification

Code	Aggregate Industry	No. of Disaggregated Sectors	No. of Disaggregated Sectors Included	Rationale for Sector Exclusion
A	Agriculture, Forestry, and Fishing	39	39	
B	Mining and Quarrying	15	15	
C	Manufacturing	230	230	
D	Electricity, Gas, Steam, and Air Conditioning	8	8	
E	Water Supply and Sewerage	9	9	
F	Construction	22	22	
G	Wholesale and Retail Trade	91	91	
H	Transportation and Storage	23	23	

[26] For example, health provision in Europe versus the United States.

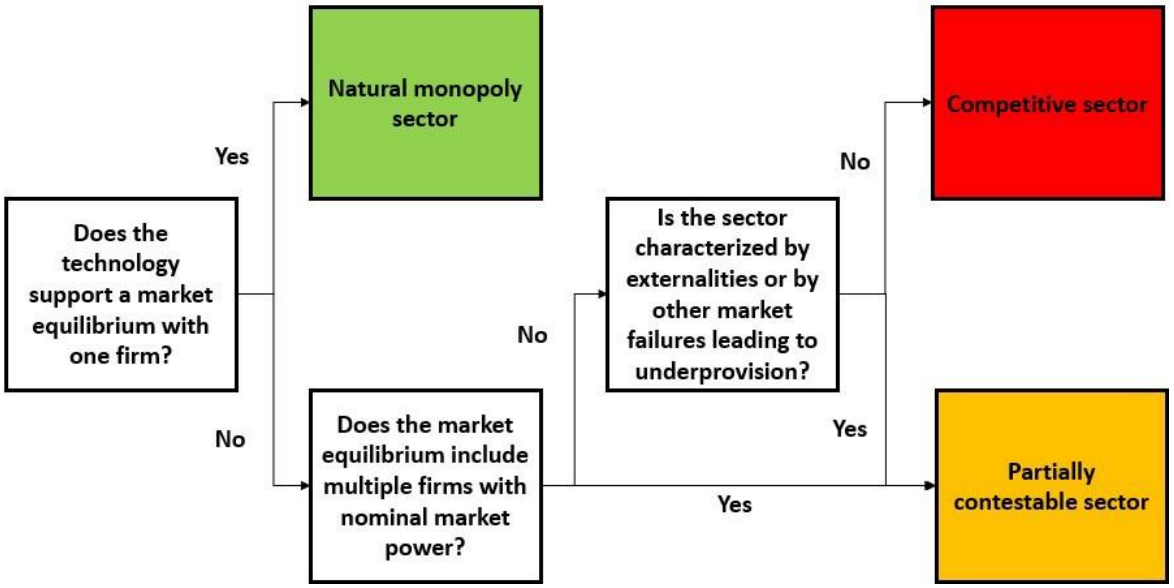
I	Accommodation and Food Services	8	8	
J	Information and Communication	26	26	
K	Financial and Insurance Activities*	18	16	*Pension funding (6530) is excluded on the basis that it involves principally (voluntary) employer pension plans, activities proximate to compulsory social security activities. Central Banking (6411) is also excluded.*
L	Real Estate Activities	4	4	
M	Professional, Scientific, and Technical Activities	19	19	
N	Administrative and Support Services	33	33	
O	Public Administration and Defense	9	0	*Excluded because it involves the provision of public goods. Defense is also deemed to be of critical strategic interest.*
P	Education	11	0	*Excluded because it generally involves the provision of public goods and characterized by positive externalities. Activities in this area are deemed to concern developmental or national public interests.*
Q	Human Health and Social Work Activities	12	0	*Excluded because it involves the provision of public goods and is characterized by positive externalities. As such, it is typically deemed to be of critical national interest across countries, meriting state ownership.*
R	Arts, Entertainment & Recreation*	15	7	*Some disaggregated sectors within this code are excluded due to their not-for-profit nature, such as activities performed by libraries and museums.*
S	Other Services*	19	13	*Disaggregated sectors excluded from the analysis include activities performed by entities that do not provide services for profit and/or their purpose is not market production.*
T	Activities of Households as Employers	3	0	*Excluded because it involves activities that are not priced by markets.*
U	Activities of Extraterritorial Organizations	1	0	*Excluded because it involves the provision of public goods.*

Source: Authors' elaboration based on NACE Rev. 2 Industry Classification.

To classify the remaining 563 disaggregated sectors of the NACE Rev. 2 classification into the three categories described in section II, the proposed taxonomy deploys a decision tree. The decision tree includes three nodes (Figure 2). The first node identifies the natural monopolies by assessing whether or not the production function supports a market-efficient equilibrium with just one firm. Sectors in which higher efficiency is attained with just one firm are classified under the natural monopolies category (green). The second node of the decision tree assesses whether, even in the absence of a natural monopoly, structural barriers to competition exist that could result in market power. Wherever an oligopolistic market structure is identified, those sectors are classified under the partially contestable group (yellow). Finally, all sectors that are not placed in the partially contestable category based on market power considerations are assessed in the third node to determine whether they are characterized by positive externalities or other market failures that may result in under-provision or generate negative externalities on the rest of the economy. If this process identifies positive externalities that lead to under-provision, large negative externalities that cannot be corrected by a Pigouvian tax,[27] or other market failures, such as information frictions, the sectors are also included in the partially contestable category. All remaining activities for which no market failure can be identified are classified under the competitive category (red).

[27] A Pigouvian tax is defined as a tax to correct inefficiencies of the price system that are due to negative external effects (Sandmo, 2008).

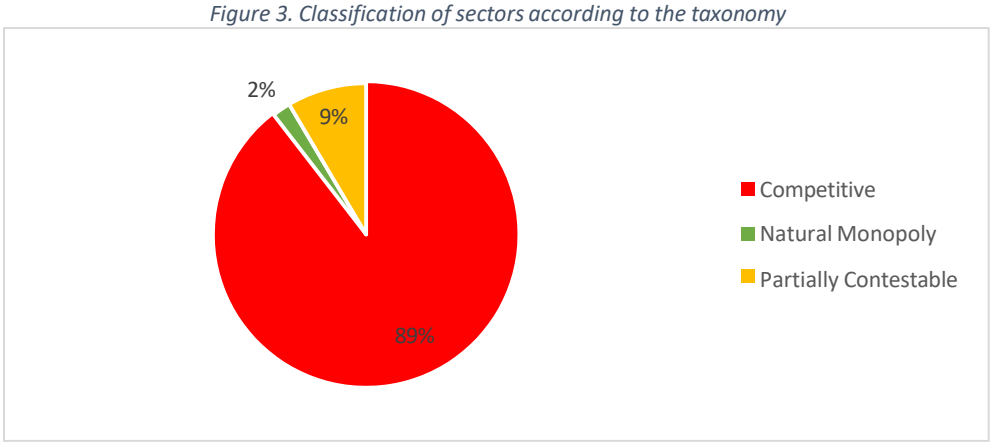
Figure 2. A taxonomy of sectors based on degree of market failure



Source: Authors' elaboration

Drawing on the economic literature and using the decision tree, the analysis classifies 11 disaggregated sectors as natural monopolies, 45 as partially contestable, and the remaining 505 as competitive (Figure 3). The taxonomy determines that all four-digit-level sectors within Wholesale and Retail Trade, Accommodation and Food Services, Real Estate Activities, Administrative and Support Services, and Other Services are competitive sectors. In the remaining aggregate (one-level) sector groups, both partially contestable and natural monopoly sectors are present at the four-digit level.

Figure 3. Classification of sectors according to the taxonomy



Source: authors' elaboration using NACE rev. 2 (4 digits) and proposed taxonomy

The level of granularity offered by the NACE four-digit level classification is necessary to appreciate nuanced differences among disaggregated economic sectors/markets within the broader umbrella of an

economic sector—differences that could have important policy implications.[28] For example, while the aggregate manufacturing sector is competitive in principle (as confirmed by the fact that 217 out of 230 activities fall into the competitive sector category according to the proposed taxonomy), 13 disaggregated economic sectors within manufacturing fall under the partially contestable category, including the manufacture of fiber cement (which has high costs that serve as barriers to entry) or the manufacture of explosives (which poses potential negative externalities). Similarly, within the aggregate electricity, gas, steam, and air conditioning supply sector, three activities are natural monopolies (such as the distribution of electricity), four are partially contestable (such as the production of electricity), and one is competitive (steam and air conditioning supply).

In some network industries, SOE often operate in multiple disaggregated sectors and restructuring reforms should first target the vertical and horizontal unbundling of incumbent state-owned monopolies.[29] Network industries such as telecommunications, railroads, electricity, and transportation are characterized by returns to scale in production, increasing returns to scale in consumption (network effects), and a high degree of complementarity between the different nodes and links in the production chain, which implies that to be delivered, services need to make use of multiple—if not all—network links (Economides 2004). Historically, SOE have been operating in those sectors by providing goods and services in multiple disaggregate sectors. In such cases, reforms aimed at improving economic efficiency and attracting private sector investment in network industries often entail the separation of the distinct nodes in the production chain (Foster et al. 2017). In the electricity sector, for instance, vertical unbundling involves allocating electricity generation, transmission, and distribution activities to different entities, while horizontal unbundling introduces competition by creating multiple entities that may have responsibility for providing the same services (USAID 2022).[30] At a disaggregated level, the sectors conforming to network industries often exhibit market power, including across complementary markets (Economides 2004), and for this reason, they are mostly classified as partially contestable and/or natural monopolies in this taxonomy. Table 2 presents a list of network industries and their corresponding disaggregated sectors (grouped under a bold margin), which roughly correspond to vertically unbundled activities, except for telecommunications and service and support activities for transportation, where the NACE classification does not align with the modalities of unbundling. For example, in the telecommunications industry, unbundling requires the incumbent to allow entrants to lease certain individual building blocks that make up a telecommunications network, with considerably less sunk investment in some or all components of a competing network (Blackman, Colin; Srivastava, Lara, 2011). In the rail transportation industry, unbundling requires the separation between train service and train infrastructure provision.

[28] According to the European Commission (2008), the four-digit-level classification was developed so that two conditions would be fulfilled whenever possible: (1) the production of the category of goods and services that characterizes a given class accounts for the bulk of the output of the units classified according to that class; and (2) the class contains the units that produce most of the category of goods and services that characterize it. In other words, at this level, the NACE categorization is relevant for the detailed industrial classification of economic units, and all economic units falling within each four-digit code will be similar with respect to the activities they perform.

[29] In some cases, SOEs can operate in multiple sectors that are not bundled. The benefit of this taxonomy is to provide a clear tool to classify the activity where the SOE is operating rather than the company itself. To apply the taxonomy classification for an SOE with multiple sectors, one option for policy makers would be to identify the branches of the company that carry out the different economic activities and apply the classification to its branches.

