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AUGUSTO CÉSAR DALL'AGNOL

THE DIFFUSION OF MILITARY POWER: A NEOCLASSICAL REALIST ANALYSIS

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Tese submetida como requisito parcial para a obtenção do título de Doutor em Estudos Estratégicos Internacionais ao Programa de Pós-Graduação em Estudos Estratégicos Internacionais da Faculdade de Ciências Econômicas da Universidade Federal do Rio Grande do Sul.

Orientador: Prof. Dr. Marco Cepik

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Porto Alegre, April 5th, 2023.
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To my parents, Anildo and Cimone, and my sister, Natália.

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"States in the upper tier find it relatively easy to remain there; states in the lower tier find it extremely difficult to move upward; and states in the middle tier generally have the capability to resist peripheralization but not the capability to move into the upper tier. Upward and downward mobility of individual states is thus not excluded but considered exceptional" (ARRIGHI; DRANGEL, 1986, p. 41-42).

#### **ABSTRACT**

This doctoral dissertation explains why some states are able to take advantage of the diffusion of major military innovations while others are not. It further develops Neoclassical Realism by answering questions neglected by Structural Neorealism and Adoption Capacity Theory. While the former consciously ignores the causes that constrain military diffusion and whether states are successful—or not—in benefiting from diffusion processes, the latter does so by overly emphasizing organizational aspects of diffusion to the detriment of political elites' preferences and international alliances. Studies of military diffusion have concentrated on single case studies or small-n comparisons of specific military technological innovations. This research is explicit about necessary and sufficient conditions, processes, and causal mechanisms. It also develops and tests hypotheses with intermediate-n observations, covering 34 countries and 32 technologies from 1991 to 2014. Such a framework binds two main methods into a Neoclassical Realism analysis: Multiple Correspondence Analysis (MCA) and Fuzzy-Set Qualitative Comparative Analysis (fsQCA). By explaining military diffusion more strategically and comparatively, one may assess whether the diffusion of military innovations leads to power centralization or decentralization in the international system. In short, backwardness advantage, logistical capacity, and the absence of alliance are necessary but trivial conditions for successful military diffusion. On the other hand, threat and the absence of threat are the only two conditions that turned out to be a condition that could be considered "almost necessary" for successful and unsuccessful military diffusion, respectively.

**Keywords**: Military diffusion. Neoclassical Realism. Internal balancing.

#### **RESUMO**

Esta tese de doutorado explica por que alguns Estados conseguem tirar proveito da difusão das principais inovações militares, enquanto outros não conseguem. Nela, aprofunda-se o desenvolvimento do Realismo Neoclássico, respondendo a questões negligenciadas pelo Neorrealismo Estrutural e pela Teoria da Capacidade de Adoção. Enquanto o primeiro ignora conscientemente as causas que limitam a difusão militar e se os Estados são bem-sucedidos ou não em se beneficiar dos processos de difusão, a segunda faz o mesmo enfatizando demasiadamente os aspectos organizacionais da difusão em detrimento das preferências das elites políticas e das alianças internacionais. Em geral, estudos sobre difusão militar concentraram-se em estudos de caso ou em comparações de pequeno-n em termos de inovações tecnológicas militares específicas. Este trabalho é explícito sobre as condições necessárias e suficientes, os processos e os mecanismos causais envolvidos. Também desenvolve e testa hipóteses com observações intermediárias, abrangendo 34 países e 32 tecnologias, de 1991 a 2014. Esse modelo analítico combina dois principais métodos em uma análise realista neoclássica: a Análise de Correspondência Múltipla (MCA) e a Análise Qualitativa Comparativa de Conjuntos Difusos (fsQCA). Ao explicar a difusão militar de forma mais estratégica e comparativa, pode-se avaliar se a difusão de inovações militares leva à centralização ou descentralização do poder no sistema internacional. Em resumo, a vantagem do atraso, a capacidade logística e a ausência de alianças são condições necessárias, mas triviais, para uma difusão militar bem-sucedida. Por outro lado, a presença ou ausência de ameaça são as únicas duas condições que se mostraram "quase necessárias" para a difusão militar bemsucedida ou mal-sucedida, respectivamente.

