State-Company Institutional Complementarities on Biomedical R & D in the US and Its Global Consequences

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Financial accumulation and technological dominance by transnational biopharmaceutical companies—and its global consequences—have been an important research topic at innovation economics, institutional economics, and international political economy literature. The United States is a privileged field for investigation, as it is home both for the companies that control the core of this industry and for the highest State-led investments on biomedical research and development (R & D). New analytical approaches that focus on State-Company interactions identify dysfunctional relations on risks and rewards. However, a neglected angle on this debate is the geopolitical dynamics surrounding market concentration, knowledge control, and technological asymmetry in the biopharmaceutical sector. This paper combines a qualitative analysis of State-Company institutional complementarities in the biopharmaceutical sector, comprised by analysis of selected official documents, review of empirical data and a case study, with a theoretical investigation inspired on the institutional thought of Torstein Veblen, the structuralism of Susan Strange and the realistic approach to international political economy of José Luis Fiori. We propose a new analytical framework in which State-Company interactions in the US are seen as symbiotic, taken under the systemic functioning of a “medical-technological-financial-complex”, what suggests “biopharmaceutical geopolitics” as an important field for future studies.

Keywords: biopharmaceutical industry, US hegemony, financial accumulation, technological asymmetry

Since 2014, pharmaceutical industry’s global income exceeded one trillion dollars (Packaging World, 2017). According to the “Fortune 500” ranking, by Forbes Magazine, the pharmaceutical sector has the highest profit margins among all industries, leaving behind the energy and financial sectors, with an average profit margin of 17.44% between 1995 and 2015 (Roy & King, 2016). The pharmaceutical company with the best performance in 2015, the US-based Gilead Sciences, achieved the impressive profit margin of 55% (Securities and Exchange Comission, 2016). It is also important to note that some characteristics of the pharmaceutical market favors concentration, such as high levels of product differentiation, high entry barriers for new competitors, inelastic demand and asymmetry of information (Agência Nacional de VigilânciaSanitária, 2003). In fact, also between 1995 and 2015, around 60 companies became only 10 companies through mergers & acquisitions (M & A) (Genpact, 2017). The formation of oligoplies is also a historical trend in this sector (Drahos & Braithwaite, 2002).

Scholars have been addressing these unique features of pharmaceutical industry under different frames,
such as “differential accumulation” (Nitzan, 1998), “value extraction” (Mazzucato & Roy, 2017), “financialized business model” (Lazonick, Hopkins, Jacobson, Sakinç, & Tulum 2017), and “global governance of knowledge” (Drahos, 2002). All these frames, in different degrees, point to a process of “corporate capture”, whereas State function, regulations, and institutions are shaped by business interests, leading to dysfunctional State-Company relations and a disproportional relation between innovation/production and earnings. These analyses are essential considering that the corporate-led accumulation model that rules the pharmaceutical sector dictates, at the same time, the conditions for access to essential medicines and other health goods, which can thus represent major social consequences for entire populations.

However, a neglected angle in the debate refers to the geopolitical dynamics surrounding the market concentration, knowledge control and technological asymmetry observed in the pharmaceutical sector. Considering many empirical analyses indicating that this is an oligopolistic sector, because despite the large number of companies just a small fraction of them concentrate the larger piece of the global market, and considering that there is a core made of just a few firms, who dictate the direction and evolution of the industry as a whole (Baranes, 2016), we must acknowledge that, in this core, there is a major presence of US-based companies. Therefore, it is worth asking what factors have enabled such a hegemony in this particular industry and what are their geopolitical implications.

To respond to this question, we propose a look to the institutional complementarities that mark the US pharmaceutical sector to then analyze them in the light of the institutional thought of Torstein Veblen (1967), the structuralism of Susan Strange (1994), and the realistic thought of Jose Luis Fiori (2004b).

The findings are based on a qualitative research performed using selected official documents issued by the US government as primary sources and other studies and analyses as secondary sources. The methodology also includes a case study focused in one particular US-based pharmaceutical company, namely Gilead Sciences, using as main source data from reports submitted by the company to the US Securities and Exchange Commission (SEC). In total, we analyzed 40 official documents: 17 related to strategic priority-setting and 23 related to the institutional architecture of the US-government funded biomedical research institutions and programs. For the case study, we analyzed 21 reports submitted by Gilead to SEC and used six public databases.

The purpose of this research is to explore a new analytical framework to understand the State-Company complementarities on biomedical R & D in the US and propose a preliminary theoretical investigation into the relationships between technological, military, and financial objectives in the biopharmaceutical sector. The research also draws attention to the connections and interferences between innovation economics, institutional economics and international political economy in this particular technological field. Hereafter, we will use the term biopharmaceutical industry, considering the considerable increase on biotechnology based products, that already represent 25% of the pharmaceutical market (Evaluate Pharma, 2017).