[30] These segments can also fall under different sector types as per the taxonomy: electricity production could be served by several market players but is partially contestable while some segments such as transmission correspond to a natural monopoly.

*Table 2. **List of network sectors with potentially unbundled disaggregated sectors***

Sector codes			Taxonomy classification
ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY (D)			
Electricity, gas, steam and air conditioning supply (35)	Production of electricity	3511	Partially Contestable
	Transmission of electricity	3512	Natural Monopoly
	Distribution of electricity	3513	Natural Monopoly
	Trade of electricity	3514	Competitive
	Manufacture of gas	3521	Competitive
	Distribution of gaseous fuels through mains	3522	Natural Monopoly
	Trade of gas through mains	3523	Competitive
TRANSPORTATION AND STORAGE (H)			
Land transport and transport via pipelines (49)	Passenger rail transport, interurban	4910	Partially Contestable
	Freight rail transport	4920	Partially Contestable
Warehousing and support activities for transportation (52)	Service activities incidental to land transportation	5221	Natural Monopoly
	Cargo handling	5224	Competitive
	Other transportation support activities	5229	Competitive
Postal and courier activities (53)	Postal activities under universal service obligation	5310	Natural Monopoly
	Other postal and courier activities	5320	Competitive
INFORMATION AND COMMUNICATION (J)			
Telecommunications (61)	Wired telecommunications activities	6110	Natural Monopoly
	Wireless telecommunications activities	6120	Partially Contestable
	Satellite telecommunications activities	6130	Partially Contestable
	Other telecommunications activities	6190	Competitive

Source: Authors' elaboration.

The following subsections present the classification of the 563 disaggregate economic activities and the rationale used for the classification, based on the decision tree of Figure 2, for. For exposition, the classification of disaggregated activities is presented separately by aggregate economic sector.

A. Agriculture, Forestry, and Fishing Industry (A)

The agriculture, forestry, and fishing industry encompasses 39 disaggregated sectors at the four-digit level. The sectors included within this category are related to the planting and growing of crops, the raising of cattle and other animals, activities supporting animal and crop production and seed propagation, silviculture, logging, and other forestry activities.

The majority of the disaggregated sectors (36) are classified as competitive, while the remaining ones (3) are partially contestable (Table 3). As expected, the agricultural sector is broadly competitive: none of the disaggregated sectors are characterized by market features that would influence market structure and lead to a natural monopoly. Three disaggregated sectors, however, are strongly associated with positive externalities and can lead to classifying the sectors as partially contestable (Table 3). This is confirmed by the literature (Grogan and Goodhue 2012; Carlson 1989), which finds empirical evidence that considerable externalities are associated with crop and silviculture activities to reduce and control pests

or other risks, such as fire (support activities for crop production, 161; silviculture and other forestry activities, 210; and support services for forestry, 240). The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.1.

Table 3. SOE taxonomy in agriculture, forestry, and fishing

Agriculture, Forestry, and Fishing Industry (A) *Distribution of disaggregated sectors by category*		
Competitive	**Natural Monopoly**	**Partially Contestable**
36	0	3
92%	0%	8%

Source: Authors' elaboration

Table 4. Non-competitive disaggregated sectors in agriculture, forestry, and fishing

Agriculture, Forestry, and Fishing (A)			Partially contestable		
NACE Code Classification			Market power	(+) externalities	(-) externalities
Sector	Disaggregated sector	Code			
(1) Crop and animal production, hunting and related service activities	Support activities for crop production	161		X	
(2) Forestry and logging	Silviculture and other forestry activities	210		X	
	Support services to forestry	240		X	

Source: Authors' elaboration

B. Mining and Quarrying Industry (B)

The mining and quarrying industry covers all activities pertaining to the search for, and extraction and processing of, natural resources. The industry includes 15 disaggregated sectors that carry out the various steps needed to exploit natural resources, including coal, petroleum, natural gas, iron, uranium, and other metals and minerals. In NACE, activities related to the extraction and basic processing of crude materials (0510-0899) are separated from activities linked to mining support services such as exploration (0910-0990).

Contestability in mining sectors is limited by the scarcity and concentration of deposits. The geographic concentration of coal, petroleum, natural gas, iron, uranium, and other metals and minerals, and the high costs of extraction, leads to sunk costs and indivisibility of production. These factors naturally limit contestability in mining sectors. They are exacerbated by extreme scarcity of known deposits, for instance in the case of uranium or lithium (Rumble, 2018), and/or relatively high transport costs, for instance in the case of natural gas which is generally transported through pipelines (Mulder, 2006). This distinguishes the economics of mining from many quarrying activities or other extraction (e.g., salt, peat) wherein the natural resource is more abundant and dispersed.

Information frictions and related externalities can also exacerbate market functioning in mining. Information on mining and quarrying deposits is valuable as it allows market participants in upstream and downstream sectors to price natural resources accurately. Conversely, imperfect information on deposits can lead to suboptimal investments/trades over time. At the same time, obtaining information on reserves is costly as it requires significant investments into exploration. The market may not price information externalities accurately and provide less information than is optimal from a welfare perspective. This market failure justifies government involvement in the provision of information on reserves, either

directly (e.g., through the provision of geological surveys) or indirectly (e.g., through the allocation of property rights).

As a result of these economic features, out of the 15 disaggregated mining and quarrying sectors, 10 are classified as partially contestable (Table 5). Of the 10 contestable sectors, eight are deemed to be partially contestable due to sunk costs: mining of hard coal (510), mining of lignite (520), extraction of crude petroleum (610), extraction of natural gas (620), mining of iron ores (710), mining of uranium and thorium ores (721), mining of other non-ferrous metal ores (729), and mining of chemical and fertilizer minerals (891) (Table 6). Mining of uranium and thorium ores is also associated with negative externalities (Sorrentino 2020). The two remaining partially contestable sectors do not appear to have high entry barriers, but they are associated with possible market inefficiencies due to uncertainty; these include support activities for petroleum and natural gas extraction (910) and support activities for other mining and quarrying (990).

Five disaggregated sectors are considered competitive (Table 5). These sectors are quarrying of ornamental and building stone, limestone, gypsum, chalk, and slate (811), operation of gravel and sand pits and mining of clays and kaolin (812), extraction of peat (892), extraction of salt (893), and other mining and quarrying (899), which includes the mining and quarrying of different materials. The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.2.

*Table 5. **SOE taxonomy in mining and quarrying***

Mining and Quarrying Industry (B) *Distribution of disaggregated sectors by category*		
Competitive	**Natural Monopoly**	**Partially Contestable**
5	0	10
33%	0%	67%

Source: Authors' elaboration

*Table 6. **Non-competitive disaggregated sectors in mining and quarrying***

Mining and Quarrying (B)			**Partially contestable**		
NACE Code Classification			**Market power**	**(+) externalities***	**(-) externalities**
Sector	**Disaggregated sector**	**Code**			
(5) Mining of coal and lignite	Mining of hard coal	510	X		
	Mining of lignite	520	X		
(6) Extraction of crude petroleum and natural gas	Extraction of crude petroleum	610	X		
	Extraction of natural gas	620	X		
(7) Mining of metal ores	Mining of iron ores	710	X		
	Mining of uranium and thorium ores	721	X		X
	Mining of other non-ferrous metal ores	729	X		
(8) Other mining and quarrying	Mining of chemical and fertilizer minerals	891	X		
(9) Mining support service activities	Support activities for petroleum and natural gas extraction	910		X*	
	Support activities for other mining and quarrying	990		X*	

Note: *Other market failures include information frictions that may lead to under-provision.
Source: Authors' elaboration

C. Manufacturing (C)

Manufacturing includes the largest share of disaggregated sectors, as it generates vertical and horizontal linkages with almost all other industries. A wide range of disaggregated sectors are covered under manufacturing, including the manufacture of food, beverages, tobacco, textiles and apparel, wood, paper, and leather products; the production of chemicals, rubber, plastic, metal, and non-metal products; and the manufacture of electrical equipment, electronics and machinery, motor vehicles, and other transportation, among others.

A large majority of manufacturing activities can be considered competitive. As expected, more than 90 percent of the disaggregated sectors in manufacturing (220 out of 230) can be considered competitive (Table 7), with little economic rationale for government provision. Furthermore, the tradeable nature of manufactured goods facilitates greater competition and technology diffusion among firms, which partly explains the industry's historically important role in export-led growth dynamics (Nayyar, Hallward-Driemeier, and Davies, 2021). The sectors categorized as competitive do not produce public goods and entry barriers in these sectors appear to be limited.

In the manufacturing industry, 7 disaggregated sectors are considered partially contestable (Table 7). Sectors in manufacturing are deemed partially contestable either because: (i) the sector exhibits high entry barriers, and thus associated market power (three sectors); or (ii) the sector relates to negative externalities (four sectors, one of which also exhibits high barriers to entry).

Some sectors in manufacturing exhibit externalities and market power as a result of high fixed costs. For example, the cement industry is characterized by technological features such as limited product tradability, large scale economies relative to market size, limited access to inputs, and demand-side features such as demand density (Beirne and Kirchberger 2021; UK Competition and Markets Authority 2014; World Bank 2016; Syverson 2004). Similarly, the production of refined oil and gas products exhibits barriers to entry that lead to market power. Scherer (1996) finds that the petroleum refining industry is characterized by economies of scale that may lead to concentration, depending on the country's market size. In addition, Hastings and Gilbert (2005) find that vertical integration in refining activities (classified under manufacturing) is a source of market power. Sectors with high barriers to entry include manufacture of coke oven products (1910), manufacture of refined petroleum products (1920), and manufacture of fiber cement (2365).

Some manufacturing sectors are also subject to externalities. For example, the production of weapons can be associated with harmful externalities, including crime and fatalities (Efrat 2010; Metcalf 2018). These externalities do not necessarily imply the need to exert control over their production and commercialization through SOEs, as other potential avenues may be available, such as regulation. Sectors identified as posing negative externalities include manufacture of explosives (2051), processing of nuclear fuel (2446), manufacture of weapons and ammunition (2540), and manufacture of military fighting vehicles (3040). The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.3.