Palavras-chave: Difusão militar. Realismo Neoclássico. Balanceamento interno.

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#### 1 INTRODUCTION

The diffusion of military power is a critical issue in the field of international relations, with important implications for global security and stability. This dissertation explores the factors contributing to military power's successful or unsuccessful diffusion. For example, Brazil's efforts to develop a domestic defense industry have led to the production of fighter aircraft, armored vehicles, and naval vessels, while its attempts to acquire advanced military technologies, such as missile technology, have faced challenges due to political and economic constraints. In Australia, the acquisition of military power has focused on enhancing maritime capabilities, including acquiring advanced submarines and surface ships and investing in intelligence, surveillance, and reconnaissance capabilities. Egypt's military power has been shaped by its strategic location and geopolitical context, focusing on acquiring advanced air defense systems, tanks, and other conventional weapons and developing a nuclear energy program with potential military applications.

In Japan, the diffusion of military power has been constrained by constitutional and political factors, leading to a reliance on defensive technologies, such as missile defense systems, and limited investment in offensive capabilities. Myanmar provides another case study in the diffusion of military power, characterized by a complex and evolving dynamic. Myanmar's military has a long history of reliance on foreign military assistance, with China being the most significant supplier of military equipment and technology. In recent years, however, Myanmar has sought to diversify its sources of military technology, including by expanding its cooperation with Russia and other countries. This has led to the acquisition of advanced fighter aircraft, air defense systems, and naval vessels, as well as investments in cyber capabilities and other emerging technologies. These examples illustrate the diverse range of military technologies and weapons systems involved in the diffusion of military power and the complex political, economic, and strategic factors that shape this process.

In conceptual terms, military innovations are "changes in the conduct of warfare designed to increase the ability of a military organization to convert the components of potential military power into actual military power" (HOROWITZ; PINDYCK, 2019, p. 17). Diffusion is "the process by which an innovation is communicated through certain channels over time among the members of a social system" (ROGERS, 1983, p. 5). In its turn, military power is "the way that states generate organized violence for use either on the battlefield or as part of coercive strategies" (HOROWITZ, 2010, p. 22). Military power represents "the combination of

the technology, or hardware, used to fight [...] and the organizational processes, or software, used to plan the use of and actually employ the hardware".

This doctoral dissertation provides a Neoclassical Realist (NCR) explanation to questions neglected by Structural Neorealism and Adoption Capacity Theory by addressing the causes and mechanisms by which some countries benefited from the process of military power diffusion while others did not. Military diffusion refers to the spread of military technology and weapons systems to different states and non-state actors. It can happen through various means, such as trade, research and development, and military alliances.

For example, Uruguay getting M108 howitzers and Urutu transport vehicles from a Brazilian donation, and Brazil getting a new fighter jet through technological transference and joint production with Sweden count as military diffusion. Also, the French Mistral, a class of amphibious assault ships, provides an interesting case study of the diffusion of military power. Originally built for Russia, France suspended delivery of the Mistral ships to Russia in 2014 following Russia's annexation of Crimea. Subsequently, Egypt expressed interest in purchasing the Mistral ships, seeing an opportunity to enhance its military capabilities and bolster its regional standing. After a series of negotiations, Egypt agreed to purchase the Mistral ships from France in 2015, which were delivered to Egypt later that year. This example highlights the role of political factors in shaping the diffusion of military power and the strategic considerations of both the seller and buyer in such transactions. It also illustrates military power diffusion's fluid and dynamic nature as countries adapt to changing geopolitical circumstances and seek to enhance their capabilities in a complex and contested global security environment.

Hence, why were some states able to take advantage of the diffusion of major military innovations while others were not? I explain using five causal conditions from my theoretical framework: external threat, backward advantage, developmental states, logistical capacity, and external alliance. Also, two mechanisms link the successful military adoption to whether—or not— states may diminish power differential vis-à-vis more powerful states.

The first mechanism is different internal balancing strategies available to states. In conceptual terms, three are the internal balancing strategies at states' disposal. First, military innovation refers to radical organizational structure, resource allocation, doctrine, and strategy changes. It covers processes of adapting war institutions and practices to changing technological opportunities and social and political developments (GOLDMAN, 2004). Military emulation is the systematic and deliberate imitation of one country's technology, organization, and doctrine by another. It is a strategy aimed at increasing security in response

to external threats. Finally, offsetting strategies involve quantitative increases in arms, troops, and budget to compensate for the increase in an opponent's capabilities (RESENDE-SANTOS, 2007).