**State-Company Institutional Complementarities on Biomedical R & D in the US**

The US was home in 2016 to six of the 10 largest biopharmaceutical companies, ranked by income volume, including the top three in the ranking (Igeahub, 2017). According to Organisation for Economic Co-operation and Development (OECD) evaluation, from 2009, the US was the destination of 68% of venture capital invested in life sciences (Salter, 2011). In biotechnology, that is now driving most of the new trends in the life sciences sector, the US is the first in number of companies, patent applications and in number of treatments approved by regulatory agencies (The Balance, 2019).
As the US is widely recognized as a liberal market economy (LME), such numbers could be attributed to company-led investments, but, in reality, in the biopharmaceutical sector, the US has a large presence of State-led investments, or what Mazzucato (2013) would call an “entrepreneurial state”, who actually creates value.

In effect, at the same time, the US has the largest venture capital market. It has also the largest scientific research base in the world (Department of Commerce, 2016), formed by solid academic institutions that count on substantial government funding. This combination of regular and substantial public investments in one hand and a robust ecosystem of investors and stock markets in the other hand is actually the cornerstone of US hegemony in the biomedical sector (Salter, 2011). The two institutional arrangements are connected through regulations and dynamics that lead to concentration of knowledge and power in the hands of big US-based biopharmaceutical companies, which benefit directly from licensing and transfer of research made by public institutions, or indirectly using financial market dynamics to do mergers & acquisitions (M & A) of smaller companies that, by their turn, emerged from the combination of government-led investments and venture capital investment. Looking to the biotechnology field, for example, we can notice that the major clusters are formed right in the cities that have a solid venture capital scene and a strong network of universities and research institutes, such as Boston and San Francisco, the two main biotechnology clusters in the US today (Owen, 2017).

In the biopharmaceutical sector, state investments are particularly led by the Department of Health and Human Services (DHHS) and the Department of Defense (DoD). According to data from the American Association for the Advancement of Science (AAAS), the biomedical discipline, which is a subgroup of the life sciences, is the top target of federal investments since 1984 (Department of Commerce, 2016), especially due to outstanding investments by the National Institute of Health (NIH), linked to DHHS. These investments increased at a faster pace since the late 90’s.

The NIH has 27 research centers and invests around U$41.7 billion per year on biomedical research (National Institutes of Health, 2020). More than 80% of this amount is directed to “extramural” research, which means projects performed outside NIH centers. Every year, around 50,000 grants are given to more than 300,000 researchers in more than 2,500 universities, medical schools, and research institutes, inside and outside the US (National Institutes of Health, 2020). Only 10% of NIH’s budget is spent in “intramural” projects, which are those performed by NIH laboratories, where around 6,000 scientists work. The reach of NIH funding is impressive, a recent study found that between 2010 and 2016, all (100%) new molecular entities (NME) approved in the US market were connected to publications and projects funded by NIH (Galkina, Beierlein, Khanuja, McNamee, & Ledley, 2018, p. 4).

In 2016, considering the investments made by NIH and other DHHS related institutes and agencies, namely, the Center for Disease Control and Prevention (CDC), the Center for Medicare and Medicaid Services (CMS), the Food and Drug Administration (FDA), the Agency for Health Research and Quality (AHRQ), the Biomedical Advanced Research and Development Authority (BARDA), and the Bioshield project, the total found was U$35.2 billion (Carvalho, 2019).

In general numbers, the Department of Defense (DoD) has 22 research institutes involved in biomedical research, out of which 10 are managed by the Army (three of them located outside the US), nine managed by the Marine (four of them located outside the US), two managed by the Air Force, and one related to the Defense Department as a whole. This represents 35% of the DoD network of laboratories and research centers,
comprised by 63 institutions (Government Accountability Office, 2018, p. 1). Furthermore, four out of the 18 agencies connected to the Office of the Secretary of Defense coordinate and/or execute biomedical research. Also, the DoD has 167 Military Treatment Facilities (MTFs) (Tier Seven, 2017b) that are often used for clinical trial purposes.

In 2016, the identified investments made by DoD in biomedical related research totals US$4.2 billion (Carvalho, 2019), considering funds provided by the Defense Health Program (DHP), the Congress Directed Medical Research Program (CDMRP), the Clinical Investigation Program (CIP), the Chemical and Biological Defense Program (CBDP), the Defense Advanced Research Projects Agency (DARPA), the Office of Naval Research (ONR), the Army Research Office (ARO), and the Air Force Research Laboratory (AFRL).

It is worth highlighting that although DoD investments are much smaller in comparison to the DHHS, they have important particularities, such as the fact they are normally mission-oriented, have a focus on radical innovation, and take a multidisciplinary approach, focusing on the convergence between different fields of knowledge. Therefore, DoD has a strong capacity to move the technological frontier, exploring new concepts and creating new disciplines, as synthetic biology for example (Carvalho, 2019), that later on are explored for commercial purposes. In summary, as DoD supports R & D to sustain US military and technological superiority, the investments are driven towards high risk innovations, that when successful have a huge impact on scientific and technological progress.