*Table 7. **SOE taxonomy in manufacturing***

Manufacturing (C)		
Distribution of disaggregated sectors by category		
Competitive	**Natural Monopoly**	**Partially Contestable**
223	0	7
97%	0%	3%

Source: Authors' elaboration

*Table 8. **Non-competitive disaggregated sectors in manufacturing***

Manufacturing (C)			Partially contestable		
NACE Code Classification			Market power	(+) externalities	(-) externalities
Sector	Disaggregated sector	Code			
(19) Manufacture of coke and refined petroleum products	Manufacture of coke oven products	1910	X		
	Manufacture of refined petroleum products	1920	X		
(20) Manufacture of chemicals and chemical products	Manufacture of explosives	2051			X
(23) Manufacture of other non-metallic mineral products	Manufacture of fiber cement	2365	X		
(24) Manufacture of basic metals	Processing of nuclear fuel	2446			X
(25) Manufacture of fabricated metal products, except machinery and equipment	Manufacture of weapons and ammunition	2540			X
(30) Manufacture of other transport equipment	Manufacture of military fighting vehicles	3040			X

Source: Authors' elaboration

D. Electricity, Gas, Steam, and Air Conditioning Supply (D)

This industry includes disaggregated sectors related to the production, transmission, distribution, and trade of electricity and gas, as well as the supply of steam and air conditioning. In addition to increasing returns to scale, network industries—such as electricity and gas, telecommunications, and certain transportation and financial services—exhibit a high degree of complementarity among the different activities involved in the delivery of the service (Economides 2006). For this reason, many countries enforce the "unbundling" of these complementary services through regulation, to ensure the separation of generation, transmission, and distribution activities, some of which are more amenable to competition than others.

Of the eight industries in electricity, gas, steam, and air conditioning supply, three are natural monopolies (Table 9) and one is partially contestable (Table 10). The natural monopoly sectors involve the transmission of electricity (3512), the distribution of electricity (3513), and the distribution of gaseous fuels through mains (3522). These sectors exhibit economies of scale and subadditivity cost structures, such that the most efficient provision can be attained by a monopoly at the local level. The partially contestable sectors are associated with high entry barriers is the production of electricity (3511). The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.4.

While, traditionally, electricity, gas, and steam provision have been considered to be natural monopoly industries, recent technological developments and economic analysis have highlighted variations in these disaggregated industries. Taken as a whole, electricity provision has technological and cost structure characteristics that can lead to a natural monopoly. Its cost structure has promoted government involvement in many countries, including the United States. Over time, the unbundling of the various activities associated with electricity provision (generation, transmission, and distribution) has resulted in the entry of several market players, although high entry costs and economies of scale often result in market power and thus partial contestability. For example, electricity production relies on generating units that are large in size, such as hydroelectric dams, and sometimes rely on costly energy sources, such as nuclear energy, which act as barriers to entry. Empirical studies support the existence of scale

economies in electricity generation (Akkemik 2009; Rungsuriyawiboon and Stefanou 2007; Hiebert 2002; Kleit and Terrell 2001; Maloney 2001; Considine 2000). Similarly, the technological characteristics of transmission and distribution of electricity to final consumers, through grids that cover long distances and a large network of transmission lines, suggest that it is more efficient for there to be few market players (Kopsakangas-Savolainen and Svento 2008; Kwoka 2005; Yatchew 2000; Burns and Weyman-Jones 1996).

Electricity utilities in several countries are still vertically and horizontally integrated. Typically, network sector reforms aimed at unbundling start with the *corporatization* of government authorities, or the establishment of separate SOEs in charge of different stages of the service delivery chain (USAID 2022). In many countries, SOEs have gone through full or partial privatization, with the goal of improving service delivery and access, company management, and commercial performance (USAID 2022).

*Table 9. **SOE taxonomy in electricity, gas, steam, and air conditioning supply***

Electricity, Gas, Steam, and Air Conditioning Supply (D) *Distribution of disaggregated sectors by category*		
Competitive	**Natural Monopoly**	**Partially Contestable**
4	3	1
50%	38%	12%

Source: Authors' elaboration

*Table 10. **Non-competitive disaggregated sectors in electricity, gas, steam, and air conditioning***

Electricity, Gas, Steam, and Air Conditioning Supply (D)			**Partially contestable**			**Natural monopoly**
NACE Code Classification			**Market power**	**(+) externalities**	**(-) externalities**	
Sector	**Disaggregated sector**	**Code**				
(35) Electricity, gas, steam, and air conditioning supply	Production of electricity	3511	X			
	Transmission of electricity	3512				X
	Distribution of electricity	3513				X
	Distribution of gaseous fuels through mains	3522				X

Source: Authors' elaboration

E. Water Supply, Sewerage, Waste Management, and Remediation Activities (E)

This industry encompasses water collection, treatment, and supply; sewerage; collection, management, and treatment of waste; and dismantling, recovering, and remediation activities. Of the nine sectors in the water supply, sewerage, waste management, and remediation industry, two are categorized as natural monopolies, four are competitive, and three are partially contestable (Table 11 and Table 12). Activities related to water collection, treatment, and supply (3600) and sewerage (3700) exhibit high fixed costs, economies of scale, and subadditivity of costs similar to electricity transmission. In this case, the most cost-efficient provision is achieved by a single operator in the relevant market.

The three sectors classified as partially contestable are the collection (3812), treatment and disposal (3822) of hazardous waste, as well as the treatment of non-hazardous waste (3821). These services may be underprovided in the absence of direct government provision. Some water supply and sewerage activities are characterized by large, fixed costs as well as positive and negative externalities. For example,

water supply is characterized by large capital investments in infrastructure, such as wells, pumps, and storage facilities, which generate market power (Fabri and Fraquelli 2000). Empirical evidence shows economies of scale in water supply across countries (Romano and Guerrini et al. 2011, 2018; Carvalho and Marques 2014; Nauges and van den Berg 2007; Shih et al. 2006). In addition, some sewerage and waste management activities are associated with positive externalities, as they control the spread of diseases and pests, including diarrheal incidence, a leading cause of mortality among children in developing countries (Kresch et al. 2020; Fewtrell et al. 2005; ; Wolf et al. 2014; Prüss-Ustün et al. 2019; Motohashi, 2022), but could also lead to negative externalities in case the private sector were to underinvest and possible pollution were to be created, with potentially to create permanent damage to soil, air and water (Grimm & Mbavarira, 2021). The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.5.

*Table 11. **SOE taxonomy in water supply and sewerage***

Water Supply, Sewerage, Waste Management, and Remediation Activities (E) *Distribution of disaggregated sectors by category*		
Competitive	**Natural Monopoly**	**Partially Contestable**
4	2	3
44%	22%	33%

Source: Authors' elaboration

*Table 12. **Non-competitive disaggregated sectors in water supply, sewerage, waste management, and remediation activities***

Water Supply, Sewerage, Waste Management, and Remediation Activities (E)			**Partially contestable**			**Natural Monopoly**
NACE Code Classification			**Market power**	**(+) externalities**	**(-) externalities**	
Sector	**Disaggregated sector**	**Code**				
(36) Water collection, treatment and supply	Water collection, treatment and supply	3600				X
(37) Sewerage	Sewerage	3700		X	X	X
(38) Waste collection, treatment and disposal activities; materials recovery	Collection of hazardous waste	3812		X	X	
	Treatment and disposal of non-hazardous waste	3821		X	X	
	Treatment and disposal of hazardous waste	3822		X	X	

Source: Authors' elaboration

F. Construction (F)

The construction industry encompasses all kinds of construction and development projects, including residential and infrastructure projects, as well as site preparation and demolition, and all other activities related to construction, such as plastering, roofing, wall painting, and so on. Of the 22 sectors in the construction industry, all are classified as competitive (Table 13), as it is economically viable for several providers to operate and barriers to entry are generally low. At the same time the number of operators capable to carry out large construction projects, such as roads and motorways, is limited (De Valance 2011). Yet, evidence collected by the World Bank (Iimi and Benamghar 2012) suggests that even large road contracts attract multiple bidders. In Nepal, for instance, an average of six bidders participated in public procurement related to the construction of roads. Since the government is a major buyer of

construction services, it can also be proactive in promoting contestability, while bearing in mind the need for efficient scale. The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.6.

*Table 13. **SOE taxonomy in construction***

Construction (F)		
Distribution of disaggregated sectors by category		
Competitive	**Natural Monopoly**	**Partially Contestable**
22	0	0
100%	0%	0%

Source: Authors' elaboration

G. Wholesale and Retail Trade and Repair of Motor Vehicles and Motorcycles (G)

This industry includes all types of sectors involved in the sale of goods, from wholesale to retail sale via stalls and markets, agents, and others. All 91 disaggregated sectors in this industry are categorized as competitive because none of them exhibit entry barriers relating to cost structure and they do not involve externalities or other market failures (Table 14). The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.7.

*Table 14. **SOE taxonomy in wholesale and retail trade and repair of motor vehicles and motorcycles***

Wholesale and Retail Trade and Repair of Motor Vehicles and Motorcycles (G)		
Distribution of disaggregated sectors by category		
Competitive	Natural Monopoly	Partially Contestable
91	0	0
100%	0%	0%

Source: Authors' elaboration

H. Transportation and Storage (H)

The transportation and storage industry encompasses land transportation (including pipelines), water and air transport, warehousing, and other transport support activities such as cargo handling, and postal and courier services. Certain economic activities within the transportation sectors portray high entry barriers associated with large, fixed investments and economies of scale. Furthermore, the technological characteristics of some transport activities can lead to some degree of market power. For example, the economies of scale and network features of post office activities under universal service obligation imply that efficiency is attained by having one producer (Filippini and Koller 2012; Filippini et al. 2010; Bradley et al. 2006; Farsi et al. 2006; Filippini and Zola 2005; Mizutani and Uranishi 2003; Cazals et al. 2002; Gazzei et al. 2002; Wada, Tsunoda, and Nemoto 1997; and Norsworthy et al. 1991). Similarly, evidence of significant economies of scale has been found for airports, providing a rationale for their operation as local natural monopolies (Fuerst and Gross 2018; Martin and Voltes-Dorta 2010; Main et al. 2003; Rendeiro 2002; Tolofari et al. 1990). Other transport activities, such as air, land, and water transport of passengers and freight, are subject to barriers that deter entry to an extent, but do not eliminate competition among a few players.[31] For example, seminal work by Baumol, Panzar, and Willig (1982) shows that, even under scenarios in which technology may imply the presence of a single player market,

[31] Pitt and Norsworthy (1999) document high fixed costs for airline transport. Caves et al. (1981) find economies of scale for railroad transport.

like the airline industry, entry and exit of firms can result in a more competitive structure and less market concentration relative to a monopoly. Transport industries, therefore, can be characterized by an oligopolistic structure.

The transportation and storage industry is composed of 23 activity sectors, of which five are categorized as natural monopolies, six as partially contestable, and 12 as competitive (Table 15 and Table 16). The natural monopolies exhibit significant economies of scale and are characterized by high fixed costs, which make it more efficient for one firm to supply these services relative to many competitors: transport via pipelines (4950); service activities incidental to land (5221), water (5222), and air transportation (5223); and postal and courier activities (5310). The sectors that are categorized as partially contestable have high entry barriers relating to cost structure and network economies: passenger rail transport, interurban (4910); freight rail transport (4920); urban and suburban passenger land transport (4931); passenger air transport (5110); freight air transport (5121); space transport (5122); Similar to the Electricity and Gas industries, some activities (e.g., courier services 5320) are marked as competitive even though contestability may be limited due to the bundling of services-based and infrastructure based activities. This is so because these activities do not have characteristics that inherently constrain contestability and unbundling reforms have opened the sector to competition. The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.8.