Waltz (1979, p. 118) defines internal balancing as "moves to increase economic capability, to increase military strength, to develop clever strategies". In other words, mere economic growth does not count as balancing. For a state to balance, it is not enough to have economic conditions. It is necessary to effectively shift this economic potential into military capabilities (WALTZ, 1979, p. 118-121, 180).

Second, there are different state-building strategies at states' disposal (self-strengthening and self-weakening reforms) (HUI, 2005). The concept of self-strengthening reforms implies "fundamental socio-economic reforms [...] to reorient the course of national economic development through state intervention" (SKOCPOL, 1979, p. 31). This means that changes in a state's economic and military capabilities are not random or accidental outcomes but rather the result of deliberate political projects (CENTENO, KOHLI; YASHAR, 2017; SPRUYT, 2017). Therefore, internal balancing processes and the self-strengthening reform mechanisms are structural insofar as they are compelled by systemic competition and are agential, as their successful pursuit requires institutional innovations in the state apparatus (HUI, 2005). Eventually, such successful military adoption will lead to structural change (DAWOOD, 2013).

Studies about military diffusion have concentrated on single case studies or small-n comparisons of specific military technological innovations. While there are comparative studies on contemporary military transformations (ADAMSKY, 2010; DYSON, 2010; FARREL; RYNNING; TERRIF, 2013), these usually focus on U.S. European allied countries, thus neglecting relevant cases such as Australia (EVAN, 2004), Brazil (DEGAUT, 2016), India (NEVES JUNIOR, 2015), and South Korea (RASKA, 2011).

Here, I offer a framework to develop and test hypotheses with intermediate-n observations, being explicit about necessary and sufficient conditions, processes, and causal mechanisms. For example, a necessary condition is a condition that must be present in all cases where the outcome is observed. On the other hand, a sufficient condition is sufficient to produce the outcome, even if other conditions are also present.

I also address INUS conditions in the analysis. In the context of QCA, an INUS (Insufficient but Necessary, part of a larger Unnecessary but Sufficient) condition refers to a condition necessary for an outcome to occur but not sufficient on its own. In other words, it is

necessary but not sufficient. An INUS condition is necessary to be present, but it is not sufficient to produce the outcome by itself. The outcome can only be obtained when other conditions are present as well, but it is not possible without the INUS condition, thus meaning that an INUS condition is necessary to be present, but it is not sufficient to produce the outcome by itself. Other conditions are needed as well.

This dissertation advances Goertz's (2017) notion of causal constraint mechanisms—or mechanisms that prevent the occurrence of a specific outcome. Hence, the framework explains why certain states benefited from the diffusion of military power and others did not. Despite the overall prohibitive costs underlying the development of weapons systems and platforms, some countries could pay such costs, albeit with asymmetrical capabilities. Therefore, the diffusion of military power poses fundamental challenges to the United States, as it allows other countries to challenge former U.S. advantages within the global commons by creating contested zones<sup>1</sup> (BIDDLE; OELRICH, 2016; BOWEN, 2020; RASMUSSEN, 2015).

This analysis covers macro-historical processes of military power diffusion<sup>2</sup>. Specifically, it deals with the uneven process of diffusion of technological and organizational innovations (BUZAN, 1987) arising from the process of digitization of warfare and the possible concentration (BECKLEY, 2018; BROOKS, 2007; CAVERLEY, 2007; GHOLZ, 2007)—or deconcentration (GOLDMAN; ANDRES, 1999; JOHNSON, 2019B; NYE, 2011; WORK; BRIMLEY, 2014)—of military power in the contemporary international system. It is important to note that the diffusion of military power does not necessarily mean that the military capabilities of all states will become equal but rather that there will be a more diverse distribution of military power among states.

#### The diffusion of military power in the literature

Johnson (2019b) argues that strategic competition, in terms of the dual use of artificial intelligence, will likely narrow the technology gap separating great powers and, to a lesser extent, other technically advanced middle powers. However, the author recognizes that prohibitive costs may constrain the diffusion of artificial intelligence among advanced weapon systems. Hence, these constraints could further consolidate the leadership of these critical technologies between the United States and China.

