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Viagens de descobrimento: mapeando a geografia da economia de plataformas

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Resumo: Este artigo traz novas evidências em relação à geografia econômica das plataformas digitais. Nosso objetivo é duplo. Primeiro, propomos uma nova metodologia usando ferramentas de ciência de dados e inteligência artificial para identificar empresas baseadas em plataformas. Em segundo lugar, com uma lista de mais de três mil empresas, apresentamos mapas mundiais inéditos nos quais é possível observar os países e cidades que hospedam essas plataformas. Neste sentido, nossa metodologia busca superar a limitação dos estudos de plataformas que restringem a investigação às gigantes GAFAM e BAT. Enquanto observamos uma concentração geográfica de empresas de plataforma nos EUA e na China, também há indícios de que as empresas de plataforma estão se difundindo em todas as direções geográficas, o que reforça a hipótese da "plataformização" enquanto fenômeno mundial. Este mapeamento ao nível do país e de cidades é complementado por uma caracterização das plataformas em termos de setores econômicos e data de fundação. Ao elaborar este panorama, damos o primeiro passo na tentativa de compreender os determinantes locacionais das empresas de plataforma digital.

Palavras-chave: plataformização; capitalismo de plataforma; processamento de linguagem natural; Orbis

Código JEL: F01; L86; O33

Área Temática: Novos temas – Indústria 4.0, Internet das Coisas, outros (1.6)

Voyages of discovery: charting the new geographies of the platform economy

Abstract: This paper explores new evidence on the digital platform economy geography. Our objective is twofold. First, we propose a novel methodology using data science and artificial intelligence tools to identify platform companies. Second, with a set of over three thousand companies, we introduce original worldwide maps where it is possible to see the countries that host platform companies, not only the giant GAFAM and BAT. This mapping at country and city levels is complemented by a characterization of the economic sector and date of foundation. While we observe a geographic concentration of platform companies in the U.S. and China, we also see that digital platform companies are spreading to all geographical directions, reinforcing the hypothesis that "platforming" is a worldwide phenomenon. In elaborating this panorama, we first understand the locational determinants of digital platform companies.

Keywords: platformization; platform capitalism; natural language processing; Orbis

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1. Introduction

There has been an increasing interest in the literature on the accelerated transformations in the capitalist system caused by digital technologies. Concepts like "Platform economy" (KENNEY; ZYSMAN, 2016), "Platform society" (VAN DIJCK; POELL; WAAL, 2018), "Platform capitalism" (SRNICEK, 2017), and "Surveillance capitalism" (ZUBOFF, 2019) while presenting different nuances, all highlight the significant role played by private big tech companies. They also emphasize the intense use of digital platforms and associated technologies, which drive economies of scale and scope in supply and demand (RIKAP; LUNDVALL, 2021) and economies of scope in innovation (GAWER, 2014) fueled by the self-reinforcing mechanisms of network effects (KATZ; SHAPIRO, 1985; SRNICEK, 2017). Platforms are conceived as evolving organizations or meta-organizations (GAWER, 2014). They allow controllers to realize monopoly rents on vast volumes of data (SRNICEK, 2017) and extract value by controlling peer-to-peer and peer-to-business relations (PAPADIMITROPOULOS, 2021). Besides, they coordinate agents who can innovate and compete (GAWER, 2014)and entail a modular technological architecture composed of a (stable) core and (variable) peripheral components (TIWANA; KONSYNSKI; BUSH, 2010). Finally, platforms intervene in peoples' behavior (ZUBOFF, 2019). These transformations are more and more intense due to the pervasiveness of platforms that are creating new markets and reorganizing traditional industrial sectors (KENNEY; BEARSON; ZYSMAN, 2021), and reshaping the geography of value creation and extraction (KENNEY; ZYSMAN, 2020).

Literature main contributions are focused on the ecosystem of both controlling firms, associated third-parties, and users dependent on "GAFAM" on one pole and "BAT" on the other. The former is the acronym used to refer to the U.S. giant tech titans – Google/Alphabet; Amazon; Facebook/Meta; Apple; and Microsoft – while the latter refers to the Chinese counterpart – Baidu; Alibaba; and Tencent. BAT internationalization strategies are discussed by Jia, Kenney, and Zysman (2018), and their involvement with the government is discussed by Su and Flew (2021), Jia and Kenney (2021), and McKnight, Kenney, and Breznitz (2021). Kenney and Zysman (2020) discuss the complexity and multiplicity of ways Amazon and Google Maps (platform controlled by Alphabet) is reorganizing the geography of economic activity within the U.S., while Gautier and Lamesch (2021) investigate the pattern of mergers and acquisitions of GAFAM.

Despite exciting insights, there are still gaps in the literature that need to be addressed for understanding how digital platforms produce and distribute value between and within countries, therefore providing a better comprehension of the global geography of the platform economy.

This paper explores new evidence on the platform economy geography. Our objective is twofold. First, we propose a novel methodology using data science and artificial intelligence tools to identify platform companies. Second, with a list of over three thousand companies, we introduce an unprecedented worldwide map where it is possible to see the countries (and cities) that host platform companies, not only the giant GAFAM and BAT. The characterization of platform companies complements this mapping at country and city levels in terms of economic sector and date of foundation. While we observe a geographic concentration of platform companies in China and the U.S., we see their diffusion to all geographical directions, reinforcing the hypothesis that "platforming" is a worldwide phenomenon.

The remainder of the article is structured as follows. In section 2, we present recent studies on the geography of the platform economy, revealing, to our understanding, that there are roughly three main avenues of investigation that are taking shape: a) studies that focus on digitally mediated nexus of platform operations that produce and distribute value between territories that is digital value network analysis; b) studies whose focal point are on the urbanization which platforms have profoundly shaped, that is, platform urbanism; and, c) studies that use econometric models and case studies to identify local determinants that attract platforms. Section 3 develops our methodology to identify what we call platform companies. Section 4 presents the main results in a primarily descriptive fashion once we deal with a new phenomenon that is still developing. We present a discussion on the evolution of platform companies; their economic sector based on the statistical classification of economic activities in the European Community (NACE) and their geographical location in both country and city levels. Section

5 briefly discusses how our data can provide new insights for the three main research avenues presented in section 2. We finish the paper by presenting conclusions and the limitations of our research.

2. The geography of the platform economy

Digital platforms have consolidated themselves as a new organizational model (GAWER, 2021) whose importance and centrality in the process of value creation and appropriation is equivalent to the centrality of factories in the era prior to digitalization (BEARSON; KENNEY; ZYSMAN, 2021; KENNEY; ZYSMAN, 2016). "Platforms are now redefining the scope of market competition, the organization of industrial relations and work process, and influencing the power arrangements across the economy" (BEARSON; KENNEY; ZYSMAN, 2021, p. 23). Given the "new organizational form based on a relationship between the platform and the ecosystem of firms dependent on the platform and users who interact and transact through it" (KENNEY; ZYSMAN, 2020, p. 55), understanding the creation and capture of value across space has been challenging.

Bearson, Kenney, and Zysman (2021) proposed categories that are very useful to systematically understand work, employment, and value creation in the platform economy. While providing exciting insights into the geography of the platform economy, they do not eliminate the complexity in the platform economy. Their proposition derives from looking at the three fundamental actors – the platform firm itself, platform-dependent goods and services providers, and prosumers (RITZER; JURGENSON, 2010) – and how value creation occurs in different ways. On the platform side, while value creation occurs within the platform firm, the platform ecosystem enables value creation in the platform-dependent business and prosumers sides.