*Table 15. **SOE taxonomy in transportation and storage***

Transportation and Storage (H) *Distribution of disaggregated sectors by category*		
Competitive	Natural Monopoly	Partially Contestable
12	5	6
52%	22%	26%

Source: Authors' elaboration

*Table 16. **Non-competitive disaggregated sectors in transportation and storage***

Transportation and Storage (H)			**Partially contestable**			**Natural monopoly**
NACE Code Classification			**Market power**	**(+) externalities**	**(-) externalities**	
Sector	**Disaggregated sector**	**Code**				
(49) Land transport and transport via pipelines	Passenger rail transport, interurban	4910	X	X		
	Freight rail transport	4920	X			
	Urban and suburban passenger land transport	4931	X	X		
	Transport via pipeline	4950				X
(51) Air transport	Passenger air transport	5110	X			
	Freight air transport	5121	X			
	Space transport	5122	X			
(52) Warehousing and support activities for transportation	Service activities incidental to land transportation	5221				X
	Service activities incidental to water transportation	5222				X
	Service activities incidental to air transportation	5223				X
(53) Postal and courier activities	Postal activities under universal service obligation	5310				X

Source: Authors' elaboration

I. Accommodation and Food Services (I)

Accommodation and food and beverage service activities include those provided by hotels, short-stay accommodations, and other types of accommodations, as well as restaurant and catering services. All eight disaggregated sectors in this industry are categorized as competitive because none of them exhibit entry barriers relating to cost structure and they do not involve externalities or other market failures (Table 17). The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.9.

*Table 17. **SOE taxonomy in accommodation and food services***

Accommodation and Food Services (I) *Distribution of disaggregated sectors by category*		
Competitive	**Natural Monopoly**	**Partially Contestable**
8	0	0
100%	0%	0%

Source: Authors' elaboration

J. Information and Communication (J)

The information and communication industry includes a wide range of economic activities, including publishing; motion video and music recording and production; satellite, wired, and wireless telecommunications; computer programming, facilities, and consultancy services; and data processing and other information service activities, such as those provided by news agencies and web portals. Some sectors in telecommunications are associated with high entry costs, resulting in market power as well as positive externalities. As explained by Laffont and Tirole (1993), the telecommunications services sector has evolved in recent decades, from a highly regulated domain of a "secure monopolist" (public or private) due to "large fixed costs in several parts of the network, whose duplication was neither privately profitable nor socially desirable," to a sector rendered more competitive by unbundling, privatization, and deregulation.[32] However, wired, wireless, and satellite telecommunications activities continue to have technological and network structures that limit market participation (Sridhar 2011; Noam 2010). Similarly, some telecommunications activities are associated with positive externalities, for example broadband access and firm-level productivity growth (Varian et al. 2002; Franklin et al. 2009), consumer welfare (Dutz et al. 2009; Greenstein and McDevitt 2011), and regional development (Jung and Lopez-Bazo 2020). Telecommunications infrastructure and mobile telephony have also been found to have impacts on economic growth more generally (Röller and Waverman 2001; Chavula 2013; Koutroumpis 2019).

The information and communication industry includes 26 sectors at the four-digit level, of which one is a natural monopoly, four are partially contestable, and 21 are competitive (Table 18 and Table 19). Wired telecommunication activities (6110) have market conditions characterized by high fixed costs, network economies, economies of scale, and subadditivity cost structures, which lead to the sector's classification as a natural monopoly, as provision of these services is most efficient through a single supplier. The partially contestable sectors involve high fixed costs and network economies: wireless telecommunications activities (6120), satellite telecommunications activities (6130), radio broadcasting (6010), and television programming and broadcasting activities (6020). The latter three are characterized by positive externalities and low entry barriers. The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.10.

[32] Laffont and Tirole (1999, Chapter 1). See also Cave (2002, Chapter 3).

*Table 18. **SOE taxonomy in information and communication***

Information and Communication (J)		
Distribution of disaggregated sectors by category		
Competitive	**Natural Monopoly**	**Partially Contestable**
21	1	4
81%	4%	15%

Source: Authors' elaboration

*Table 19. **Non-competitive disaggregated sectors in information and communication***

Information and Communication (J)			Partially contestable			Natural Monopoly
NACE Code Classification			Market power	(+) externalities	(-) externalities	
Sector	Disaggregated sector	Code				
(60) Programming and broadcasting activities	Radio broadcasting	6010		X		
	Television programming and broadcasting activities	6020		X		
(61) Telecommunications	Wired telecommunications activities	6110				X
	Wireless telecommunications activities	6120	X			
	Satellite telecommunications activities	6130	X	X		

Source: Authors' elaboration

K. Financial and Insurance Activities (K)

Outside of central banking and pension funding, which are excluded from the taxonomy, this industry includes all other kinds of financial and insurance activities, including credit granting, financial leasing, trust and fund management, financial brokerage services, and risk and damage evaluation. Of the 16 sectors included in the classification, two are deemed partially contestable and 14 competitive (Table 20 and Table 2).

Other monetary intermediation is classified as partially contestable on the basis of information frictions that result in asymmetric information (Freixas and Rochet 1998; Claus and Grimes, 2003; Sufi 2007; Wanniarachchige et al. 2017). Market failures that justify the role of state-owned banks include the presence of asymmetric information that limits access to finance for certain potential borrowers (for example, those without a credit history) as well as externalities that result in underfinancing of socially valuable projects, where profitability may not reflect the overall value of the project (Gutierrez et al. 2011). State-owned banks may also help crowd in private investment and finance long-term and large investment projects, such as those related to infrastructure (Gutierrez et al. 2011; World Bank 2013). The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.11.

Table 20. SOE taxonomy in financial and insurance activities

Financial and Insurance Activities (K)		
Distribution of disaggregated sectors by category		
Competitive	**Natural Monopoly**	**Partially Contestable**
14	0	2
88%	0%	13%

Source: Authors' elaboration

Table 21. Non-competitive disaggregated sectors in financial and insurance activities

Financial and Insurance Activities (K)			Partially contestable		
NACE Code Classification			Market power	(+) externalities	(-) externalities
Sector	Disaggregated sector	Code			
(64) Financial service activities, except insurance and pension funding	Other monetary intermediation	6419	X	X*	

*Other market failures include asymmetric information and risks.

Source: Authors' elaboration

L. Real Estate Activities (L)

This industry includes buying and selling of own real estate, rental and operation of leased real estate, real estate agencies, and the management of real estate on a fee or contract basis. All four of the four-digit sectors in this industry are categorized as competitive because none of them exhibit entry barriers relating to cost structure and they do not involve externalities or other market failures (Table 22). The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.12.

*Table 22. **SOE taxonomy in real estate activities***

Real estate activities (L)		
Distribution of disaggregated sectors by category		
Competitive	Natural Monopoly	Partially Contestable
4	0	0
100%	0%	0%

Source: Authors' elaboration

M. Professional, Scientific, and Technical Activities (M)

The professional, scientific, and technical activities industry includes a wide range of activities, including legal activities; accounting, business, engineering, and architectural services; research; advertising; and other activities. There are 19 sectors in this industry, four of which are classified as partially contestable and the remaining 15 as competitive (Table 23 and Table 24). The partially contestable sectors concern research activities on biotechnology (7210), natural sciences (7211), engineering (7219), and social sciences and the humanities (7220); and veterinary activities (7500), which includes vaccination of animals. These sectors do not appear to exhibit high barriers, but they do seem to generate positive externalities (Alston et al. 2014; Brooks and Barfoot 2006; El-Zein and Hedemann 2016; Harris 2008). The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.13.

*Table 23. **SOE taxonomy in professional, scientific, and technical activities***

Professional, Scientific, and Technical Activities (M)		
Distribution of disaggregated sectors by category		
Competitive	Natural Monopoly	Partially Contestable
15	0	4
79%	0%	21%

Source: Authors' elaboration

*Table 24. **Non-competitive disaggregated sectors in professional, scientific, and technical activities***

Professional, Scientific, and Technical Activities (M)			Partially contestable		
NACE Code Classification			Market power	(+) externalities	(-) externalities
Sector	Disaggregated sector	Code			
(72) Scientific research and development	Research and experimental development on biotechnology	7211		X	
	Other research and experimental development on natural sciences and engineering	7219		X	
	Research and experimental development on social sciences and humanities	7220		X	
(75) Veterinary activities	Veterinary activities	7500		X	

Source: Authors' elaboration

N. Administrative and Support Service Activities (N)

This industry includes rental and leasing activities, employment activities, travel agency and related services, security, and investigation services, building services, and other administrative and office support activities. All of the 33 disaggregated sectors in this industry are categorized as competitive because none of them exhibit entry barriers relating to cost structure and they do not involve externalities or other market failures (Table 25). The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.14.

*Table 25. **SOE taxonomy in administrative and support service activities***

Administrative and Support Service Activities (N) *Distribution of disaggregated sectors by category*		
Competitive	Natural Monopoly	Partially Contestable
33	0	0
100%	0%	0%

Source: Authors' elaboration

O. Arts, Entertainment, and Recreation (R)

This industry encompasses creative arts, entertainment, cultural activities, such as those performed by libraries and museums, as well as sports and recreation activities. Of the 15 sectors within the arts, entertainment, and recreation industry, eight are excluded[33] and seven are classified as competitive (Table 26). The excluded sectors involve the provision of public goods, and private participation would generally be considered undesirable given that the underlying activities relate to matters of national cultural and historical interest (for example, creative arts and entertainment activities, libraries, archives, and museums). Competitive sectors in this industry group are classified as such because they do not involve public goods and none of them exhibit entry barriers relating to cost structure. The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.15.

[33] Eight sectors classified under codes 90 and 91 at the two-digit level are excluded on the basis that they relate to education and national cultural heritage.

*Table 26. **SOE taxonomy in arts, entertainment, and recreation***

Arts, Entertainment, and recreation (R) *Distribution of disaggregated sectors by category*		
Competitive	**Natural Monopoly**	**Partially Contestable**
7	0	0
100%	0%	0%

Source: Authors' elaboration

P. Other Service Activities (S)

Other service activities include those performed by membership organizations, trade unions, and religious and political organizations, as well as the repair of personal goods and appliances and other personal services such as hairdressing, among others. Of the 19 sectors at the four-digit level in this industry, six are excluded from the taxonomy and 13 are classified as competitive (Table 27). The excluded sectors involve membership organizations, which generally do not provide services for profit and/or their purpose is not market production. As such, these sectors are excluded on the basis that any state-owned entities operating therein do not satisfy the paper's definition of SOEs as entities engaged in production for the purposes of generating a profit. The remaining sectors are classified as competitive because they do not involve public goods and none of them exhibit entry barriers relating to cost structure. The classification for each disaggregated sector in this industry is provided in Appendix 2, Table A.16.