Adding the total investments identified at DoD level (US$4.2 billion) to the total investments identified at DHHS level (US$35.2 billion), the final amount is US$39.4 billions, invested in biomedical R & D by two departments of the US government in 2016. When it comes to industry's investments, the report from Research America says that, in 2016, the biopharmaceutical sector spent US$89.82 billion in R & D (Research America, 2017, p. 5). A ranking based on the reports filed by companies to the Securities and Exchange Commission (SEC) reveals that from the 15 biopharmaceutical companies with the best performance in 2016, eight were north-Americans (IgeaHub, 2017). Looking to these eight companies and adding their investments on R & D, the total found was US$44.4 billion. The investments by company are: Pfizer (7.87B), J & J (9.09B), Merck (10.12B), Gilead (3.39B), Amgen (3.84B), AbbVie (4.36B), Eli Lilly (5.24B), and BMS (0.53B). Therefore, we can notice that the total investment by the government, considering only two Departments, is quite close to the total investment of the eight largest US biopharmaceutical companies. Also, considering that the total investment by industry was US$89.82 billion and that big companies were responsible for around US$44.4 billion, it is possible to assume that medium and small companies accounted for the other US$45 billion.

Coming back to the government's role, it is worth noting that beyond these investments themselves, there are a number of initiatives and programs that complement or orientate the flow of government support to biomedical research. Both DHHS and DoD run, for example, the Small Business Innovative Research Program (SBIR) and the Small Business Technology Transfer Program (STTR), which focuses on government support to small companies or to joint ventures between small businesses and non-profit research institutions, fostering the final development and commercialization of innovations. At DoD level, there is also the Rapid Innovation Fund (RIF) that is used to invest in final development, test, and evaluation of technologies. Any company can apply for RIF, but small companies are given priority (Department of Defense, 2017b, p. 248).

Both DHHS and DoD also run Cooperative Research and Development Agreements (CRADAs), an instrument created to build proximity between government and industry in R & D efforts. CRADAs do not imply financial resources, but rather the offering of the infrastructure, human resources, services, equipment
and knowledge from federal laboratories to private companies and the other way around. CRADAs are preferentially offered to small companies, but big companies can also use this instrument. In 2016, the NIH initiated 115 new CRADAs, leading to a total of 523 active CRADAs in that year (NIH, 2016, p. 5). In 2014, the DoD was the government department with the largest number of active CRADAs, 2,762 out of 9,180, or 30% of all CRADAs from all government departments (Tier Seven, 2017a). In 2016, it was not possible to identify how many DoD-led CRADAs were related to biomedical research. However, it is fair to say it is a considerable number given that only the Navy had, between 1989 and 2017, a total of 1,569 CRADAs in the biomedical field, around 33% of the total of CRADAs the Navy held in this period (Department of the Navy, 2017).

Other relevant initiatives are the Federally Funded Research and Development Centers (FFRDCs) and University Affiliated Research Centers (UARC). These institutions are sponsored by different federal agencies, including DHHS and DoD, and they respond to specific technical needs. The UARCs in general focus on multidisciplinary research.

DoD also funds Institutes for Manufacturing Innovation (IMIs) that serve as hubs of articulation between government, industry, and academia. These institutes have a mix funding structure in which private partners need to match the investment made by the government. Other instruments used by DoD are the Collaborative Technology and Research Alliances (CTAs) and Collaborative Research Alliances (CRAs) that aims to bring private sector expertise and academia expertise to the DoD laboratories, especially on basic research. Finally, DoD also coordinates a program called Multidisciplinary University Research Initiative (MURI), that involves a coalition of universities and is focused on accelerating technical progress in areas considered strategic by the defense, with emphasis on radical innovations that can serve as a reference for the applied research initiatives to be taken by DoD laboratories.

By its turn, the NIH has a well-developed structure for technology transfer through licenses and collaboration agreements. Between 2013 and 2017, NIH performed around 1,280 licensing agreements over research initiated in NIH laboratories and institutes. In 2016 alone, NIH granted 95 licenses of technology for big companies and 112 to small companies.

Such institutional environment provides new insights about the different investments clusters, here divided in government investment (DoD and DHHS), investment by small-medium companies and investment by large companies (the top eight US companies in 2016).

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*Figure 1.* Proportion between investments by large pharmaceutical companies, government agencies, and small and medium companies in the US in 2016.
The big circles represent the investments made by the selected government agencies (US$39.4 billion), by the eight largest US-based pharmaceutical companies (US$44.4 billion) and by small and medium US-based companies (US$45 billion). The small circles represents government funding through direct contracts, SBIR/STTR funds, NIH “extramural” grants, etc. The line represents joint development efforts, collaboration and technology transfer agreements, through CRADAs, NIH licenses, etc. The small triangles represents mergers & acquisitions (M & A).

Some important remarks are necessary. Firstly, the idea that government investments are only on basic research can be challenged considering that, in 2016, the major volume of investments made by NIH was on clinical research, considering that CRADAs can be used in any stage of research, including in clinical trials stage and considering that SBIR/STTR programs are focused on late stage development. Also, special attention should be paid to small companies. As mentioned above, many programs have a special focus on these companies and they are also normally close, or even born at university research centers funded by government money. Therefore, they have an important role in making the transition of a relevant research from the university to big companies. Their performance normally relates to moving a given research from basic to advanced stage, benefiting from government support (funding, licensing, etc.) and attracting investors in the financial market, then becoming target for mergers & acquisitions by larger companies, when the innovation is mature enough.