The biggest platform firms in the U.S. – the biggest globally–have increased their revenue substantially since the early 2000s (BEARSON; KENNEY; ZYSMAN, 2021). They assume dominant market positions, can detour regulations, and operate at a different spatial scale than the other fundamental actors in the platform economy (GRAHAM, 2020). Most platform firms do not have any physical presence (e.g., local offices) in many countries where they operate. Platform-dependent business is atomized complementors whose existence is only vital if it adds value to the platform (CUTOLO; KENNEY, 2021). The examples include platform-dependent vendors, platform-dependent in-person service providers, platform-dependent remote service providers, and platform-dependent consignment content creators (BEARSON; KENNEY; ZYSMAN, 2021). "While platform-dependent businesses vary with respect to work arrangements, the returns nearly always have a long-tail distribution, whereby most receive little or no income, while a few reap large returns, thus creating a skewed distribution" (BEARSON; KENNEY; ZYSMAN, 2021, p. 11). Platform-dependent businesses are not necessarily in the exact geographic location of platform firms. Instead, they are spread throughout the globe, and while competing against one another, they (still) lack the associational power needed to confront platform firms (GRAHAM, 2020). Finally, prosumers produce monetized data as they consume digital content, allowing platform firms to earn money by selling prosumers' data. Power asymmetry is at the heart of the relationship between the platform firm and its ecosystem members, and it is intrinsic to the economics and the technical architecture of digital platforms (CUTOLO; KENNEY, 2021).

The case of Stack Overflow[1] – a platform where users find and contribute answers to technical challenges on computer science and programming – offers a very illustrative overview of the geography of flows of digital platforms. Although the platform was developed in the U.S. in 2008 and was acquired by a Dutch fund in 2021, it is virtual. Notwithstanding that, Braesemann et al. (2019) mapped the knowledge flows within the platform and found concentrated flows in the global north in 2009, which expanded to include some regions of India in 2017. They also found a concentration of flows in a smaller number of cities between 2009 and 2017, indicating that the geography of digital platforms can incur agglomeration economies despite their virtuality. The importance of the local context also appears in the study of the de-internationalization of digital platforms conducted by Lindblom et al. (2022).

Digital platforms extend the notions of global production beyond the conventional pillars of

[1] https://stackoverflow.co/

commodities and manufactured goods and financial markets, deepening globalization in sectors historically resistant to commodification, such as services (HOWSON et al., 2021; LOONAM; O'REGAN, 2022). Howson et al. (2021, p. 02), inspired by theories of global value chains (GVC) and global production networks (GPN), introduce the "digital value network" (DVN) concept by analyzing gig platforms: "DVN is a digitally mediated nexus of platform operations that produce and distribute value between territories, based on labour transactions" and is controlled by what Bearson, Kenney, and Zysman (2021) called "platform firm." Despite the contributions, the DVN concept still lacks a more operational approach. According to Howson et al. (2021), while geographically tethered platforms are more locally embedded, in cloud-work/online platforms, spatial relations do not disappear completely. Even networks that seem to be de-territorialized, globalized power relations created by the untethered platform (such as Upwork) still exploit and reproduce existing geographical asymmetries (HOWSON et al., 2021).

Woodcock and Graham (2020) classify digital platforms as either "on-location" service fulfillment (geographically tethered platforms) or fully online service (cloud work platforms), providing insights into the geography of the platform economy and its spatiality (WOODCOCK; GRAHAM, 2020). Internet-based platforms have varying spatial and temporal control degrees (WOODCOCK; GRAHAM, 2020). For example, considering digital platforms that mediate work (e.g., Uber, Upwork, iFood), spatial control refers to the level of control platforms exert over where workers do their work. In contrast, temporal control refers to the ability of platforms (especially geographically tethered ones) to encourage workers to be active at particular times, which results from a combination of an oversupply of workers and financial incentives to work at certain times. That seems to be an essential feature of gig platforms which help to explain their explicit coordination power: when platforms can control the location and manage the time of workers, they can operate (with more or less) barriers to entry for their workers and exert (more or less) explicit coordination over the labor process (WOODCOCK; GRAHAM, 2020), therefore, affecting (more or less) the urban geography where they operate.

The link between tethered, or "on-location" platforms and urban geography has been quite explored recently (CHIAPPINI, 2020; DUNN, 2020; FERREIRA et al., 2021; FIELDS; BISSELL; MACRORIE, 2020; GRAHAM, 2020; HARDAKER, 2021; MCNEILL, 2021; STEHLIN; HODSON; MCMEEKIN, 2020). Platforms can be approached from a socio-spatial perspective, given their infrastructural position in cities, their ability to reprioritize the use of specific locations, and the practices of urban encounters. In response, geographers have focused on "platform urbanism": "a mode of urbanization that is deeply shaped by conditions and affordances of platforms" (BARNS, 2019, p. 03). Tozi (2020) presents Uber's (a geographically tethered platform with high spatial control and a high degree of explicit coordination as suggested by Woodcock and Graham (2020)) territorial expansion in Brazil, showing that the Brazilian market was the second most profitable for the company in the past three years and it was the most widespread application software transport company in the country. He concludes that the corporation's huge income potential is directly linked to its territorial strategies and that the arrival of such platforms controlled by global corporations created a process of "vampirization" of income that previously circulated in the local economy. In an in-depth analysis, Tozi et al.(2021) discuss the case of Belo Horizonte, showing the advance of geographically tethered platforms like Uber, Didi Chuxing (controller of 99), and Cabify imposed substantial changes in the historical forms of organization of social life and territories. Their results corroborate that digital platforms are "embodied and grounded in different places and social relations" (HOWSON et al., 2021, p. 14) and have profound implications on the organization of urban life (STEHLIN; HODSON; MCMEEKIN, 2020). As Crawford (2021) points out, these companies can apply a sort of "microphysics of power" – disciplining bodies and their movement through space – connecting it to a "macrophysics of power" – controlling planetary time and information.

In a different key, scholars from evolutionary economic geography and international business have been investigating the locational determinants of digital platforms on a global scale. Stalkmap and Schotter (2021) offer a fruitful theorization on the internationalization of digital platforms from the perspective of the geographic scope of network externalities. According to the authors, although all platforms leverage network externalities as firm-specific advantages (FSA), it is possible to

differentiate between within-country and cross-country network externalities. Borders and distance are elements that constrain the reach of externalities. Digital platforms that mediate the delivery of goods, for example, leverage externalities constrained by distance: consumers and service providers need to be geographically close. Other elements, such as regulation cultural homogeneity, can also lead to within-country network externalities.

On the other hand, other platforms, such as app stores (Apple Store, Play Store), are constrained locally, neither by borders nor by distance. Thus, their user base benefits from cross-country network externalities. This differentiation implies different strategies for the internationalization of the platforms. Stalkmap and Schotter (2021) raise some points to be empirically tested for the two different groups of platforms: their strategies for entering new international markets (independent, for cross-country; associated with local incumbents, for within-country); their international strategic posture (global strategy for cross-country; multi-domestic strategy for within-country); and their selection of international markets (institutional/cultural proximity).