*Table 27. **SOE taxonomy in other service activities***

Other Service Activities (S) *Distribution of disaggregated sectors by category*		
Competitive	**Natural Monopoly**	**Partially Contestable**
13	0	0
100%	0%	0%

Source: Authors' elaboration

V. Application: Empirical Exercise to Validate the Sector Taxonomy

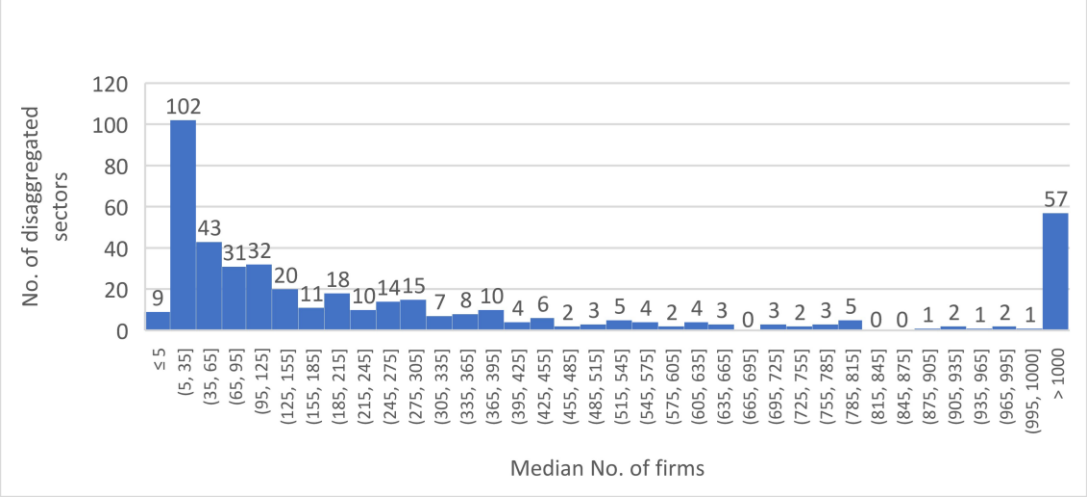
An analysis of the average number of firms operating in each disaggregate sector was conducted using data published by Eurostat. In recent years, granular data on the number of firms has increasingly become available at a disaggregated sector level. Data on the number of firms at the level of NACE 4-digit sectors was obtained for 30 high-income countries and 5 upper middle-income countries in Europe using from Eurostat's Structural Business Statistics (SBS). The data is compiled yearly by national statistical institutes based on information from statistical business registers, administrative sources, and surveys. SBS covers NACE Rev. 2 sections B to N and division 95, corresponding to 505 out of the 615 4-digit sectors in NACE Rev. 2. The analysis used the most recent data for 2019, cleaned to remove country sectors with missing information and country sectors with zero firms. In the latter case the sector has been presumed as non-existent in a country, hence not relevant for the analysis.

The number of firms operating in disaggregated sectors is used to review and validate the proposed taxonomy. It is important to note that the number of firms proxy is imperfect because the number of firms observed in a sector does not automatically indicate whether a sector is competitive or not. This is due to two reasons. First, the number of firms in a sector may be high but composed of several markets (e.g., local markets) that are not competitive. Secondly, the observed number of firms can be different from

the efficient number of firms in a sector or market. For example, the presence of a limited number of firms in a sector is *per se* not sufficient to warrant a categorization as natural monopoly, since other factors, not necessarily cost structure, can be behind such an outcome.[34] Nevertheless, the presence of a high number of operating firms in natural monopoly sectors raises important questions and merits further examination. Similarly, the presence of a limited number of operating firms in competitive sectors deserves a close review.

The analysis confirms that competitive sectors are characterized by a high number of firms. Using a median number of 5 firms per sector as a proxy for competitive conditions, the analysis confirms that 98% of the disaggregated subsectors categorized as competitive have more than 5 firms, on average (Figure 4). The cut-off has been informed by a simple Cournot model described in Appendix 1 as well as international best practice in competition enforcement.[35] A few competitive sectors present a relatively low number of operating firms: these include the extraction of salt (NACE 4-digit code 893), and the manufacture of ceramic insulators and insulating fittings (NACE 4-digit code 2343), both with an average number of 5 firms. Upon analysis of the individual disaggregated sectors it was confirmed that these can still be considered competitive since it is economically viable for multiple firms to operate due to relatively low sunk costs (entry barriers). In the case of salt extraction, for instance, the sector is fairly fragmented, with a fair number of small extraction sites operating worldwide, many of them under traditional extraction methods. Almost every country in the world has salt deposits or solar evaporation operations of various sizes (U.S. Geological Survey, Mineral Commodity Summaries, January 2020).

Figure 4. Competitive category: Number of disaggregated sectors by the number of firms



Source: Authors' elaboration with SBS data

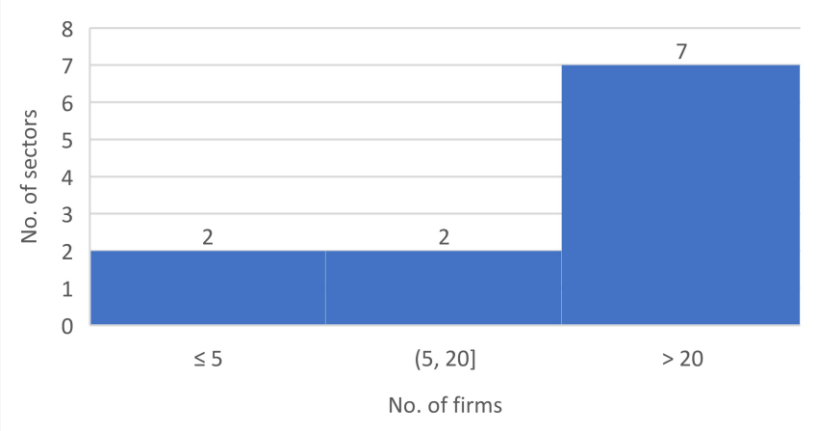
The number of firms in sectors classified as natural monopolies is higher than expected, but many of those operate in regional markets. Seven out of the 11 sectors classified originally as natural monopolies have more than 20 firms (Figure 5). Upon closer investigation, the classification has been kept as these sectors turned out to be sectors that comprised many local, not country-wide, natural monopolies. For instance,

[34] Such as legal barriers to entry which generate a legal – not natural – monopoly.

[35] Markets with five or fewer firms are considered as moderately concentrated by established competition authorities, such as the US Department of Justice. This is because a market with five firms will always have a higher Herfindahl-Hirschman Index (HHI) than 1,500. The HHI is the sum of the squares of the shares of each firm competing in the relevant market. In its Horizontal Merger Guidelines, the US Department of Justice considers markets with an HHI between 1,500 and 2,500 as moderately concentrated, whilst markets with an HHI of 2,500 are considered highly concentrated. By extension, markets with five or fewer firms are always considered as moderately concentrated markets by the Department of Justice, as the sum of the squares of the shares in a market with five firms will be always higher than 1,500.

there are on average 48 companies operating in the distribution of electricity (NACE 4-digit code 3513) and 194 firms operating in sewerage provision (NACE 4-digit code 3700).

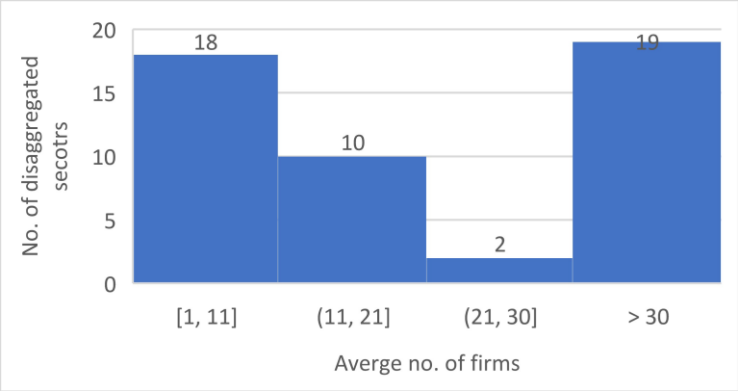
Figure 5. Natural monopoly: Number of disaggregated sectors by the number of firms



Source: Authors' elaboration with SBS data

Partially contestable sectors exhibit a wide variation in the average number of firms. For instance, there are about 6 firms on average operating in the extraction of natural gas disaggregated sector (NACE 4-digit code 620), compared to an average of 873 firms operating in the production of electricity (NACE 4-digit code 3511). Nonetheless, both sectors qualify as partially contestable sectors. For example, in the case of production of electricity, despite the fact that the increasing variety in production technologies, using solar and wind energy for instance, has rendered the sector more contestable, there are still production activities that rely on massive economies of scale (for instance, large hydro dams). Figure 6 shows the distribution of disaggregated sectors by the number of average operating firms.

Figure 6. Partially contestable: disaggregated sectors by the number of firms



Source: Authors' elaboration with SBS data

The choice of data and its use respond to the theoretical limitations to an important extent. First, the data used for the analysis covers 30 high-income economies and 5 upper middle-income economies, including all European Union economies. The European Union is the world's largest single market area and one of the most outward-oriented economic blocs in the world. The likelihood of significant distortions due to government policies is therefore presumed to be relatively low. Second, the data has been used conservatively, primarily to make inferences about sectors with a high number of firms (competitive sectors) than sectors with a low number of firms.

VI. Conclusion

The taxonomy put forward in this paper provides a common ground on which to compare countries over time and in a more granular way than before. Countries that have deregulated, unbundled, and privatized their electricity sectors, for example, will only feature an SOE in the natural monopoly segments (transmission and distribution), and this can now be differentiated from a country that still has an SOE operating in every electricity subsector. Similarly, paired with data on SOEs, this taxonomy has the potential to provide valuable insights on the sectoral footprint of the state across different countries, as in the World Bank's new Businesses of the State (BOS) database and provide guidance on the options for SOE reforms (World Bank, PSD Toolkit, forthcoming).[36] [37] Preliminary cross-country analysis (World Bank 2022, forthcoming) shows that the state's footprint in competitive sectors is bigger than previously captured: on average across 80 economies covered in the BOS database, more than half of businesses with state ownership operate in fully competitive sectors.