Nonetheless, the public investments play a key role in mobilizing venture capital during this cycle. So, even if the government investments under some programs can be seen as small, they are used by small companies to attract attention from investors. Normally the announcement of a contract with the government has a positive effect in the stocks of small companies, resulting in increased private investments (Niler, 2002, p. 24). As an example, when the company Cepheid got a US$5 million grant from DARPA to develop a device that can rapidly detect the DNA of organisms transmitted through the air, its stocks increased from US$1.50 to US$8.00, despite the company’s poor sales balance (Niler, 2002, p. 24).

The same happens when CRADAs or licenses from NIH are announced. Although these two instruments do not represent any financial resources to the company, they send signals to the financial market. The SBIR/STTR program by its turn is divided in three stages and the last one that is based on commercialization of the product normally requires that the company adopts fundraising strategies in the private market.

Big companies can also benefit from all the opportunities provided by government institutions, such as CRADAs, licenses, direct R & D contracts, and SBIR/STTR funds. The company Gilead Sciences, for example, between 1988 and 2017, had 14 CRADAs signed with the DHHS, got eight exclusive licenses from NIH and six grants from DHHS through the SBIR/STTR program. Between 1991 and 2017, Gilead also had 16 R & D contracts with the Department of Defense (DoD). Under this research, it was not possible to find information sources about CRADAs involving Gilead and DoD.

In order to have a better picture of how much Gilead absorbed knowledge and research performed with government funding and support, it is necessary to consider not only the company itself but all the companies that were targeted by Gilead on its mergers & acquisition (M & A) strategy. From 1996 to 2017, a total of 17 companies were target of M & A by Gilead (one merger and 16 acquisitions). Most of these companies

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1 Data from KEI and SBIR program websites. The six SBIR/STTR grants to Gilead were between 1989 and 1994, when the company was small.
2 Data extracted from: https://www.fpds.gov/fpdsng_cms/index.php/en/.
originated from university research centers, which got intense flows of government support to R & D in many levels (project funding, building of laboratories, training of highly qualified scientists). For example, the company Triangle Pharmaceuticals, acquired by Gilead in 2003, had obtained an exclusive license and global rights from Emory University for the use of purified forms of the drug emtricitabine on HIV/Aids and Hepatitis B (Securities and Exchange Commission, 2003). With the acquisition, these rights went to Gilead. Most of the research by Emory on emtricitabine was funded by NIH (Chemical & Engineering News, 2005).

In fact, from the 17 companies acquired by Gilead, the most expensive ones were exactly those that had more connections with the government support flows: Kite pharma (three CRADAs and 16 NIH licenses), Pharmasset (one NIH License and 14 projects funded with SBIR), and Myogen (eight projects funded with SBIR). As noted above, such connections help on the valuation of company’s stocks, especially when positive research results are announced.

The stock market has an important role in a broader sense, as according to many scholars, important institutional changes have put forward a “new economy” that established a new “variety of capitalism” in the US economy, which has the financializing process as its main feature. Lazonick (2010; 2013) and Lazonick et al. (2017) had extensive research on “new-economy business model” and on how this model has been applied to the biopharmaceutical industry. At industry’s level, this model means that distribution of profits (dividends) and valuation of share price activities prevails over investment in productive capacity, innovation, human resources, etc. leading to what some may call “shareholder capitalism”. This model contributes to an ever-expanding number of M & A as a way for big companies to compensate for the lack of investment in innovation and increase their market share. To operate in such a way, big corporations have entered financial markets, so when they want to perform M & A operations they can rely not only on their accumulated profits, but also raise high volumes of money in financial markets (Lapavitsas, 2013). As Lazonick et al. (2017) noted, many biopharmaceutical companies also do regular “buybacks”, purchasing their own shares to increase their price. In this regimen, the short-term logic prevails over decision-making and big corporations are more and more governed by the need to maximize shareholder value, therefore earnings per share (EPS) become the main indicator of superior performance in the financialization era (Lazonick, 2016), what represents a considerable change in institutional culture in comparison to the previous model, based on retention of profits to reinvest in long-term innovation strategies.

Lazonick (2016) and others (Cassier, 2016; Mazzucato & Roy, 2017) had also indicated that price strategies are increasingly focused on its capacity to increase share price, rather than in its capacity of generating sales return. The same happens to intellectual property rights that are another indicator used by financial markets to value companies. The economist, Elli Malki (1997), analyzed the financialization of biotechnology companies and found that most of them have negative balance sheets, but still are highly valued in stock markets due to their potential of future earnings, measured by their patent portfolios.

As discussed, financialization changes company’s governance model and behavior, influencing their expansion, price decisions, and reliance on the patent system. Despite the capacity of big biopharmaceutical corporations to operate in the financial markets themselves, they are also quite connected to financial institutions, especially investment funds.

The financial institutions are relevant in the structure of the biopharmaceutical market not only because they are major shareholders of big biopharmaceutical companies, but also because they facilitate quite often
market operations. Baranes (2016), when observing the waves of M & A in the biopharmaceutical sector, noted in the 80’s a fourth wave associated with Regan administration and its liberalizing policies, after which banks started to be more regularly involved in loans to finance M & A by biopharmaceutical companies.