The role of institutions in the locational decision of digital platforms was investigated by Punt et al. (2021), who tested whether Uber's expansion correlates with strong economic, political, and labor institutions. They found evidence that places with solid economic institutions prioritize places, although the evidence is less conclusive for the other two sets. Their tests also indicate that Uber's mobile customer base across cities is a defining element of its expansion strategy. The importance of consumer mobility, both as a latent demand and as a legitimizing and disseminating community, stands as another type of firm-specific advantage leveraged by platforms, a possibility that was highlighted by Stalkmap and Schotter (2021). Shaheer et al. (2020) empirically address platform locational decisions from the perspective of the nature of the lead market. They investigate whether acting in specific lead markets benefits digital platforms to expand. The authors differentiate two types of lead markets: consumers with heterogeneity in demand and those with overlapping preferences. Using download data from 1,910 apps in the Apple Store over two years (2016–17) for 57 countries, Shaheer et al. (2020) support the hypothesis that operating in lead markets (of both types) accelerates the diffusion in other markets. Finally, Deng et al. (2022) analyze the transactions of a B2B (business to business) platform that facilitates the export of small and medium-sized enterprises (SMEs). They find robust evidence to corroborate that digital platforms allow the rapid internationalization of SMEs, with a significant decrease in costs, which implies higher rates of export continuity and presence in international markets.

The previous studies allow us to identify three main avenues of investigation that are taking shape within the perspective of the geography of platform economy: a) studies that focus on digitally mediated nexus of platform operations that produce and distribute value between territories that is, those that are trying to operate the concept of digital value networks; b) studies centered on the deep transformations caused by platforms on urbanization, that is, those that centralize their efforts on understanding the platform urbanism dynamics; and, c) studies that use econometric models to identify local determinants that attract platforms. Even though we diagnosed three main trends, they usually leverage well-known case studies such as GAFAM, BAT, and other well-established platforms like Uber, Upwork, and Airbnb. Recent studies also show a geographic concentration of platform controllers/owners in two world regions: the U.S. and China (RIKAP; LUNDVALL, 2021; VAN DIJCK, 2020). Our main contribution is to propose a methodology to identify platform companies, enlarging the analytical possibilities for future research on the previous avenues opened.

3. Data and methodology

3.1. Orbis database

To collect the information of products or services provided by companies, we used the largest and most complete commercial database available regarding economic-financial data, products, and ownership structure of companies. Orbis database currently covers around 425 million companies and entities worldwide. Orbis' geographical coverage is as follows: 30% of companies and entities are located in Europe; 27% in Asia; 17% in North America; 14% in Latin America and the Caribbean; 8% in Oceania; and, 5% in Middle East and Africa (BVD, 2020). Despite covering both privately and publicly traded

companies, the minority of them (about 40 million) is held under private ownership.

For each company and entity, Orbis provides identification data (such as name, address, e-mail, URL, and a brief history); productive activity or line of action (economic activities classification, description of business and products and services); economic-financial indicators (balance sheet containing 26 items, profit and loss accounting containing 26 items and other financial indices containing 33 indices); company ownership structure featuring its parent companies and subsidiaries; among other information. Bureau van Dijk collects all the previous information from more than 160 suppliers and performs a standardization task reconciling the different accounting formats, currency, fiscal period allowing us to compare different companies from different countries directly (BVD, 2020).

The information on the products and services provided by Orbis, jointly with natural language processing (NLP), allows the identification of platform companies (understood hereafter as the categories proposed by Bearson, Kenney, and Zysman (2021), i.e., "platform firm" and "platform-dependent business") and then the possibility to elaborate maps with their precise locations. Thus, we process Orbis' fields that present companies' history and their products and services descriptions. As both fields contain unstructured texts, we resort to NLP to extract the meaningful information for our analysis: the products and services provided by companies.

3.2. Natural language processing (NLP)

NLP is a field of Artificial Intelligence (AI) that makes it possible to extract information from unstructured texts that do not present metadata and cannot be easily mapped into predefined fields of a database. NLP combines the power of linguistics and computer science to analyze the rules and structure of language and creates applications capable of understanding, analyzing, and extracting meaning from texts as we write routinely. Therefore, NLP is used to understand the structure and meaning of the human language, analyzing different aspects such as syntax, semantics, and morphology, transforming this linguistic knowledge into algorithms that extract structured information from unstructured texts (INDURKHYA; DAMERAU, 2010).

NLP algorithms create a vector representation of the words, thus transforming a text into something a machine can handle through mathematical operations. With this vector representation, AI algorithms are trained by associating the input text (now a set of vectors) and the characteristics we want to extract. In this step, NLP uses supervised AI algorithms that require a training base to identify the association patterns of the input and output variables of the algorithm's problem. We use a large set of texts, called corpus, freely written by their authors as a training base. In general, the corpus contains a large volume of literary works, Wikipedia pages, news transmitted through Google News, among others, all in the language that will be analyzed. As part of the NLP process related to this paper, we can mention:

- Tokenization breaks a sequence of words into smaller semantical units called tokens. Phrase tokenization divides the continuous text into different phrases identifying the beginning and end of each, while word tokenization divides a phrase into the different words that compose it. Word tokens are usually separated by whitespace and sentence tokens by punctuation symbols. However, there are also more complex structures, such words that usually come together as collocations and phrasal verbs. To illustrate the tokenization of words, see how the following sentence is tokenized: Customer service could not be better! = "Customer service", "could", "not", "be", "better".
- Marking part of speech (PoS) involves adding a category to identify the grammatical class to each token within the text. PoS markup is essential for identifying the relationships between words and understanding the meaning of sentences. Common PoS tags are verb, adjective, noun, pronoun, conjunction, preposition, and intersection. In this case, the words of the example above will be associated with the following tags: "Customer service": NOUN, "no": ADVER, "could": VERB, "be": VERB, "better": ADJECTIVE, "! ": PUNCTUATION.
- Dependency analysis: Dependency grammar refers to the way words in a sentence are connected. Therefore, an algorithm identifies how the "headwords" are related and modified by

other words to understand a sentence's syntactic structure. The dependency analysis marker identifies grammatical structures such as subject, verb, direct and indirect object, and predicate.

To perform the tokenization, PoS, and dependency analysis steps, we use the Python spaCy[2] library trained from a corpus built collaboratively between BBN Technologies, University of Colorado, University of Pennsylvania, University of Southern California, Emory University, Princeton University. It includes several text genres such as news, telephone conversations, weblogs, internet news, and talk shows, thus capturing different uses of words and contexts[3].

The AI algorithm implemented in spaCy is trained using this corpus, thus creating a statistical model of association of each word with its markup: a tokenization separator character, a grammatical class, a dependency relation.

It is noteworthy mentioning that when we train the algorithm, we not only want it to memorize the records contained in the training base (corpus) but also to identify a pattern of association between these records and the characteristics we want to identify and generalize this pattern to other records. That is what makes AI algorithms predictable.

3.3. Identifying the different products and services of the companies

Information about the products and services of the companies contained in Orbis is available either in the "Description and history" or "Product and services" description fields. Those fields are unstructured text and may contain other information besides the description of products and services (see Table 1 for an example). Thus, it is necessary to use NLP tools to identify the sentences in which products and services are described and get these products.