There are important caveats to the taxonomy, however, which relies on the NACE Revision 2 and is therefore subject to the same shortcomings as any other industry classification or methodology based on industry classification. For example, the disaggregated sector classification of one specific SOE is not necessarily representative of the main economic activity in which that SOE is engaged, nor does the classification accurately capture multi-product SOEs that operate across sectors. SOEs may have changed their main business line entirely and may serve in multiple (related) sectors in different ways. These shortcomings are the same for public entities and private entities.

Perhaps more challenging is the fact that sector characteristics (and market failures) are not constant across countries, across markets of different sizes, or across countries and markets at different stages of development. Electricity generation, for example, may be a natural monopoly in a small economy, but when the economy grows, the sector may be able to profitably sustain more than one generator. Similarly, the economic rationale for state ownership in mobile telecommunications is stronger in countries with a wholesale access network because such a network is a natural monopoly.

Furthermore, the taxonomy may not capture differences in market features among some subsectors within sectors disaggregated to the four-digit level. For instance, the economic rationale for SOE presence is weaker in the generation of electricity from wind energy, but stronger in the generation of electricity from nuclear energy. To accommodate this reality, the taxonomy classifies sectors into the three categories in a generally conservative way—that is, it considers an economic activity to be a natural monopoly even when in some (more advanced or larger) economies it may already be competitive. As a result, the sector categorization is indicative only; the economic rationale for SOE presence may still vary among countries and should be analyzed in detail in the context of any country-level diagnostic.

Technological innovations that affect the fundamentals of certain sectors, including their cost structures and barriers to entry, represent another challenge to industry classification. New technologies may disrupt previous natural monopolies and make those sectors contestable, for example by lowering fixed costs. Innovations in the field of financial technology, for example, could potentially transform the market structure of traditional insurance markets through the analysis of real-time data on risk profiles, dynamic underwriting, and personalized premium setting (Ricci and Battaglia 2021). As a result, the categorization

[36] EFI SOE Global Database Project, led by Andrea Dall'Olio (TTL), Tanja Goodwin (co-TTL), and Mariem Malouche (co-TTL).

[37] The CPSD Knowledge note (Sanchez-Navarro, Goodwin, & Kikeri, 2021) and the forthcoming toolkit on state footprint and private sector development offer a good set of tools for practitioners on how to implement the findings of the global BOS database and the taxonomy of sectors to design SOE reforms including the sequence, prioritization of sectors, as well as the definition of the right instrument of reform (beyond privatization).

of sectors may vary over time and would thus need to be reassessed periodically to ensure its temporal relevance. As technologies change in the future, this information can be used to inform the recategorization of sectors as necessary.

APPENDIX

Appendix 1. Proxying entry barriers based on the number of firms[38]

Derivation

In a simple Cournot model[39] with the equilibrium at Q=n*q, q (quantity), p (price) and Π (profit) are given by:

$$q = \frac{1 - c}{n + 1}$$

$$p = c + \frac{1 - c}{n + 1}$$

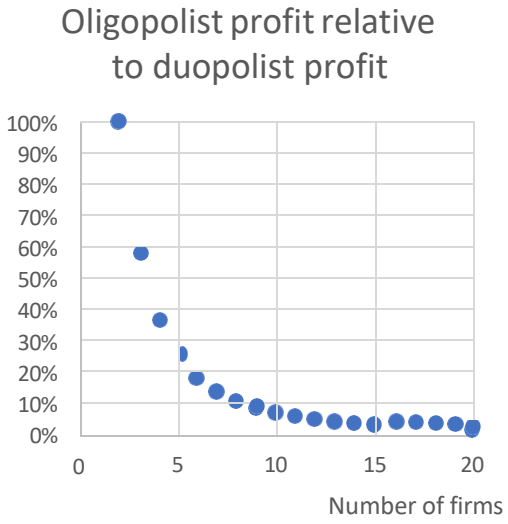
$$\Pi = \frac{(1 - c)^2}{(n + 1)^2}$$

Assuming same costs across markets with *n* firms the oligopolists' profits can be expressed as:

$$\Pi = \frac{1}{(n + 1)^2}$$

For any given number of firms (n) greater than two, the capacity of the oligopolists to price above cost can be expressed as the ratio of their profits to duopoly profits:

Number of firms	Oligopolist profits relative to duopolist profits
2	100%
3	56%
4	36%
5	25%
6	18%
7	14%
8	11%
9	9%
10	7%
11	6%
12	5%
13	5%
14	4%
15	4%
16	3%
17	3%
18	2%
19	2%
20	2%



[38] Based on Tirole (1994, 218–21).

[39] Assumes that firms are rival and compete in a market of a homogeneous product to maximize their profits through setting a **quantity** of the good provided.

Appendix 2. Disaggregated Sector Classification

Table A.1. Agriculture, Forestry, and Fishing – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Growing of cereals (except rice), leguminous crops and oil seeds	111			X
Growing of rice	112			X
Growing of vegetables and melons, roots and tubers	113			X
Growing of sugar cane	114			X
Growing of tobacco	115			X
Growing of fibre crops	116			X
Growing of other non-perennial crops	119			X
Growing of grapes	121			X
Growing of tropical and subtropical fruits	122			X
Growing of citrus fruits	123			X
Growing of pome fruits and stone fruits	124			X
Growing of other tree and bush fruits and nuts	125			X
Growing of oleaginous fruits	126			X
Growing of beverage crops	127			X
Growing of spices, aromatic, drug and pharmaceutical crops	128			X
Growing of other perennial crops	129			X
Plant propagation	130			X
Raising of dairy cattle	141			X
Raising of other cattle and buffaloes	142			X
Raising of horses and other equines	143			X
Raising of camels and camelids	144			X
Raising of sheep and goats	145			X
Raising of swine/pigs	146			X
Raising of poultry	147			X
Raising of other animals	149			X
Mixed farming	150			X
Support activities for crop production	161		X	
Support activities for animal production	162			X
Post-harvest crop activities	163			X
Seed processing for propagation	164		X	
Hunting, trapping and related service activities	170			X
Silviculture and other forestry activities	210		X	
Logging	220			X
Gathering of wild growing non-wood products	230			X
Support services to forestry	240		X	
Marine fishing	311			X
Freshwater fishing	312			X
Marine aquaculture	321			X
Freshwater aquaculture	322			X

Table A.2. Mining and Quarrying – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Mining of hard coal	510		X	
Mining of lignite	520		X	
Extraction of crude petroleum	610		X	
Extraction of natural gas	620		X	
Mining of iron ores	710		X	
Mining of uranium and thorium ores	721		X	
Mining of other non-ferrous metal ores	729		X	
Quarrying of ornamental and building stone, limestone, gypsum, chalk and slate	811			X
Operation of gravel and sand pits; mining of clays and kaolin	812			X
Mining of chemical and fertiliser minerals	891		X	
Extraction of peat	892			X
Extraction of salt	893			X
Other mining and quarrying n.e.c.	899			X
Support activities for petroleum and natural gas extraction	910		X	
Support activities for other mining and quarrying	990		X	

Table A.3. Manufacturing – Sector Classification

Sector	Sector Code	Natural Monopoly	Contestable	Competitive
Processing and preserving of meat	1011			X
Processing and preserving of poultry meat	1012			X
Production of meat and poultry meat products	1013			X
Processing and preserving of fish, crustaceans and molluscs	1020			X
Processing and preserving of potatoes	1031			X
Manufacture of fruit and vegetable juice	1032			X
Other processing and preserving of fruit and vegetables	1039			X
Manufacture of oils and fats	1041			X
Manufacture of margarine and similar edible fats	1042			X
Operation of dairies and cheese making	1051			X
Manufacture of ice cream	1052			X
Manufacture of grain mill products	1061			X
Manufacture of starches and starch products	1062			X
Manufacture of bread; manufacture of fresh pastry goods and cakes	1071			X
Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes	1072			X
Manufacture of macaroni, noodles, couscous and similar farinaceous products	1073			X
Manufacture of sugar	1081			X
Manufacture of cocoa, chocolate and sugar confectionery	1082			X
Processing of tea and coffee	1083			X
Manufacture of condiments and seasonings	1084			X

Manufacture of prepared meals and dishes	1085			X
Manufacture of homogenised food preparations and dietetic food	1086			X
Manufacture of other food products n.e.c.	1089			X
Manufacture of prepared feeds for farm animals	1091			X
Manufacture of prepared pet foods	1092			X
Distilling, rectifying and blending of spirits	1101			X
Manufacture of wine from grape	1102			X
Manufacture of cider and other fruit wines	1103			X
Manufacture of other non-distilled fermented beverages	1104			X
Manufacture of beer	1105			X
Manufacture of malt	1106			X
Manufacture of soft drinks; production of mineral waters and other bottled waters	1107			X
Manufacture of tobacco products	1200			X
Preparation and spinning of textile fibres	1310			X
Weaving of textiles	1320			X
Finishing of textiles	1330			X
Manufacture of knitted and crocheted fabrics	1391			X
Manufacture of made-up textile articles, except apparel	1392			X
Manufacture of carpets and rugs	1393			X
Manufacture of cordage, rope, twine and netting	1394			X
Manufacture of non-wovens and articles made from non-wovens, except apparel	1395			X
Manufacture of other technical and industrial textiles	1396			X
Manufacture of other textiles n.e.c.	1399			X
Manufacture of leather clothes	1411			X
Manufacture of workwear	1412			X
Manufacture of other outerwear	1413			X
Manufacture of underwear	1414			X
Manufacture of other wearing apparel and accessories	1419			X
Manufacture of articles of fur	1420			X
Manufacture of knitted and crocheted hosiery	1431			X
Manufacture of other knitted and crocheted apparel	1439			X
Tanning and dressing of leather; dressing and dyeing of fur	1511			X
Manufacture of luggage, handbags and the like, saddlery and harness	1512			X
Manufacture of footwear	1520			X
Sawmilling and planing of wood	1610			X
Manufacture of veneer sheets and wood-based panels	1621			X
Manufacture of assembled parquet floors	1622			X
Manufacture of other builders' carpentry and joinery	1623			X
Manufacture of wooden containers	1624			X
Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	1629			X
Manufacture of pulp	1711			X
Manufacture of paper and paperboard	1712			X