Looking again to Gilead Science and analyzing data provided at NASDAQ database (consultation performed in February 2019) we found that there are five institutions that control over 35% of the company’s institutional shares: Black Rock (10.07%), Vanguard Group Inc. (9.59%), Capital Research Global Investors (6.89%), State Street Corp (5.53%), and Bank of New York Mellon Corp (3.09%). They are all financial institutions with the exception of the Vanguard Group. They are also part of the 50 “top control holders” according to a study by Vitali, Glattfelder, and Battiston (2011) that identified a network of global corporate control, a small number of corporations that control most of the value of a universe of 43.060 transnational corporations.

An example of how stock control and company strategy are connected can be found in the case of Gilead. In order to enable one of its latest M & A moves, the acquisition of Pharmasset, Gilead used bank loans (Cassier, 2016) and issuance of new securities in the financial market. The bank loan came mostly from Barclays Capital (Pollack & De La Merced, 2011), that is one of the members of the Black Rock investment fund. In addition, Black Rock also became one of the four largest institutional shareholders of Pharmasset during its Initial Public Offering (IPO) in 2007, acquiring more than 5% of the company (Roy, 2017, p. 117).

Figure 2 shows and correlates all data gathered about Gilead Science, in order to demonstrate how the institutional complementarities between government investments on R & D and the financialized governance model of the biopharmaceutical industry are convergent and contribute to concentration of knowledge and power in the hands of the largest companies, such as Gilead Sciences, specially through M & A, but also through patent portfolios. Figure 2 also accounts for strategic alliances with other biopharmaceutical companies. Most of these alliances involve exclusive licensing of a patent right and, in many cases, we also found that companies exchange stocks as part of payment arrangements, what creates institutional connections between them, reinforcing the idea that large companies in this sector create a sort of closed network of dominant companies, that can only be accessed by those who achieved considerable critical mass in intellectual property and high levels of valuation on financial markets. This leads to higher barriers for companies that are not part of this core (Herscovici, 2007, p. 403).

The four zones of Figure 2 are correlated, what indicates a systemic functioning. The M & A strategies (second quarter), for example, are taken forward based on a financialized business model focused on maximizing shareholder value. Stock offerings are also means for raising funds for an M & A operation. Thus, the major shareholders listed in the graphic (third quarter) have an important role in defining the strategic direction for M & Es. In addition, when a M & A process takes place, Gilead also acquires the accumulated knowledge of the target company, which means also the knowledge produced with government support (fourth quarter). Remembering that the government programs are both a material contribution for the advancement of important research and a valuation factor for the stocks of small companies that become targets of M & A, such valuation is also important to motivate investments that will ensure the maturation of research to the point it justifies a M & A move by a big company. The constant interaction between State and companies has thus an effect of constant renovation of the investments by financial markets, that works in two levels: boosting the technological development that is led by state investments and boosting the concentration of this knowledge in the hands of big companies, which by their turn use this expansive process to increase their geographical
dispersion, through subsidiaries (first quarter), achieving privileged market positions across the globe, but especially in Europe where most of the other big biopharmaceutical companies are based. The dispersion of subsidiaries also indicates a process of “great fragmentation of the firm” (Reurink & Garcia-Bernardo, 2018) whereas not only the operational activities of transnational corporations are off shored, but also their legal-financial structure, with some subsidiaries holding equity or debt stakes and intellectual property rights and top holding companies located in low-tax jurisdictions. Such dispersion “enable firms to more efficiently capture the value created by their globalized operational activities” (Reurink & Garcia-Bernardo, 2018, p. 10).

Figure 2. Gilead Science political-economic anatomy (Data from 1997 to 2018).

Geopolitical Motivations Behind Institutional Complementarities

This model can be seen through the lens of appropriation or “value extraction” (Mazzucato & Roy, 2017), given that government takes most of the risks over R & D investments and big companies reap the resulting benefits, leading to an unbalanced “risk and reward nexus” (Mazzucato & Lazonick, 2013). According to Mazzucato and Lazonick (2013), the high public investments and the entrepreneurial role played by the State in R & D should bring as return tax collection, job creation and life quality improvement for citizens, but these rewards are undermined for the sake of the intensification of the financialized model, with increased tax evasion, migration of jobs, decreasing innovation levels and unsustainable prices for the resulting products.

As it is well noted by Mazzucato (2016), State-led investments are not just to fix markets; they actually create markets and technological breakthroughs. However, the agendas and strategic priorities behind this state investment are less discussed in her work. More broadly speaking, very few scholars have brought inter-state competition into the picture. Therefore, we propose the need to maintain technological, economic, and military
superiority as a hypothesis that explains State-led investments in the biopharmaceutical sector. As discussed by Medeiros (2004), the need to be in a higher position in the international system through technological dominance, has created, especially in the military field, a very dynamic innovation environment that has no parallel in the civil sphere.