Even though Orbis “capture[s], treat[s] and standardize[s] data from a wide range of sources to provide (…) value-added company information” (BVD, 2020, p. 03) about public and private firms (including bank and insurance companies) from all countries, there are lacking information in the database. To give an idea of Orbis's complexity, richness, and limitations, we present Table 1, containing a sample of an identified firm: MercadoLibre. The company has its headquarters in Buenos Aires and is the leading Latin American platform whose biggest market in the region is Brazil, and it represents 55% of the firm's total income (ALTIMARI, 2021). Note, however, that Orbis shows three results for MercadoLibre: one firm located in Argentina, one in Colombia, and another in the U.S. There is much more information available for the U.S. affiliated firm, while for the Colombian counterpart, there are just a few details.

After the previous caveat, the first step is identifying the words marked as a verb by the PoS. We identified the verbs following the procedure described above using a sample of 150,000 companies collected on Orbis. We chose to locate the verbs because this would be the easiest way to identify the action related to each sentence to identify later the one associated with production. Then, among all verbs identified, we picked up those associated with phrases that effectively describe the products and services of the companies and, considering those with occurrence greater than 100 (relative frequency above 0.1%), we obtain the following list of verbs associated with the products and services: engaged, providing, including, provides, include, provide, engage, offers, includes, sell, produced, manufacturing, rent, develop, make, sells, producing, selling, offering, specializing, developing, distributes, produces, deliver, manufactures, produce, design, processing, fabricated, focuses, engages, forging, making.

After identifying the verbs associated with the products and services, in the second step, we selected only phrases that present such verbs in the history, product, or trade description fields and, using the spaCy dependency analysis markup, we identified the direct or indirect objects associated with them. Therefore, those objects are the products and services the analyzed companies provide.

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[2] https://spacy.io/

[3] We are aware that text archives are not neutral collections of language. “There are no neutral ground for language, and all text collections are also accounts of time, place, culture, and politics.” (CRAWFORD, 2021, p. 103). With that in mind, we opt to use spaCy to identify verbs and the direct or indirect objects associated with them, so possible bias does not interfere with our analysis.

Figure 1 illustrates the dependency analysis and shows how such marking allows the identification of direct and indirect objects.

Table 1 – Example of Orbis information available on products/services and history of companies listed in the database

Company name	MercadoLibre Inc.	MercadoLibre Colombia Ltda	MercadoLibre SRL
ID number	US980212790	CO170001515680	AR30-70308853-4
Country code	US	CO	AR
City	-	Bogota	Buenos Aires
NACE (*)	7490	6209	-
Trade description	MercadoLibre, Inc. is an e-commerce company. The Company enables commerce through its *marketplace platform* in Latin America, designed to provide users with a portfolio of services to facilitate commercial transactions. Its geographic segments are Brazil, Argentina, Mexico, Venezuela, and Other Countries (…).	Technology and computer service activities	Operates an online trading platform in Latin America
Products and services	Classifieds service that enables users to list their offerings related to motor vehicles, vessels, aircraft, real estate, and services outside the *marketplace platform*; and MercadoPago, an integrated online payments solution to facilitate transactions on and off the MercadoLibre Marketplace by providing a mechanism that allows its users to send and receive payments online (…).	Offers a marketplace, an online trading service that permits businesses and individuals to list items and conduct sales and purchases online in a fixed-price or auction-based format; and MercadoPago online payments solution, an integrated online payments solution	Latin America
Description and history	MercadoLibre, Inc., incorporated on October 15, 1999, is an e-commerce company. The Company enables commerce through its *marketplace platform* (…) in Latin America. The Company's platform is designed to provide users with a portfolio of services to facilitate commercial transactions (…). The Company offers its users an ecosystem of six integrated e-commerce services: the MercadoLibre Marketplace, the MercadoLibre Classifieds Service, the MercadoPago payments solution, the MercadoLibre advertising program, the MercadoShops online Webstores solution, and the MercadoEnvios shipping service. (…) The Company competes with Rakuten, Amazon, B2W Inc., Cnova, Aliexpress, Netshoes, Dafiti, Casas Bahia, Walmart, (…), Facebook, Google, Amazon, Microsoft, Yahoo!, Paypal, DineroMail, Bcash, PagSeguro, Western Union, PayU, MOIP, Alamaula.com, OLX.com, and QueBarato.	-	MercadoLibre SRL

Source: Authors' own. Data sourced from Orbis, Bureau van Dijk. Note: (*) NACE stands for *Nomenclature statistique des activités économiques dans la Communauté européenne*

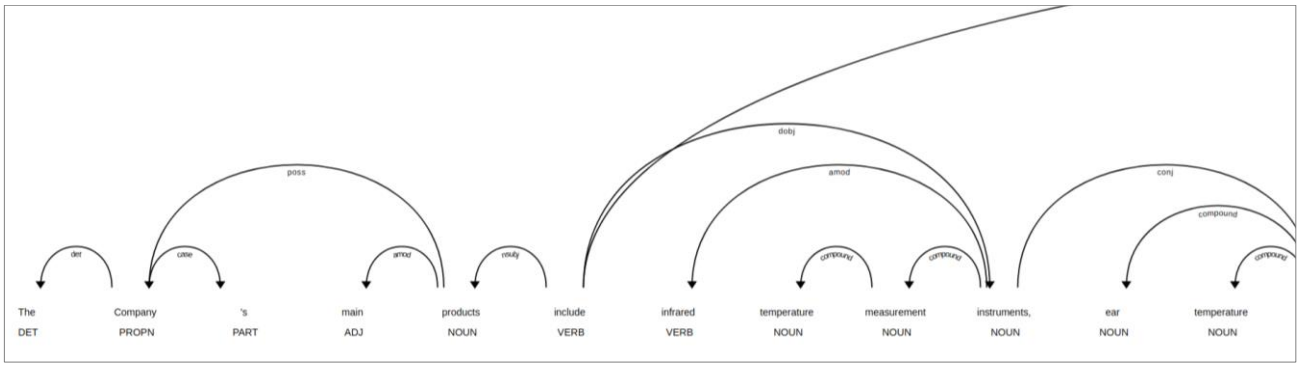

Figure 1 – Example of dependency analysis markup

Source: Authors' own.

3.4. Applying the NLP to support the identification of platform companies

Our first step is to depart from twenty digital multisided platform companies[4] listed in Fortune's Digital 100 identified by Acs et al. (2021) and retrieve their product/service description texts on Orbis, using the fields: "Description and history", "Product and services", and "Trade description" as shown in Table 1. Then, we applied the NLP described in the previous section to identify products and services provided by those digital multisided platform companies, which allowed us to create a first list with the 37 most often terms (Table 6, column 1, Annex). The result showed over 16 thousand firms.

We gathered the terms related to platforms from that first list (Table 6, Annex), and while adding up other 12 terms known to be related to this area, we excluded other 20 once they resulted in many "false negative" firms (Table 6, column 2, Annex). We then implement another search on Orbis, looking up the terms of this second list in the fields that may presented information regarding products and services. Thus, we got a broader set of firms whose information we also retrieved and analyzed using NLP as in the previous step. We updated our second list, including the other seven terms related to platforms, and excluding three terms from the second list and our final list had 33 terms (Table 6, final column, Annex) which allowed us to identify 3,147 platform companies.