Manufacture of corrugated paper and paperboard and of containers of paper and paperboard	1721			X
Manufacture of household and sanitary goods and of toilet requisites	1722			X
Manufacture of paper stationery	1723			X
Manufacture of wallpaper	1724			X
Manufacture of other articles of paper and paperboard	1729			X
Printing of newspapers	1811			X
Other printing	1812			X
Pre-press and pre-media services	1813			X
Binding and related services	1814			X
Reproduction of recorded media	1820			X
Manufacture of coke oven products	1910		X	
Manufacture of refined petroleum products	1920		X	
Manufacture of industrial gases	2011			X
Manufacture of dyes and pigments	2012			X
Manufacture of other inorganic basic chemicals	2013			X
Manufacture of other organic basic chemicals	2014			X
Manufacture of fertilisers and nitrogen compounds	2015			X
Manufacture of plastics in primary forms	2016			X
Manufacture of synthetic rubber in primary forms	2017			X
Manufacture of pesticides and other agrochemical products	2020			X
Manufacture of paints, varnishes and similar coatings, printing ink and mastics	2030			X
Manufacture of soap and detergents, cleaning and polishing preparations	2041			X
Manufacture of perfumes and toilet preparations	2042			X
Manufacture of explosives	2051		X	
Manufacture of glues	2052			X
Manufacture of essential oils	2053			X
Manufacture of other chemical products n.e.c.	2059			X
Manufacture of man-made fibres	2060			X
Manufacture of basic pharmaceutical products	2110			X
Manufacture of pharmaceutical preparations	2120			X
Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres	2211			X
Manufacture of other rubber products	2219			X
Manufacture of plastic plates, sheets, tubes and profiles	2221			X
Manufacture of plastic packing goods	2222			X
Manufacture of builders' ware of plastic	2223			X
Manufacture of other plastic products	2229			X
Manufacture of flat glass	2311			X
Shaping and processing of flat glass	2312			X
Manufacture of hollow glass	2313			X
Manufacture of glass fibres	2314			X
Manufacture and processing of other glass, including technical glassware	2319			X

Manufacture of refractory products	2320			X
Manufacture of ceramic tiles and flags	2331			X
Manufacture of bricks, tiles and construction products, in baked clay	2332			X
Manufacture of ceramic household and ornamental articles	2341			X
Manufacture of ceramic sanitary fixtures	2342			X
Manufacture of ceramic insulators and insulating fittings	2343			X
Manufacture of other technical ceramic products	2344			X
Manufacture of other ceramic products	2349			X
Manufacture of cement	2351			X
Manufacture of lime and plaster	2352			X
Manufacture of concrete products for construction purposes	2361			X
Manufacture of plaster products for construction purposes	2362			X
Manufacture of ready-mixed concrete	2363			X
Manufacture of mortars	2364			X
Manufacture of fibre cement	2365		X	
Manufacture of other articles of concrete, plaster and cement	2369			X
Cutting, shaping and finishing of stone	2370			X
Production of abrasive products	2391			X
Manufacture of other non-metallic mineral products n.e.c.	2399			X
Manufacture of basic iron and steel and of ferro-alloys	2410			X
Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	2420			X
Cold drawing of bars	2431			X
Cold rolling of narrow strip	2432			X
Cold forming or folding	2433			X
Cold drawing of wire	2434			X
Precious metals production	2441			X
Aluminium production	2442			X
Lead, zinc and tin production	2443			X
Copper production	2444			X
Other non-ferrous metal production	2445			X
Processing of nuclear fuel	2446		X	
Casting of iron	2451			X
Casting of steel	2452			X
Casting of light metals	2453			X
Casting of other non-ferrous metals	2454			X
Manufacture of metal structures and parts of structures	2511			X
Manufacture of doors and windows of metal	2512			X
Manufacture of central heating radiators and boilers	2521			X
Manufacture of other tanks, reservoirs and containers of metal	2529			X
Manufacture of steam generators, except central heating hot water boilers	2530			X
Manufacture of weapons and ammunition	2540		X	
Forging, pressing, stamping and roll-forming of metal; powder metallurgy	2550			X

Treatment and coating of metals	2561			X
Machining	2562			X
Manufacture of cutlery	2571			X
Manufacture of locks and hinges	2572			X
Manufacture of tools	2573			X
Manufacture of steel drums and similar containers	2591			X
Manufacture of light metal packaging	2592			X
Manufacture of wire products, chain and springs	2593			X
Manufacture of fasteners and screw machine products	2594			X
Manufacture of other fabricated metal products n.e.c.	2599			X
Manufacture of electronic components	2611			X
Manufacture of loaded electronic boards	2612			X
Manufacture of computers and peripheral equipment	2620			X
Manufacture of communication equipment	2630			X
Manufacture of consumer electronics	2640			X
Manufacture of instruments and appliances for measuring, testing and navigation	2651			X
Manufacture of watches and clocks	2652			X
Manufacture of irradiation, electromedical and electrotherapeutic equipment	2660			X
Manufacture of optical instruments and photographic equipment	2670			X
Manufacture of magnetic and optical media	2680			X
Manufacture of electric motors, generators and transformers	2711			X
Manufacture of electricity distribution and control apparatus	2712			X
Manufacture of batteries and accumulators	2720			X
Manufacture of fibre optic cables	2731			X
Manufacture of other electronic and electric wires and cables	2732			X
Manufacture of wiring devices	2733			X
Manufacture of electric lighting equipment	2740			X
Manufacture of electric domestic appliances	2751			X
Manufacture of non-electric domestic appliances	2752			X
Manufacture of other electrical equipment	2790			X
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	2811			X
Manufacture of fluid power equipment	2812			X
Manufacture of other pumps and compressors	2813			X
Manufacture of other taps and valves	2814			X
Manufacture of bearings, gears, gearing and driving elements	2815			X
Manufacture of ovens, furnaces and furNACE burners	2821			X
Manufacture of lifting and handling equipment	2822			X
Manufacture of office machinery and equipment (except computers and peripheral equipment)	2823			X
Manufacture of power-driven hand tools	2824			X
Manufacture of non-domestic cooling and ventilation equipment	2825			X
Manufacture of other general-purpose machinery n.e.c.	2829			X

Manufacture of agricultural and forestry machinery	2830			X
Manufacture of metal forming machinery	2841			X
Manufacture of other machine tools	2849			X
Manufacture of machinery for metallurgy	2891			X
Manufacture of machinery for mining, quarrying and construction	2892			X
Manufacture of machinery for food, beverage and tobacco processing	2893			X
Manufacture of machinery for textile, apparel and leather production	2894			X
Manufacture of machinery for paper and paperboard production	2895			X
Manufacture of plastics and rubber machinery	2896			X
Manufacture of other special-purpose machinery n.e.c.	2899			X
Manufacture of motor vehicles	2910			X
Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	2920			X
Manufacture of electrical and electronic equipment for motor vehicles	2931			X
Manufacture of other parts and accessories for motor vehicles	2932			X
Building of ships and floating structures	3011			X
Building of pleasure and sporting boats	3012			X
Manufacture of railway locomotives and rolling stock	3020			X
Manufacture of air and spacecraft and related machinery	3030			X
Manufacture of military fighting vehicles	3040		X	
Manufacture of motorcycles	3091			X
Manufacture of bicycles and invalid carriages	3092			X
Manufacture of other transport equipment n.e.c.	3099			X
Manufacture of office and shop furniture	3101			X
Manufacture of kitchen furniture	3102			X
Manufacture of mattresses	3103			X
Manufacture of other furniture	3109			X
Striking of coins	3211			X
Manufacture of jewellery and related articles	3212			X
Manufacture of imitation jewellery and related articles	3213			X
Manufacture of musical instruments	3220			X
Manufacture of sports goods	3230			X
Manufacture of games and toys	3240			X
Manufacture of medical and dental instruments and supplies	3250			X
Manufacture of brooms and brushes	3291			X
Other manufacturing n.e.c.	3299			X
Repair of fabricated metal products	3311			X
Repair of machinery	3312			X
Repair of electronic and optical equipment	3313			X
Repair of electrical equipment	3314			X
Repair and maintenance of ships and boats	3315			X
Repair and maintenance of aircraft and spacecraft	3316			X
Repair and maintenance of other transport equipment	3317			X
Repair of other equipment	3319			X

Installation of industrial machinery and equipment	3320			X

Table A.4. Electricity, Gas, Steam, and Air Conditioning – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Production of electricity	3511		X	
Transmission of electricity	3512	X		
Distribution of electricity	3513	X		
Trade of electricity	3514			X
Manufacture of gas	3521			X
Distribution of gaseous fuels through mains	3522	X		
Trade of gas through mains	3523			X
Steam and air conditioning supply	3530			X

Table A.5. Water Supply, Sewerage, Waste Management, and Remediation Activities – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Water collection, treatment and supply	3600	X		
Sewerage	3700	X		
Collection of non-hazardous waste	3811			X
Collection of hazardous waste	3812		X	
Treatment and disposal of non-hazardous waste	3821		X	
Treatment and disposal of hazardous waste	3822		X	
Dismantling of wrecks	3831			X
Recovery of sorted materials	3832			X
Remediation activities and other waste management services	3900			X

Table A.6. Construction – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Development of building projects	4110			X
Construction of residential and non-residential buildings	4120			X
Construction of roads and motorways	4211			X
Construction of railways and underground railways	4212			X
Construction of bridges and tunnels	4213			X
Construction of utility projects for fluids	4221			X
Construction of utility projects for electricity and telecommunications	4222			X
Construction of water projects	4291			X
Construction of other civil engineering projects n.e.c.	4299			X
Demolition	4311			X
Site preparation	4312			X
Test drilling and boring	4313			X
Electrical installation	4321			X

Plumbing, heat and air-conditioning installation	4322			X
Other construction installation	4329			X
Plastering	4331			X
Joinery installation	4332			X
Floor and wall covering	4333			X
Painting and glazing	4334			X
Other building completion and finishing	4339			X
Roofing activities	4391			X
Other specialised construction activities n.e.c.	4399			X

Table A.7. Wholesale & Retail Trade – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Sale of cars and light motor vehicles	4511			X
Sale of other motor vehicles	4519			X
Maintenance and repair of motor vehicles	4520			X
Wholesale trade of motor vehicle parts and accessories	4531			X
Retail trade of motor vehicle parts and accessories	4532			X
Sale, maintenance and repair of motorcycles and related parts and accessories	4540			X
Agents involved in the sale of agricultural raw materials, live animals, textile raw materials and semi-finished goods	4611			X
Agents involved in the sale of fuels, ores, metals and industrial chemicals	4612			X
Agents involved in the sale of timber and building materials	4613			X
Agents involved in the sale of machinery, industrial equipment, ships and aircraft	4614			X
Agents involved in the sale of furniture, household goods, hardware and ironmongery	4615			X
Agents involved in the sale of textiles, clothing, fur, footwear and leather goods	4616			X
Agents involved in the sale of food, beverages and tobacco	4617			X
Agents specialised in the sale of other particular products	4618			X
Agents involved in the sale of a variety of goods	4619			X
Wholesale of grain, unmanufactured tobacco, seeds and animal feeds	4621			X
Wholesale of flowers and plants	4622			X
Wholesale of live animals	4623			X
Wholesale of hides, skins and leather	4624			X
Wholesale of fruit and vegetables	4631			X
Wholesale of meat and meat products	4632			X
Wholesale of dairy products, eggs and edible oils and fats	4633			X
Wholesale of beverages	4634			X
Wholesale of tobacco products	4635			X
Wholesale of sugar and chocolate and sugar confectionery	4636			X
Wholesale of coffee, tea, cocoa and spices	4637			X
Wholesale of other food, including fish, crustaceans and molluscs	4638			X
Non-specialised wholesale of food, beverages and tobacco	4639			X