According to Fiori’s work, the inter-state system is essentially competitive and anarchical, and has the war as its main dynamic, integrative, and hierarchizing force. Therefore, the need for technological superiority, the need for a better performance in potential wars, and the need for economic superiority, to secure resources for improved defense capacity, are present in many fields, especially the ones dealing with disruptive innovations. Seeking all these levels of hegemony also imply reducing the space for other states to develop their own capacities. Taking this view, we can understand market concentration, knowledge control and technological asymmetry as more than a mere market phenomenon, boosted by the economic strength of big companies alone, but rather as the result of the conditions created by the US for its companies to operate in, favoring its geopolitical objectives. This brings us to the concept of structural power, put forward by Susan Strange (1994), conceived as “the capacity to shape the structures of the global political economy in which other states and their political institutions and their professionals will need to operate” (p. 24). According to Strange (1994), to possess the technological edge “means both military superiority and economic prosperity, invulnerability and domination” (p. 136). Currently, biotechnology is considered an important technological edge, with great relevance due to its strategic features (Chase-Dunn, Niemeyer, & Allison, 2005).

Under Fiori’s realistic approach that the international system evolves around the war or preparation for war, and that financial accumulation is essential for warfare superiority, we may understand capitalism itself as an accumulation strategy inside the inter-state dispute, that creates an automated accumulation dynamic for the advantage of a given state in the disputes with other States for resources and territories (Fiori, 2004b, p. 24). This view is strongly opposed to the theory by Hardt and Negri (2000) of a superstructure of the globalized capitalist economy that is governed by market forces, making it irrelevant the power of states. Fiori emphasizes the opposite, and according to his theory, the globalization of capitalism was not performed by capital, it was the result of expansive disputes among national State-economies, that successively imposed one to the other their currency, their public debt and their taxation model, in order to make the international monetary system a privileged space for the expansion of their national financial capital (Fiori, 2004a, p. 102).

Fiori is strongly influenced by the economic structuralism of Tavares and Melin (1997) that sees the establishment in the 80’s of the international financial system as we know today as a strategy from the US power to rebuild its hegemony in a new basis. This systemic rupture imposed a new model of wealth management, based on accumulation of financial titles, that became a systemic global pattern and reinforced the central position of the US currency, that became the main denomination currency for international reserves and for financial and commercial transactions (Tavares, 2009). Another consequence of this rupture was the consolidation of a “trustified capitalism” (Tavares & Belluzzo, 2004, p. 115), where all sectors are dominated by large companies, under control of financial capital.

Among the benefits the US has by ruling such a financialized regimen, we can highlight the reinforcement of the dominant position of the currency, as discussed by Tavares and Melin (1997), but also the possibility of increasing the volume of resources at disposal, increasing thus the capacity of “sustaining power actions in the
international arena, whether economic or military in nature” (Teixeira, 2018, p. 264). From this perspective, the fact that the US financial market has the highest liquidity worldwide and the fact that the dollar is the currency in which most of the international reserves are denominated (Teixeira, 2018, p. 262) provides the US with an almost unlimited capacity of investment, in all fields. This is an explanation, for example, for the impressive amount of resources applied in biomedical research through the NIH, that totalized 804 billion between 1938 and 2011, with more than half of this amount invested 1998 onwards (Mazzucato & Lazonick, 2013, p. 1112). Therefore, if the State obtains its large investment capacity in the biomedical field through the subordination of other actors to a “pattern of regulation and functioning of the international monetary system based on its self-interest” (Teixeira, 2014, p. 434), we can relativize the argument made by Mazzucato and Lazonick (2013) in two aspects: Firstly, the amount of money invested by the State is not a concern from such a privileged position and, secondly, the “return” on such investments made by the State should be understood not only in terms of taxes, jobs and life quality improvement, but also in geopolitical terms when it comes to the maintenance of a dominant position, both in the economic and technological spheres.

Chesnais’s (2003) analysis of the globalization of capital and the “new economy” converges with Tavares once he concludes that the financialized regimen happened first in the US in conditions that cannot be reproduced anywhere else. According to Chesnais (2002), “It was only in the US where the accumulation regimen with financial domination was fully implemented and where all its characteristics apply” (p. 38).

In geopolitical terms, under the realistic approach to international relations, pushing national companies to monopolistic privileged global positions is also a strategic move in the inter-state dispute (Padula, 2017); therefore the globalization of this model of financial accumulation has benefited US companies, in many sectors, including the biopharmaceutical sector. Monopolistic positions for US companies are also the result of the globalization of the patent regimen in a shape defined by a strategic alliance between the US companies and the US government (Drahos, 1996, p. 15). As Strange (1995) had argued, “the influence of U.S. laws on patents and property rights in medicine and pharmaceutical research throughout the world demonstrates a structural power that directly affects the life chances good or bad-of millions of people” (pp. 65-66).

The financialization and the expansion of patent rules are connected, as they both converge in ensuring that financial profits surpass operational profits (Tavares & Belluzzo, 2004, p. 127) and that profit seeking through the accumulation of rent generating intangible assets prevails over the production of serviceable output (Baranes, 2017). In a way, patents and other intangible assets serve as basis for financialization (Baranes, 2017).