4. A first attempt to map the world platform-related economy

4.1. Economic sector

Our mapping reached a total of 3,147 platform companies. Figure 2 shows the dispersion of the founding date of these companies by year. It is possible to notice that the vast majority were founded after the commercial opening of the internet in the mid-1990s. There are also two very noticeable and historically well-characterized growth spikes. The first, in the 1990s, concerns the founding's (and financing) boom of "internet companies" that culminated in the Dot-com crisis in 2000. The growth in the number of new companies resumed from approximately 2002 onwards, to suffer a sharp retraction with the financial crisis of 2008. Finally, the 2010s witnessed the expansion of the platform model, reaching the mark of more than 300 companies a year in the middle of the decade. These data corroborate the perception that we live in the era of "platformania" (CUSUMANO; GAWER; YOFFIE, 2019), and we are under a "platform revolution" (PARKER; ALSTYNE; CHOUDARY, 2016).

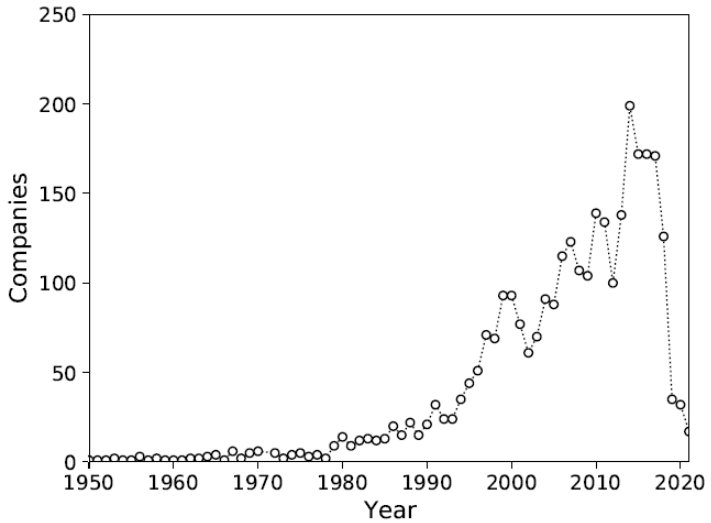

Figure 2 – Platform companies by incorporation year, 1950–2021

Source: Authors' own. Data sourced from Orbis.

[4] They are Activision Blizzard, Alibaba; Alphabet; Amazon; Apple; Baidu; Booking Holdings; eBay; Facebook; Fidelity National Information; Fiserv; JD.com; Microsoft; Naspers; NetEase; Nintendo; PayPal; Rakuten; Recruit Holdings; and Tencent.

However, it should be noted that there are also a considerable number of companies whose foundation dates back to the pre-Internet era. Even among the big techs, this period's representative (e.g., Microsoft and Apple, established respectively in 1975 and 1976). Many companies have been following the sector's evolution since before the Internet age. There is probably another group that, although not dedicated initially to digital services, transformed its organizational model to include platform services at some point. In short, while there is a preponderance of "born digital" companies, there is also a not inconsiderable number of analog companies that have carved out their place in the platform economy.

Regarding the sectoral concentration, it is possible to observe Table 2. Although only one section concentrate more than 50% of platform companies – "information and communication" (NACE "J") – (Table 2), we can identify platform companies in all sectors but two: "activities of households as employers" (NACE "T") and "activities of extraterritorial organizations and bodies" (NACE "U"). It is also noticeable that "professional, scientific and technical activities" (NACE "M") and "manufacturing" (NACE "C") concentrate each about 9% of total firms (Table 2).

Table 2 – Platform companies according to NACE Rev.2 sections

Section	Description	N.	%
J	Information and communication	1,589	54.7%
M	Professional, scientific and technical activities	283	9.7%
C	Manufacturing	271	9.3%
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	250	8.6%
K	Financial and insurance activities	170	5.8%
N	Administrative and support service activities	112	3.9%
R	Arts, entertainment and recreation	76	2.6%
H	Transportation and storage	28	1.0%
S	Other service activities	19	0.7%
I	Accommodation and food service activities	18	0.6%
L	Real estate activities	18	0.6%
F	Construction	17	0.6%
P	Education	17	0.6%
Q	Human health and social work activities	12	0.4%
B	Mining and quarrying	10	0.3%
A	Agriculture, forestry and fishing	6	0.2%
D	Electricity, gas, steam and air conditioning supply	5	0.2%
O	Public administration and defense; compulsory social security	4	0.1%
E	Water supply; sewerage, waste management and remediation activities	1	0.0%

Source: Authors' own. Data sourced from Orbis. Note: NACE was available for 92% of our database.

Considering only "information and communication," it is possible to observe that, while being in all sectional divisions (from NACE 58 to 63), there is a high division concentration in "information service activities" (35.8%), "publishing activities" (26.8%) and "computer programming, consultancy and related activities" (26.1%) (Table 3).

It is also possible to observe a high concentration in only a division of the "manufacturing" section (NACE 10 to 33): "Manufacture of computer, electronic and optical products" (41.7%). And in what regards "professional, scientific and technical activities" (NACE 69 to 75), 30.7% refers to "advertising and market research" and 44.2% to "other professional, scientific and technical activities".

Table 3 – Platform companies according to NACE Rev.2 division of sectors "J", "C", and "M"

Sector	Division	N.	%
J - Information and communication	-	1,589	100
Publishing activities	58	426	26.8
Motion picture, video and television programme production, sound recording and music publishing activities	59	17	1.1
Programming and broadcasting activities	60	30	1.9
Telecommunications	61	133	8.4
Computer programming, consultancy and related activities	62	414	26.1
Information service activities	63	569	35.8
C - Manufacturing	-	271	100

Sector	Division	N.	%
Manufacture of wearing apparel	14	8	3
Printing and reproduction of recorded media	18	23	8.5
Manufacture of basic pharmaceutical products and pharmaceutical preparations	21	20	7.4
Manufacture of computer, electronic and optical products	26	113	41.7
Manufacture of electrical equipment	27	8	3
Manufacture of machinery and equipment n.e.c.	28	14	5.2
Other manufacturing	32	30	11.1
Others	-	55	20.3
M - Professional, scientific and technical activities	-	283	100
Legal and accounting activities	69	4	1.4
Activities of head offices; management consultancy activities	70	52	18.4
Architectural and engineering activities; technical testing and analysis	71	9	3.2
Scientific research and development	72	5	1.8
Advertising and market research	73	87	30.7
Other professional, scientific and technical activities	74	125	44.2
Veterinary activities	75	1	0.4

Source: Authors' own. Data sourced from Orbis.

4.2. The global distribution of digital platform companies

In Figure 3, we plot the host cities of platform companies on the world map. In addition, countries are colored according to the concentration of digital platforms at the national level. The main takeaway from this map is that the platform economy is a global phenomenon. Not only restricted to the Global North, but it also spreads, albeit unevenly, to the Global South.