Wholesale of textiles	4641			X
Wholesale of clothing and footwear	4642			X
Wholesale of electrical household appliances	4643			X
Wholesale of china and glassware and cleaning materials	4644			X
Wholesale of perfume and cosmetics	4645			X
Wholesale of pharmaceutical goods	4646			X
Wholesale of furniture, carpets and lighting equipment	4647			X
Wholesale of watches and jewellery	4648			X
Wholesale of other household goods	4649			X
Wholesale of computers, computer peripheral equipment and software	4651			X
Wholesale of electronic and telecommunications equipment and parts	4652			X
Wholesale of agricultural machinery, equipment and supplies	4661			X
Wholesale of machine tools	4662			X
Wholesale of mining, construction and civil engineering machinery	4663			X
Wholesale of machinery for the textile industry and of sewing and knitting machines	4664			X
Wholesale of office furniture	4665			X
Wholesale of other office machinery and equipment	4666			X
Wholesale of other machinery and equipment	4669			X
Wholesale of solid, liquid and gaseous fuels and related products	4671			X
Wholesale of metals and metal ores	4672			X
Wholesale of wood, construction materials and sanitary equipment	4673			X
Wholesale of hardware, plumbing and heating equipment and supplies	4674			X
Wholesale of chemical products	4675			X
Wholesale of other intermediate products	4676			X
Wholesale of waste and scrap	4677			X
Non-specialised wholesale trade	4690			X
Retail sale in non-specialised stores with food, beverages or tobacco predominating	4711			X
Other retail sale in non-specialised stores	4719			X
Retail sale of fruit and vegetables in specialised stores	4721			X
Retail sale of meat and meat products in specialised stores	4722			X
Retail sale of fish, crustaceans and molluscs in specialised stores	4723			X
Retail sale of bread, cakes, flour confectionery and sugar confectionery in specialised stores	4724			X
Retail sale of beverages in specialised stores	4725			X
Retail sale of tobacco products in specialised stores	4726			X
Other retail sale of food in specialised stores	4729			X
Retail sale of automotive fuel in specialised stores	4730			X
Retail sale of computers, peripheral units and software in specialised stores	4741			X
Retail sale of telecommunications equipment in specialised stores	4742			X
Retail sale of audio and video equipment in specialised stores	4743			X
Retail sale of textiles in specialised stores	4751			X
Retail sale of hardware, paints and glass in specialised stores	4752			X

Retail sale of carpets, rugs, wall and floor coverings in specialised stores	4753			X
Retail sale of electrical household appliances in specialised stores	4754			X
Retail sale of furniture, lighting equipment and other household articles in specialised stores	4759			X
Retail sale of books in specialised stores	4761			X
Retail sale of newspapers and stationery in specialised stores	4762			X
Retail sale of music and video recordings in specialised stores	4763			X
Retail sale of sporting equipment in specialised stores	4764			X
Retail sale of games and toys in specialised stores	4765			X
Retail sale of clothing in specialised stores	4771			X
Retail sale of footwear and leather goods in specialised stores	4772			X
Dispensing chemist in specialised stores	4773			X
Retail sale of medical and orthopaedic goods in specialised stores	4774			X
Retail sale of cosmetic and toilet articles in specialised stores	4775			X
Retail sale of flowers, plants, seeds, fertilisers, pet animals and pet food in specialised stores	4776			X
Retail sale of watches and jewellery in specialised stores	4777			X
Other retail sale of new goods in specialised stores	4778			X
Retail sale of second-hand goods in stores	4779			X
Retail sale via stalls and markets of food, beverages and tobacco products	4781			X
Retail sale via stalls and markets of textiles, clothing and footwear	4782			X
Retail sale via stalls and markets of other goods	4789			X
Retail sale via mail order houses or via Internet	4791			X
Other retail sale not in stores, stalls or markets	4799			X

Table A.8. Transportation and Storage – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Passenger rail transport, interurban	4910		X	
Freight rail transport	4920		X	
Urban and suburban passenger land transport	4931		X	
Taxi operation	4932			X
Other passenger land transport n.e.c.	4939			X
Freight transport by road	4941			X
Removal services	4942			X
Transport via pipeline	4950	X		
Sea and coastal passenger water transport	5010			X
Sea and coastal freight water transport	5020			X
Inland passenger water transport	5030			X
Inland freight water transport	5040			X
Passenger air transport	5110		X	
Freight air transport	5121		X	
Space transport	5122		X	
Warehousing and storage	5210			X

Service activities incidental to land transportation	5221	X		
Service activities incidental to water transportation	5222	X		
Service activities incidental to air transportation	5223	X		
Cargo handling	5224			X
Other transportation support activities	5229			X
Postal activities under universal service obligation	5310	X		
Other postal and courier activities	5320			X

Table A.9. Accommodation and Food Services – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Hotels and similar accommodation	5510			X
Holiday and other short-stay accommodation	5520			X
Camping grounds, recreational vehicle parks and trailer parks	5530			X
Other accommodation	5590			X
Restaurants and mobile food service activities	5610			X
Event catering activities	5621			X
Other food service activities	5629			X
Beverage serving activities	5630			X

Table A.10. Information and Communication – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Book publishing	5811			X
Publishing of directories and mailing lists	5812			X
Publishing of newspapers	5813			X
Publishing of journals and periodicals	5814			X
Other publishing activities	5819			X
Publishing of computer games	5821			X
Other software publishing	5829			X
Motion picture, video and television programme production activities	5911			X
Motion picture, video and television programme post-production activities	5912			X
Motion picture, video and television programme distribution activities	5913			X
Motion picture projection activities	5914			X
Sound recording and music publishing activities	5920			X
Radio broadcasting	6010		X	
Television programming and broadcasting activities	6020		X	
Wired telecommunications activities	6110	X		
Wireless telecommunications activities	6120		X	
Satellite telecommunications activities	6130		X	
Other telecommunications activities	6190			X
Computer programming activities	6201			X
Computer consultancy activities	6202			X
Computer facilities management activities	6203			X

Other information technology and computer service activities	6209			X
Data processing, hosting and related activities	6311			X
Web portals	6312			X
News agency activities	6391			X
Other information service activities n.e.c.	6399			X

Table A.11. Financial and Insurance Activities – Sectors Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Other monetary intermediation	6419		X	
Activities of holding companies	6420			X
Trusts, funds and similar financial entities	6430			X
Financial leasing	6491			X
Other credit granting	6492			X
Other financial service activities, except insurance and pension funding n.e.c.	6499			X
Life insurance	6511			X
Non-life insurance	6512			X
Reinsurance	6520			X
Administration of financial markets	6611			X
Security and commodity contracts brokerage	6612			X
Other activities auxiliary to financial services, except insurance and pension funding	6619			X
Risk and damage evaluation	6621			X
Activities of insurance agents and brokers	6622			X
Other activities auxiliary to insurance and pension funding	6629			X
Fund management activities	6630			X

Table A.12. Real Estate Activities – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Buying and selling of own real estate	6810			X
Rental and operating of own or leased real estate	6820			X
Real estate agencies	6831			X
Management of real estate on a fee or contract basis	6832			X

Table A.13. Professional, Scientific, and Technical Activities – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Legal activities	6910			X
Accounting, bookkeeping and auditing activities; tax consultancy	6920			X
Activities of head offices	7010			X
Public relations and communication activities	7021			X
Business and other management consultancy activities	7022			X
Architectural activities	7111			X

Engineering activities and related technical consultancy	7112			X
Technical testing and analysis	7120		X	
Research and experimental development on biotechnology	7211		X	
Other research and experimental development on natural sciences and engineering	7219		X	
Research and experimental development on social sciences and humanities	7220		X	
Advertising agencies	7311			X
Media representation	7312			X
Market research and public opinion polling	7320			X
Specialised design activities	7410			X
Photographic activities	7420			X
Translation and interpretation activities	7430			X
Other professional, scientific and technical activities n.e.c.	7490			X
Veterinary activities	7500		X	

Table A.14. Administrative and Support Services – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Rental and leasing of cars and light motor vehicles	7711			X
Rental and leasing of trucks	7712			X
Rental and leasing of recreational and sports goods	7721			X
Rental of video tapes and disks	7722			X
Rental and leasing of other personal and household goods	7729			X
Rental and leasing of agricultural machinery and equipment	7731			X
Rental and leasing of construction and civil engineering machinery and equipment	7732			X
Rental and leasing of office machinery and equipment (including computers)	7733			X
Rental and leasing of water transport equipment	7734			X
Rental and leasing of air transport equipment	7735			X
Rental and leasing of other machinery, equipment and tangible goods n.e.c.	7739			X
Leasing of intellectual property and similar products, except copyrighted works	7740			X
Activities of employment placement agencies	7810			X
Temporary employment agency activities	7820			X
Other human resources provision	7830			X
Travel agency activities	7911			X
Tour operator activities	7912			X
Other reservation service and related activities	7990			X
Private security activities	8010			X
Security systems service activities	8020			X
Investigation activities	8030			X
Combined facilities support activities	8110			X

General cleaning of buildings	8121			X
Other building and industrial cleaning activities	8122			X
Other cleaning activities	8129			X
Landscape service activities	8130			X
Combined office administrative service activities	8211			X
Photocopying, document preparation and other specialised office support activities	8219			X
Activities of call centres	8220			X
Organisation of conventions and trade shows	8230			X
Activities of collection agencies and credit bureaus	8291			X
Packaging activities	8292			X
Other business support service activities n.e.c.	8299			X

Table A.15. Arts, Entertainment, and Recreation – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Gambling and betting activities	9200			X
Operation of sports facilities	9311			X
Activities of sports clubs	9312			X
Fitness facilities	9313			X
Other sports activities	9319			X
Activities of amusement parks and theme parks	9321			X
Other amusement and recreation activities	9329			X

Table A.16. Other Services – Sector Classification

Sector	Sector Code	Natural Monopoly	Partially Contestable	Competitive
Repair of computers and peripheral equipment	9511			X
Repair of communication equipment	9512			X
Repair of consumer electronics	9521			X
Repair of household appliances and home and garden equipment	9522			X
Repair of footwear and leather goods	9523			X
Repair of furniture and home furnishings	9524			X
Repair of watches, clocks and jewellery	9525			X
Repair of other personal and household goods	9529			X
Washing and (dry-)cleaning of textile and fur products	9601			X
Hairdressing and other beauty treatment	9602			X
Funeral and related activities	9603			X
Physical well-being activities	9604			X
Other personal service activities n.e.c.	9609			X

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