Looking at the financial reports of all pharmaceutical companies listed at Fortune 1,000 between 2002 and 2014, Baranes (2017) found expressive increases in ratio of intangible assets to productive capital (265%), the ratio of goodwill to net physical assets (239%), and the ratio of other intangible assets to net physical assets (406%). Baranes (2017) also looked at four different calculations of profit rates: return on revenue (ROR), return on assets (ROA), return on equity (ROE), and earnings per share (EPS). He showed that ROR has increased, ROA remained relatively unchanged (despite the reduction in physical capital), and ROE remained between 17% and 21% and EPS increased by 78%. He draws the conclusion that pharmaceutical companies increasingly rely on intangible rent-generating assets to secure their profit rates, in disregard of their productive and innovative capacity. In this context, price increases are necessary to maintain return on revenue despite the reduction in pharmaceutical output. Also, as many scholars (Cassier, 2016; Lazonick, 2016; Mazzucato & Roy,
have indicated, high prices also lead to increased valuation on stock markets, favoring thus a better result in earnings per share.

This data seem to confirm Veblen’s institutional theory of the business enterprise when it comes to American pharmaceutical industry. Veblen describes a sort of evolution in the role played by intangible assets according to different stages of firm growth: commercial enterprise, industrial enterprise, and finally financial enterprise. In this last stage, Veblen identifies that industry and business have become inherently distinct realms. Industry relates to the collective human activity of creativity and material production, while business is the sphere of pecuniary distribution, and the link between them is not positive but negative (Nitzan, 1998). Given this separation, the owners of industrial facilities are not anymore responsible for the production management; these decisions are taken by businessmen in the scope of financial markets. Therefore, modern capitalists are disconnected from the production realm; that is why Veblen calls them “absentee owners”.

According to Veblen (1904), when the businessmen achieves a dominant position, he does not direct its efforts to sustain or improve the efficiency of industrial production, but rather to shape the market structure, influence the behavior of investors and the perception of other players in that market (p. 35). That is why Veblen considered that the earnings of a businessmen were not proportional to its productive contribution, but to its capacity to cause harm in the industrial process as a whole.

Plainly, ownership would be nothing better than an idle gesture without this legal right of sabotage. Without the power of discretionary idleness, without the right to keep the work out of the hands of the workmen and the product out of the market, investment, and business enterprise would cease. (Veblen, 1967, p. 66)

The conclusion is that profit maximization is only possible if some social needs are not covered, not because there is no capacity to address them, but because there is a process of “industrial sabotage”. For this purpose, intangible assets are essential, because they are ownership rights whose primary purpose is to grant a differential advantage through a “locking out” process (Veblen, 1904). Such logic has evident negative effects on the rate of productive innovation; as discussed by many scholars, however, in geopolitical terms, it creates advantages for a State that has hegemony over financial markets and technological edge. This State will benefit from market concentration, knowledge control and will create technological asymmetry in comparison to other States.

In this regard, the expansion in the scope of application of intellectual property rights and the intensification of other forms of appropriation and accumulation of knowledge, such as mergers & acquisitions and government subsidies to R & D, are equivalent to a “primitive accumulation of knowledge, comparable to the primitive accumulation described by Marx” (Herscovici, 2007, p. 402) and blocks the accumulation of knowledge by others, reducing thus the economic and technological threats posed by rival states. In this perspective, Veblen’s “industrial sabotage” can be understood in a broader sense, that goes beyond the mere relationship between the businessman and the community, in which the former deprives the later from the fruits of creativity and production, and includes the dimension of the hegemonic state depriving rival states from strategic knowledge, what brings us back to Strange’s (1994) definition of the structural power over knowledge: “A negative capacity of deny knowledge and exclude others” (p. 119).

The US biomedical R & D governance model described above is quite unique, not only because the almost unlimited investment capacity by the government and the high performance of the firms (both related to a structural power over the financial system and over the global norm-setting on intellectual property), but also
because of its connection with national security objectives, what creates an incredible dynamism between the different stakeholders. In fact, seems that military, technological and economic objectives are indissociably linked, what reflects in a symbiotic structure between State, universities, and companies.

Looking to the institutional mandates of different government agencies and departments analyzed in this paper, this interconnection becomes more evident. The NIH, for example, is guided by two inter-related objectives: “promoting the health of American people and all mankind through biosciences research, and fostering a vigorous domestic biotechnology industry” (President’s Council of Advisors on Science and Technology, 1992, p. 1). Also, in the scope of the Bay Dhole Act, NIH acquired as part of its institutional obligations “to ensure that new technologies developed in its laboratories will be transferred to private sector and commercialized rapidly and efficiently” (Schacht, 2012, p. 13). By its turn, DoD major objective on R & D is:

To provide a strong Science & Engineering (S & E) basic research foundation for the discovery and enhancement of new and future technologies, assist in the development of revolutionary military capabilities and systems, keep DoD informed of worldwide technological developments and opportunities, that might affect US defense. (Department of Defense, 2017b, p. 4)

DARPA by its turn has as mission “to prevent and create technological surprise” (Defense Advanced Research Projects Agency, 2016) in a way that US armed forces become “initiators and not victims of technological surprises” (Defense Advanced Research Projects Agency, 2016). In 2014, DARPA created the Biological Technologies Office (BTO), to promote research able to direct and remodel biotechnology in order to create advantages for the US (Department of Defense, 2017b). Even the SBIR program that is focused on small companies has as its mission to develop and deliver cost-effective innovations that are able to sustain the technological and economic superiority of the US over its adversaries (Department of Defense, 2015b, pp. 3-4).