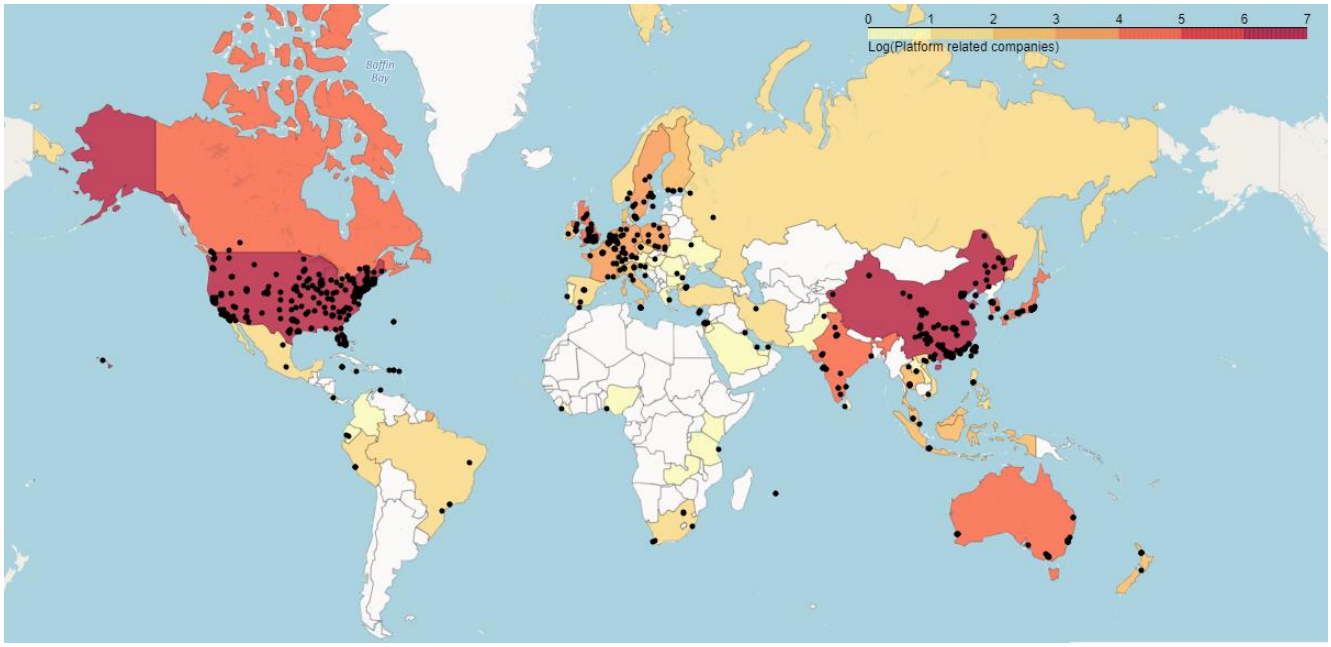

Figure 3 – Concentration of platform companies by country and location of cities where those companies were identified

Source: Authors' own. Data sourced from Orbis.

The recurrence of platform studies focused on the U.S. and Chinese cases, as demonstrated in section 2) is not by chance. The map illustrates how the U.S. and China are the two main poles of the platform economy, concentrating 27.2% and 32.8% of the world's platform companies (Table 4 and Table 5). That corroborates once again their lead in the global platform race. The visualization also makes it possible to identify an uneven distribution within these two countries. China's platform companies cluster in the east of the country, where only six cities (Hangzhou, Shanghai, Shenzhen, Guangzhou, Shen Zhen, and Zhuhai) concentrate 38% of Chinese platform companies. Shenzhen is the city with most platform companies globally, followed by Beijing. Shanghai features in the fifth position (Table 5).

Table 4 – Platform companies by selected countries

Countries	N.	%
China	1,031	32.8
United States of America	855	27.2
“Tax haven” countries	320	10.2
Cayman Islands	165	5.2
Singapore	57	1.8
Netherlands	20	0.6
Hong Kong	18	0.6
Bermuda	17	0.5
Ireland	16	0.5
Other Tax haven” countries	27	0.9
Great Britain	124	3.9
Japan	117	3.7
South Korea	84	2.7
Australia	73	2.3
Taiwan	65	2.1
India	62	2.0
Canada	59	1.9
Other countries	357	11.3
Total	3,147	100.0

Source: Authors’ own. Data sourced from Orbis.

Table 5 – Top 30 cities with most platform companies

Ranking	Cities	Countries	N.	Ranking	Cities	Countries	N.
1	Shenzhen	CN	231	16	Stockholm	SE	25
2	Beijing	CN	102	17	Taipei	TW	25
3	George Town	KY*	100	18	Zhuhai	CN	24
4	New York	US	76	19	San Jose	US	24
5	Shanghai	CN	74	20	Seongnam-si	KR	23
6	London	GB	73	21	Vancouver	CA	22
7	Tokyo	JP	64	22	Chicago	US	21
8	Singapore	SG*	56	23	Mumbai	IN	21
9	Seoul	KR	52	24	Hangzhou	CN	17
11	Guangzhou	CN	49	25	Hefei	CN	17
10	Grand Cayman	KY*	42	26	Toronto	CA	17
12	Las Vegas	US	34	26	Hamilton	BM*	16
13	San Francisco	US	32	27	Chongqing	CN	15
14	Xian	CN	31	28	Sydney	AU	15
15	Wuhan	CN	29	29	Taiyuan	CN	15

Source: Authors’ own. Data sourced from Orbis. Note: (*) Tax haven countries. Cities were available for 95% of our database

North-American platform companies locate on the east and west coasts, and their density is much lower in the Midwest. The agglomeration is mainly in California, where a few cities concentrate 17% of U.S. platform companies (San Francisco, San Jose, Los Angeles, Irvine, Sunnyvale, Santa Clara, Santa Monica, Wilmington, San Mateo, San Diego, Palo Alto and Redwood City) and in the Boston-New York-Baltimore polygon whose concentration arrives at 12%. New York is the U.S. city with the most platform companies and features fourth in the global ranking (Table 5).

Even though China and the U.S. are the two countries with the most platform companies in the world, Figure 3 and Table 4 also illustrate other countries with a high concentration of platforms: Great Britain (which seems to have a relatively more equal geographical distribution of platform companies if compared to other countries), Japan (mainly in Tokyo metropolitan area), South Korea (Seoul metropolitan area), Australia (mainly in Sydney and Melbourne), and Canada (mainly concentrated in Vancouver and Toronto areas). Figure 3 depicts as well, to a much lesser extent, the presence of the platform company model across other European countries such as Sweden, France, the Netherlands, Italy, and Denmark.

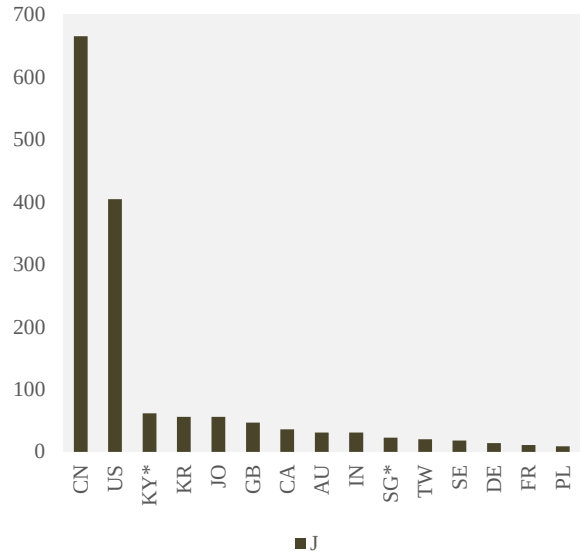

Figure 4 – 15 countries with the highest concentration of platform companies from section NACE "J"

Source: Authors' own. Data sourced from Orbis. Note: (*) Tax haven countries.