<sup>1</sup> Posen (2003, p. 22) defines contested zones as "arenas of conventional combat where weak adversaries have a good chance of doing real damage to U.S. forces".

<sup>&</sup>lt;sup>2</sup> Social processes refer to "regular sequences of such mechanisms that produce similar (generally more complex and contingent) transformations of those elements" (MCADAM; TARROW; TILLY, 2001, p. 24).

To Bitzinger (1994), the globalization of weaponry production presents a long-term challenge to the United States and its allies. This is due to the growing pressures on defense industrial bases to internationalize their operations, and the United States is interested in promoting globalization's benefits. However, the author highlights the need to evaluate the positive efficiencies and interdependencies arising from the globalization of the defense industry and the need to avoid the risks arising from diffusion. The author argues that diffusion, via technology transfers and licensed production agreements, has allowed some developing countries to build their endogenous defense industries to the point of becoming weapon exporters to other developing countries. He further points out that globalization can lead to the progressive erosion of the United States' military technological advantages by contributing to technological diffusion. By trying to help their defense industrial bases, "the industrialized countries could be trading away short-term gains that could eventually lead their military challengers to be more technologically advanced" (BITZINGER, 1994, p. 191).

Another main venue for the diffusion of innovations between countries is international trade and foreign direct investment (KELLER, 2004). Gilpin (1981, p. 177) states that "Although technology is expensive and not easily created, once it is created it usually diffuses relatively easily". For the author, in the long run, wealth and economic activities tend to diffuse from the old to the new centers of economic growth through foreign investment and technology transfer (GILPIN, 1981; 1976).

In contrast, Horowitz (2012) argues that, in the medium term, the current globalization of commercial production and the spread of information technology could introduce a shift in the production of military power. As the production base of defense components is more commercial software-based, it may decentralize the ability to produce important military hardware. In other words, the diffusion of commercial technologies could increase states' military capabilities that import military technologies from the United States. On the other hand, the author understands that, in addition to the increased costs and complexity of operations, since the beginning of the Cold War, the intense system integration requirements for the full adoption of advanced weapons systems have created incentives for the globalization of military production and restricted the number of states that could actually develop modern platforms. Thus, Horowitz (2012) emphasizes the barriers to entry and prohibitive costs of producing conventional military power.

Krause's (1995) work on military, weaponry production, and trade patterns is also relevant. The author explores how the structure of the global arms transfer and production

system - the geographic location of innovation and production centers, the pattern of arms transfers, and the diffusion of military technology - evolves. The uneven distribution of capabilities results in the imperfect diffusion of new technologies throughout the system, which results in a second and third tier of producing states. As a result, military technology and techniques diffusion is not regular or linear, and the system remains highly hierarchical and stratified. In other words, diffusion generates only partial and limited deconcentration. Therefore, the stratified structure of the system will be reinforced, with entry at higher levels becoming increasingly difficult, and thereby the weaponry market will remain concentrated rather than becoming more diffuse.

Goldman and Andres (1999) argue that dual technologies, such as computers and software, can be imitated more quickly and easily than industrial-era technologies because they are not capital-intensive and do not require enormous industrial capacity. Paarlberg (2004) analyzes whether, as a result of the faster and easier diffusion of scientific and technical knowledge generated by globalization, the scientific hegemony underpinning the military power of the United States is strong and durable or weak and temporary. Hammes (2016) discusses how the diffusion of power has larger implications for the conduct of war, force structure, and procurement. For this author, diffusion will result in the deconcentration of power, including small groups.

On the other hand, Gilli and Gilli (2016) understand that favoring the de-concentration of military power from diffusion has largely underestimated the technological challenges of designing, developing, and manufacturing effective military platforms. Thus, they argue that designing, developing, and manufacturing military technologies is difficult and involves significant technological and industrial challenges. As the capabilities of a military platform grow, the resources required for its development eventually create high barriers of entry for potential competitors. As a result, many military technologies, such as nuclear weapons and aircraft carriers, are beyond most states' budgetary and technological reach.