In the most recent US National Security Strategy (US Government, 2017), the competition with other powers is present all over the document, especially with Russia and China. The National Defense Strategy that derives from the NSS mentions that the proliferation of knowledge is eroding the historical advantages of the US and that this process must be reversed, for the sake of US security and prosperity. In this sense, the NSS puts as priority action the support to biomedical innovation. When it comes to biomedical research in particular, there is a strong emphasis in strengthening the intellectual property system, considered “the basis of biomedical industry” (US Government, 2017). In this strategy, the US government makes clear its intent to lead research, technology and innovation and its intention to monitor research under development in other countries, including in the biomedical field, in order to protect US advantages over its competitors.

The US has a National Center for Medical Intelligence (NCMI) that puts together information about external threats on health and other medical issues related to the protection of US interests worldwide (Department of Defense, 2009) and also monitors trends in biomedical research in other countries. These analyses are normally focused on rival states, such as Russia, China, Iran, and North Korea (Clemente, 2013, p. 75). The NCMI has four divisions, one of them the division on global health systems, evaluates medical capacities in other countries, including “military and civilian medical infrastructures, including all hospitals, laboratories, blood banks and pharmaceutical manufacturing units” (Clemente, 2013, p. 76).

Such intelligence is relevant because, according to US strategic documents analyzed under this research, disease burden has impact on economy, government legitimacy and military capacity of geopolitically relevant regions (National Intelligence Council, 2008). Therefore, limited access to healthcare to prevent or treat
infectious and chronic diseases tends to intensify social divisions, which is a relevant factor of political instability. From the strategic point of view, the major impact of a poor health response is the effect on younger generations, whose morbidity impacts directly on military capacity and readiness (National Intelligence Council, 2002). Therefore, monitoring rivals’ health structures and limiting their capacity to improve, it can be seen as a relevant factor in the process of safeguarding US’ superiority. Thus, we can notice a degree of convergence between technological, military, and financial objectives in the biopharmaceutical sector, evidencing that the institutional framework and the State-Company dynamics in the US limits the policy space and the stock of knowledge available for other States.

**Conclusion**

Considering that economy is always affected by power relationships, we focused on the dynamics of the biopharmaceutical sector, trying to understand what institutional factors explain US hegemony and what the geopolitical motivations are behind those factors. Taking an approach through the institutional complementarities framework, we addressed the State-Company relations, considering their dysfunctional ties when it comes to social outcomes but also their coherence towards geopolitical outcomes. Based on the perception of the US as a liberal market economy, we brought the view of structural power, to indicate that by applying its own variety of capitalism, the US “sets the game” that must be played by other States, due to its dominance over the financial system and its strategic use of the patent system.

Considering all these empirical and theoretical inputs, we propose the concept of “medical-technological-financial complex”, associated to US power affirmation. Such complex responds primarily to the strategic priorities of defense and refers to an articulation between public institutions and companies, through State-led funding channels. Using this exploratory concept, we intend to emphasize how financial accumulation and the shaping of technological edge are deeply associated and how both are connected to national defense purposes. It is clear that companies have their own priorities, but through this complex, they are constantly directed to invest in technological areas that respond to the defense challenges formulated by US defense community:

> Unlike traditional defense developers, commercial developers in biotechnology are “discovery-oriented”; that is, they are pursuing developments in many directions as determined by the marketplace, which so far is predominantly medical. The Army, however, has become used to managing and influencing R & D directed toward specific procurement objectives. (National Research Council, 2001, p. 3)

The word “complex” refers to a decentralized network, that is however partially coordinated under the institutional arrangements described in this paper. Therefore, military, technological and economic objectives are inseparable. In this sense, technological leadership is considered the best defense strategy against biological threats and biotechnology is seen as an important asset in building a more lethal force and the ability to win the wars of the future (US Government, 2018a). At the same time, emergent technologies associated with biotechnology are considered equally essential for economy (US Government, 2017). In a deeper level, there is no clear separation between these two objectives, because advancing biomedical industry is seen as a defense objective (US Government, 2018b), and in the same level, technological advancements in other countries are considered a threat both for US defense and US companies’ monopolies. That is why DoD is a central player, that can conduct R & D, but also monitor advancements in biomedical industry through its intelligence efforts, being in a privileged position to define priorities for research, shaping the technological edge in a way that
benefits both military and economic dominance, ensuring thus the continuity of US hegemony.

Our conclusion is that US pharma companies transform willingly the socio-economic institutional settings to increase their strategic control over the industry and society, but they do so under the frame of a State-led strategic agenda focused on building and maintaining technological and financial hegemony. Therefore, the debate on State-Company institutional complementarities must acknowledge not only market dynamics but also underlying biopharmaceutical geopolitics.

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