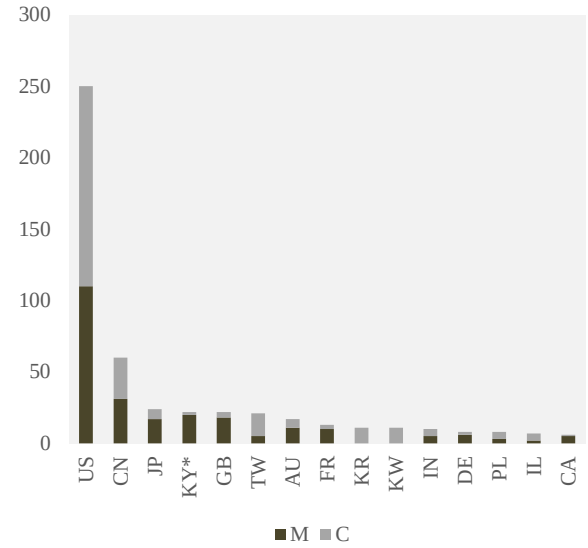

Figure 5 – 15 countries with the highest concentration of platform companies from section NACE "M" and "C"

Source: Authors' own. Data sourced from Orbis. Note: (*) Tax haven countries.

There are also geographic voids, mainly in the Global South[5]. Notwithstanding that, there are in those areas relatively more economic dynamic centers such as, Bangkok (Thailand), São Paulo (Brazil), Tehran (Iran), and Nairobi (Kenya) where we observe the (timid) presence of platform companies. Mumbai and Bangalore (India), especially the former that appears within the world top-30.

Observing platform companies hosted in different countries according to the three sectors with more companies (Table 2) – "information and communication" (section "J"), "professional, scientific and technical activities" (NACE "M"), and "manufacturing" (NACE "C") – we can observe that platform companies from sector "J" are relatively more concentrated in China and in the U.S. vis-à-vis the counterpart companies from sectors "M" and "C" which are more distributed geographically. It is interesting to note that while China is the location of the majority of platform companies from sector "J", the U.S. is the home location of most platform companies from sectors "M" and "C", followed by China (Figure 4 and Figure 5).

4.3. Tax havens and global distribution of digital platform firms by NACE

Countries commonly known as "tax havens"[6] concentrate 10.2% of the world's platform companies (Table 4). The Cayman Islands, for instance, ranks in the third position, only after China and the U.S. (Table 4). Georgetown (KY) is the third city in the world with the highest number of those firms (Table 5). For instance, PagSeguro – a Brazilian fintech platform company engaged in the operation and management of a mobile payment-based e-commerce service for commercial operations – was established in São Paulo in 2006 and was the fastest-growing company in the sector in the country (SACHS, 2018). Although its development office (PagSeguro Internet S.A.) is still located in Brazil, its headquarters (PagSeguro Digital Ltd) has been in Georgetown since 2018. PagSeguro's offices are portrayed in Figure 3, one tiny dot in Brazil and another in the Caribbean.

[5] Although we cannot point out the reason for the geographic gaps, some possible explanations that can be investigated are: Orbis indexes only larger companies or public companies, which favors finding a greater concentration in countries where the platformization originated. In other words, the database would not be adequate to capture startups and smaller companies that, as we know, started a catch-up movement in the countries of the Global South. Another possible explanation is the lack of telecommunications infrastructure in the Global South, which presents a considerable risk for digital multinationals (Nambisan, Luo, 2022).

[6] Corporate tax havens considered the classification on Oxfam International: Bermuda, Cayman Island, the Netherlands, Switzerland, Singapore, Ireland, Luxembourg, Curacao, Hong Kong, Cyprus, Bahamas, Jersey, Barbados, Mauritius, and, British Virgin Islands.

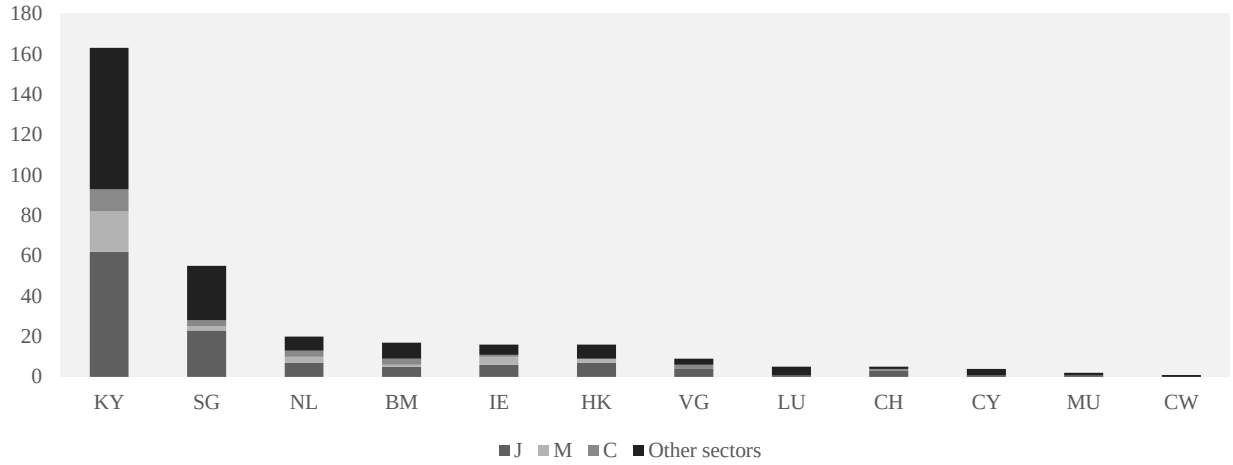

Figure 6 – Platform companies located in tax havens, per NACE section

Source: Authors' own. Data sourced from Orbis.

Some caveats about the expressive number of companies in tax havens: First, the Netherlands and Ireland are included in this group. Although they are considered tax havens, both also have a dynamic platform economy. It is also possible to observe that most platform companies located in Ireland are from sector "K" while in the Netherlands, the record is more equally distributed among sectors (Figure 6). Therefore, it is incorrect to interpret that all platform companies registered in these countries follow a "tax-driven" and "offshore jurisdiction" locational logic. Even for other countries, such as Hong Kong, it would be necessary to link this registry in search of tax benefits to headquarters and branches in other locations.

5. Discussion

Our data on platform companies may be used for providing new insights for the three main avenues of investigation presented in section 2. In what regards, the first avenue identified, i.e., "digital value network dynamics", with our database, it is possible to access information on corporate ownership structures and beneficial ownership information. Consequently, we will be able to understand the ownership network structure of those companies. In the map depicted in Figure 4, companies were pointed to the cities where their offices are located. However, no ownership was revealed. Many companies, mainly from the Global North, are parents of subsidiaries and affiliates spread around the globe.

This is paramount to see how multinationals control value extraction mainly in the developing world and understand their mergers and acquisitions strategies. Our data also allowed us to see that many platform companies are located in tax havens, and this fact is of extreme importance to understanding the value appropriation flows in the platform economy.

Studies centered on the deep transformations caused by platforms on urbanization may also benefit from our approach, as they can identify the main hubs of platform companies in the world, besides the well-known mapped cases. They can also draw on our data to propose comparative studies between cities with similar profiles but distinct platform attributes (or cities with similar platform attributes but distinct profiles).