Along these same lines, Horowitz (2010) considers that modern military operations demand enormous amounts of human and financial capital. Consequently, some states lack the capital and organizational capacity to adopt certain military innovations successfully. The greater the financial intensity required to implement the innovation, the less systemic diffusion of the innovation and the less likely a state will attempt to adopt such an innovation.

Gilli and Gilli (2019) argue that the existing literature is restricted to previous periods and has no applicability to contemporary times, especially due to the exponential increase in

technological complexity arising from the transition from the second industrial revolution to the digital age. Such an increase in complexity would have promoted a change in the production system that would make its imitation and replication difficult, overshadowing the diffusion effects of globalization and advances in communications. In particular, the authors believe that the increased complexity would have decreased the "backwardness advantage" and significantly raised the entry barriers for producing advanced weaponry systems, including for developed countries. Thus, states must possess an extremely advanced industrial, scientific, and technological base in weapon production before copying foreign military technologies.

Fagerberg and Godinho (2004) and Fagerberg and Verspagen (2002) argue that the international diffusion of technological innovations, which previously benefited developing countries, has become a more difficult, costly, and aggravating factor for them. The greater difficulty stems from, the greater requirement in terms of techniques, skills, and capabilities that global competition based on information and communication technologies requires.

To Paarlberg (2004), the emulation of military innovations is no longer as viable an option for potential rivals to the United States to reduce technological disparities as it was in the last century. This is because key military innovations are more difficult for other states to copy due to the need for complete hardware and software systems, such as sensors, satellites, and command systems, not just weapons platforms. In summary, the author understands that globalization has strengthened, not weakened, the United States' technological and military primacy but recognizes that other states may avail themselves of asymmetric responses.

Rogers (1983) argues that the consequences of adopting innovations generally widen the socioeconomic gap between organizations that adopt an innovation early and those that adopt it late. Moreover, when the system's structure is already relatively unequal, the consequences will likely lead to even greater inequality upon introducing an innovation, especially if it is a significantly high-cost innovation. However, Rogers (1983, p. 403) emphasizes that "such gap-widening inequality will usually occur unless a change agency devotes special efforts to prevent it".

Much of the literature on military innovations relate to specific military innovations, such as drones (CECCOLI; CROSSTON, 2019; FUHRMANN; HOROWITZ 2017; GILLI; GILLI, 2016), jet fighters (GILLI; GILLI, 2019), smart bombs (KAHN; HOROWITZ, 2021), ballistic missiles (BARKLEY, 2008), precision strike (BLAGDEN, 2020; WATTS, 2013), aircraft carriers and battleships (HOROWITZ, 2010), space capabilities (EARLY, 2013), and

nuclear weapons (DEBS; MONTEIRO, 2014; FUHRMANN, 2009; SAGAN, 1994). Nevertheless, the spread of military power does not limit itself to these examples.

Horowitz and Schwartz (2020) significantly contribute to the "precision strike complex". The authors argue that one must consider other elements, including strike and surveillance platforms, communication capabilities, and delivery vehicles. For Bowers and Kirchberger (2020, p. 4), no element of seapower is executed by one technology; rather, "it results from the integration of multiple technologies on various platforms into effective systems, operated according to a common doctrine".

Whereas most of the literature on military innovations tends to emphasize which states innovate and why states innovate, I focus on the diffusion of military innovations and their unfoldings for the structure of the international system (GOLDMAN; ELIASON, 2003). For example, regarding the research on the diffusion of military technologies and organizations, Farley (2016) and Dainoff, Farley, and Fay (2020) analyze how domestic and international intellectual property laws, especially patents and trade secrets, affect industrial espionage and hinder the diffusion of military innovations. Posen (1984) and Zisk (1993) analyze the nature, causes, and dynamics of innovations and diffusion of military doctrines. Grauer (2015), further in this direction, argues that the nature of the bureaucratic politics of armed forces seeking to adopt doctrinal innovations conditions the selection and the ability of communication channels to transmit information about foreign military doctrines. Furthermore, Bas and Coe (2012) developed a model based on game theory to analyze the relationship between the diffusion of military innovations and the occurrence of preemptive wars.

On the historical institutionalism end, Kadercan (2014) focuses on civil-military relations, questioning why European great powers were able to successfully reform their military practices to better adapt in the face of the military revolution of the sixteenth and seventeenth centuries, while the Ottoman Empire was not. The author argues that differences in timing regarding the emergence of centralized armies with strong institutional practices produced different bargaining powers between Ottoman and European military organizations. Similarly, Fennell and Warnecke (1988) seek to understand why organizations initially choose certain innovation and redefine it to fit and implement them in their specific context.

As for studies that use quantitative methods to analyze diffusion, Schmid (2017) finds no difference in the diffusion rate between civilian and military technologies. Neither is the diffusion rate between military technologies assigned to government agencies and private

companies. In his study, Stokes (2019) concludes that economic globalization correlates negatively with military capabilities, while informational globalization correlates positively.

Finally, studies that link diffusion to convergence, or "isomorphism" (DIMAGGIO; POWELL, 1983; PRETORIUS, 2008) are worth noting. For example, while innovation can lead to divergence among firms or states, emulation tends to erode differences, resulting in convergence (FAGERBERG; VERSPAGEN, 2002). Simply put, convergence represents that different units' policies, structures, and processes become more similar over time (KNILL, 2005). In other words, "Diffusion spreads similarity amid diversity" (WEYLAND, 2006, p. 19). However, despite increasing similarities between units, it matters for this dissertation that "the political processes by which these outcomes are reached display persistent differences". (BENNETT, 1991, p. 229). Nevertheless, these are not only one-way processes, as one might observe more than one convergence club.

### Why study the diffusion of military power?

The diffusion of military innovations is a crucial element in terms of national economic development and redistribution of global power (GILPIN, 1981; GOLDMAN; ANDRES, 1999; HOROWITZ, 2010). This point goes along with Economics' idea that the diffusion of technologies and products between firms results in asymmetries that may change the industrial structure (DOSI, 1988). Therefore, studying the causes and consequences of military diffusion is of the uttermost importance since international politics tends to work differently when resources and capabilities are more—or less—concentrated in the international system (DEUTSCH; SINGER, 1964; MEARSHEIMER, 2001; WALTZ, 1979).

The rise of possible great power in the international system often links to the literature on the "power transition" (KUGLER; DOMKE, 1986; LEMKE; TAMMEN, 2003; ORGANSKI, 1958; ORGANSKI; KUGLER, 1980; TAMMEN, 2008), the "long cycles" (MODELSKY, 1978; MODELSKY; THOMPSON, 1988; 1999; RENNSTICH, 2008; THOMPSON, 2006) and "hegemonic stability" (GILPIN, 1981; 1987; KINDLEBERGER, 1973; KRASNER, 1976; KRASNER; WEBB, 1989). I argue that the uneven growth rate results from the different levels of success of state-building and internal balancing efforts by states. This is because internal balancing strengthens the material capabilities of states, with implications, on occasion, for the system's polarity (DAWOOD, 2013). Thus, internal balancing links the system and the units, and vice versa.

It is also noteworthy that the diffusion of innovations is uneven in time and space (FREEMAN, 1987). Innovations tend to be spatially and temporally concentrated initially, thus taking time to spread. Hence, the pioneer state seeks to retain the first-mover status for as long as possible. However, there are several limitations to maintaining such status by the innovating country since innovations are concentrated only for a finite time (THOMPSON, 2020). Similarly, Bowen (2020) points out that the most useful and affordable space technologies, such as sensitive rocket and satellite technologies, will continue to spread to other states, despite the United States' initial technology control efforts.

Green and Long (2020, p. 60) point out that the speed at which countermeasures can be implemented "will affect the period during which military advantage might carry political weight. The expense required to undertake countermeasures might affect the degree to which they can be implemented across an entire force, or whether they can be implemented at all". Taking into consideration the third offset strategy developed by the United States to overcome the challenges posed by anti-access and area denial strategies, Kashin and Raska (2017, p. 4) note that its strategic effectiveness "will not only depend on the institutional agility and adoption capacity [on the part of the United States] [...], but will also depend on the responses, resources, and counter-innovations by peer competitors".