Finally, those studies that aim to identify local determinants that attract platforms may also benefit from our work. The beginning of the sectoral characterization that we propose is to identify patterns of geographic specialization in the platform economy. The mapping of these regions would allow more robust analyzes to test explanatory variables of the specialization or clustering of platforms. Our exploratory study found interesting patterns, such as the number of platform companies in a country and their GDP (Figure 7). Therefore, it is necessary to elaborate on rigorous econometric models to understand this correlation better.

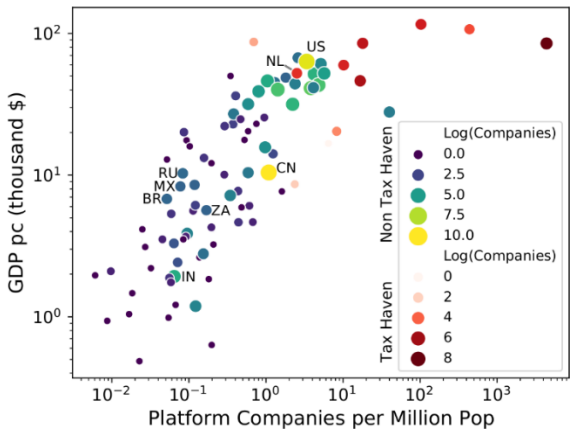

Figure 7 – Relation between 2019 GDP per capita and platform companies per million inhabitants

Source: Authors' own. Data sourced from the World Bank (for GDP), Orbis (for Platform companies), and Oxfam International (for corporate tax havens).

6. Conclusion and challenges

The paper's first objective was to present a novel methodology using data science and artificial intelligence tools to identify platform companies, and our second objective was to locate those firms geographically at the city level. We spatially located over three thousand platform companies, reinforcing the hypothesis that "platforming" is a worldwide phenomenon. In summary, we observed that our group is formed by a majority of firms “born” in digital era, accompanied by a non-negligible number of "traditional" companies; that they are concentrated in "information service activities", "professional, scientific and technical activities" and "manufacturing"; they are concentrated in China and the U.S. with a substantial presence in Great Britain, Japan, South Korea, and Australia. While there is evidence that shows there are platform companies in some dynamic countries in the Global South such as India, Thailand, Brazil, Iran, and Kenya, a great deal of them is located in tax haven countries as the Cayman Islands, Singapore, the Netherlands, Hong Kong, Bermuda and Ireland. The dynamics of the platform ecosystem is very complex, so it is its geography of production, consumption, and value extraction. Due to its reach and pervasiveness, platforms are affecting a wide variety of industrial sectors (KENNEY; BEARSON; ZYSMAN, 2021), as we showed in Table *2*, are transforming old industrial spaces (JEANNERAT; THEURILLAT, 2021).

Although we used natural language processing advanced techniques to screen what we called "platform companies" in an extensive database, there are significant limitations. The first one relates to our starting point. We used a small list of twenty big platform companies to select our first query words. A second limitation refers to the constraints related to the database itself. We were able to identify thousands of companies from the description of their products and services. However, we have no control over the quality of the information available. Even though missing information is a small portion, there is no pattern of information presented by firms in Orbis.

In some cases, there are many detailed materials, and in others, the description is so limited that it hardly ever describes precisely the products the firm offers. That happened, for example, in the case of MercadoLibre, as we presented in the paper. It was not considered in our map in Argentina, even though we know it is one of the most critical platform companies from Latin America, because its description in Orbis, as demonstrated in Table *1*, was very superficial and inaccurate and did not use any of our query words (Table *6*, Annex). MecardoLibre information for its headquarters in Buenos Aires was only "[it] operates an online trading platform in Latin America." Our algorithm was not able to match our query words with that sentence. It may also partially explain the void in some parts of the map, as in Latin America: how many other companies in the region had slight information available, as MercadoLibre, which were not captured by our algorithm? One possible way to avoid that is to use more keywords and "train" our algorithm using another dataset.

Even though we identified over three thousand companies, many other platform companies are not in Orbis once they are startups. Since we are trying to see the big picture of the platform economy, we may be missing essential infant companies, especially in many dynamic and creative cities in the Global South. Another limitation of our approach derives from the terms retrieved in the query related to a digital platform (Table *6*, Annex): some words may result in some false-negative firms, i.e., they may be identified as platform companies by our algorithm, but they are not. In other words, we may be considering firms that are not at all platform companies. Consequently, we still need to make tests to check the robustness of our list. Finally, our study does not capture all three main actors of digital platform ecosystems: platform firm (owner/sponsor/controller), platform-dependent business (complementor/third-party), and users (or consumers/prosumers). Our database comprises "platform firms" and "platform-dependent business"; however, no prosumers are on our list. This is an important caveat to be considered once we are not covering the whole platform ecosystem but parts of it. For a complete picture, it would be necessary to complement more data.

Even so, fulfilling the function of an exploratory study, our work raised promising paths. We highlight the detailed investigation of the role of tax havens in the geography of platforms, which dialogues directly with the agenda proposed by Kenney and Zysman (2020, p. 72) of "measure the amount of value that these platforms extract from users in developing countries." Second, we intend to expand our analysis using a complete Orbis database, with data from offices and headquarters from all 3,147 platform companies mapped. This will allow us to identify a network of connections and generate a ranking of the central cities of the platform economy in the World Cities style (BRAIL, 2020). This ranking based on the number of comics and connections between comics and offices in a city will allow a glimpse of "where the power and value will be concentrated" (KENNEY; ZYSMAN, 2020, p. 72) in the platform economy.

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Annex

Table 6 – Lists of terms retrieved in the query related to digital platform

1st List	2nd List	Final List
application programming interface		
cloud computing		
cloud-based solution	cloud service	
data-centric cloud		
digital banking		
digital content		
digital payment	digital marketplace *digital payment*	digital marketplace *digital payment*
ecommerce	digital platform	digital platform
e-commerce		
electronic media		
electronic payment		
e-media		
e-payment	*e-payment*	*e-payment*
fintech service		
	innovation platform	innovation platform
	internet marketplace	internet marketplace
	internet platform	internet platform
intelligent cloud		
internet search solution	*internet search solution*	*internet search solution*
internet shopping	*internet shopping*	*internet shopping*
marketplace platform	*marketplace platform*	*marketplace platform*
mobile devices		
mobile game	*mobile game*	*mobile game*
mobile payment	*mobile payment*	*mobile payment*
mobile platform	*mobile platform*	*mobile platform*
network service		
mobile service		
online advertising service	*online advertising service*	*online advertising service*
online booking	*online booking*	*online booking*
online game	*online game*	*online game*
online gaming	*online gaming*	*online gaming*
	online marketplace	online marketplace
	online platform	online platform
online reservation	*online reservation*	*online reservation*
online retailer		
		online social media
	online trading platform	
payment platform	*payment platform*	*payment platform*
payment service		
search engine	*search engine*	*search engine*
serverless computing	*serverless computing*	*serverless computing*
web application		
	social game	
		social media
		social media content
		social media management
		social media marketing
		social media strategy
social network	*social network*	*social network*
		social networking services
	software platform	software platform
	transaction platform	transaction platform
web portal		

Source: Authors' own.