Moreover, there is an emerging research field on the diffusion of "4th Industrial Revolution technologies" (BOWERS; KIRCHBERGER, 2021), especially regarding advances in artificial intelligence and its effects on future warfare and international security (FITZPATRICK, 2019; HOROWITZ; KAHN; MAHONEY, 2020; JOHNSON, 2019a; PAYNE, 2018). As Johnson (2019a, p. 1) notes, such advances include: "(1) the exponential growth in computing performance; (2) expanded datasets; (3) advances in the implementation of machine learning techniques and algorithms (especially in the field of deep neural networks); and above all, (4) the rapid expansion of commercial interest and investment in AI". Therefore, knowing how and why different states dealt with previous potentially disruptive technologies may help to inform future challenges and opportunities.

## How to assess military power diffusion?

Military technologies and weapons systems are related but distinct concepts. Briefly, military technologies refer to the scientific and technical advancements in developing and operating military equipment and systems. These can include new materials, electronics, communications, and other technologies to improve military performance and capabilities. On

the other hand, weapon systems refer to the specific equipment and systems used by the military to conduct operations. These include tanks, fighter jets, submarines, artillery, and other weapons and equipment. A weapons system comprises multiple military technologies, such as engines, sensors, communication equipment, etc.

In this dissertation, I develop a military power index. It allows one to identify the more differentiating weapons systems and military technologies. Such aspects of this research differentiate it from previous ones that focus only on one or a few technologies. Moreover, while accessing military power, it avoids relying on an exhaustive list, including less relevant weapons systems and military technologies.

Nevertheless, it does not involve quantitative elements of military power diffusion. Neither does it assess qualitative differences between certain weapons systems and military technologies. Hence, the index has limitations when it comes to differentiating generations of aircraft fighters (third generation: F-A Phantom II and MiG-21; fourth generation: F-16 and Su-27; fifth generation: F-22 and the F35); aircraft carriers propulsion systems (conventional vs. nuclear).

Furthermore, the selected weapons systems and military technologies do not necessarily represent avant-garde technologies, especially those related to the fourth industrial revolution (i.e., artificial intelligence, hypersonic, directed energy, and electromagnetic weapons). Rather, it focuses on sophisticated and complex—although not necessarily the newest—platforms and technologies. I also do not assess whether a country has adopted a particular weapon system or military technology through external acquisition or internal development. In sum, the aforementioned shortcomings of the index constitute complementary or separate issues that are tangential to this dissertation.

I selected 32 technologies from the 66 available in Gannon's (2021b) database. I considered mainly the technologies closely related to the concept of military power developed in the next chapters. Also, I selected the 34 cases, mainly considering their average military spending during the timespan of this analysis (1991-2014). The bulk of the data I use comes from the Varieties of Democracy's (V-Dem) "State ownership of economy"; the Dyadic Militarized Interstate Disputes (MID) dataset version 4.02, organized by the Correlates of War (COW) project; and the Competitive Industrial Performance (CIP) Index dataset, developed by the United Nations Industrial Development Organization (UNIDO). Although I include data from Russia and the United States in the next chapters, I do not analyze these cases within the fsQCA analysis since they do not vary their positions (cluster 10) throughout time.

**Table 1 – Average military spending, in US\$ million (1991-2014)** 

Country	Average	Country	Average	Country	Average
United States	469.395.1	Taiwan	9.467.273	Oman	3.042.84
China*	55.342.08	Netherlands	8.836.785	Chile*	2.987.735
United Kingdom*	52.784.51	Myanmar*	8.754.994	Malaysia*	2.924.646
Japan*	45.001.39	Iran*	8.706.058	Egypt*	2.910.956
France*	42.133.82	Greece	5.780.52	Venezuela*	2.439.372
Germany*	36.669.52	Sweden	5.600.911	Morocco*	2.087.001
Russia	34.147.78	Singapore	5.487.863	Angola	1.885.862
Saudi Arabia*	29.726.41	Colombia*	5.457.202	Vietnam*	1.786.597
Italy*	25.569.75	Poland*	5.349.382	Syria	1.583.023
India*	23.302.2	Pakistan*	4.540.305	Peru	1.473.17
South Korea*	20.065.75	Kuwait	4.221.7	Libya	1.412.375
Brazil*	17.378.52	Algeria*	3.643.438	Ecuador	1.054.076
Spain	14.392.98	Iraq	3.471.814	Nigeria*	1.037.522
Australia*	13.327.74	Mexico*	3.429.274	Sudan	937.541
Canada*	12.965.01	Thailand*	3.397.369	South Sudan	846.786
Turkey*	11.400.7	South Africa*	3.171.671	Tunisia	460.234
UAE*	10.606.89	Argentina*	3.118.588	Kenya*	358.540
Israel*	10.356.06	Indonesia*	3.059.248		

Source: Author's elaboration, data from SIPRI (2021).

Even though the average spending does not relate directly to the diffusion of military power, I assume that countries with higher military spending probably have higher military adoption scores. Table 1 shows each region's top military spending—ten European countries, nine from the Americas, thirteen from Asia and Oceania, seven from Africa, and ten from the Middle East. Since some countries do not have available data for assessing their causal conditions, and others would constitute very similar cases, I selected crucial and representative cases from each region according to their military spending. I come close to Waltz's (1979, p. 72) argument that "Theories that apply to self-help systems are written in terms of the systems' principal parts. It would be as ridiculous to construct a theory of international politics based on Malaysia and Costa Rica as it would be to construct an economic theory of oligopolistic competition based on the minor firms in a sector of an economy".

## Plan of the dissertation

This doctoral dissertation proceeds as follows. In Chapter 2, I outline this research's analytical framework. I shed light on existing theories addressing the diffusion of military power and build an NCR theory to address such issues. Specifically, I focus on the research's conceptual and theoretical foundation, introducing its argument, composed of the outcome (successful military adoption) and its causal conditions (external threat, backwardness

advantage, developmental states, logistical capacity, and external alliance). There are four main theoretical explanations for the diffusion of military innovations.

The first emphasizes the causal importance of each state's different threat levels. The second focuses on how infrastructural and organizational aspects constrain the diffusion of military power. The third center its analysis on how cultural similarity among countries may favor or constrain the diffusion of military innovations. Finally, some authors emphasize the importance of shared norms and international legitimacy to the diffusion of specific military innovations to the detriment of others. In the same Chapter 2, I explore the methodological procedures, combining fuzzy-set Qualitative Comparative Analysis (fsQCA) and Comparative-Historical Method (CHM). In short, QCA is a systematic methodological approach that addresses the challenge of causal complexity, whereby multiple causal pathways may lead to a particular outcome. Moreover, QCA recognizes that multiple factors may act in combination to produce an outcome and that there may be a distinct asymmetry between the explanation of a given outcome and its negation.

In Chapter 3, I present how the diffusion of military power is assessed. A few military technologies and weapons systems are strong indicators for analyzing the distribution of military power. I rely mainly on Gannon's (2021b) dataset and build a ranking using Multiple Correspondence Analysis (MCA) that allows cross-case and cross-time comparisons. In short, MCA is a statistical technique used to analyze categorical data and explore the relationships between multiple categorical variables, thus helping to identify patterns and structures in the data. It creates a new set of variables called principal components, which summarize the information contained in the original categorical variables. By bringing to light how each country performed in the distribution of military power in the last three decades, I can explain the movie rather than just its particular frames.

I have picked up 32 out of the 66 military technologies provided in the database to compose a military adoption index according to my understanding of military power developed. I separate them according to enabling, nuclear, and conventional military capabilities. By doing so, I explore the main trends in the distribution of military power across all cases and in the diffusion of military technology and weapons system themselves.

In Chapter 4, I proceed with data collection and systematization for the 34 cases. It highlights some fundamental descriptive statistics from the crude data for the causal conditions. It also outlines the truth table and the solution terms obtained after the logical minimization. In the context of QCA, minimization refers to a process of simplifying the set of conditions that

are necessary and sufficient to produce a certain outcome. In QCA, this is done by identifying the smallest possible set of conditions that can explain the occurrence of an outcome in a given set of cases. Therefore, I justify my decisions regarding the chosen proxies and the calibration process.

I can generalize my finding by analyzing various countries to great and middle powers across all regions. I still delve into the proper QCA analysis of solution formulas through logical minimization. I ran two different fsQCA to identify why some countries rose while others did not regarding the diffusion of military power. This step identifies prime implicants, intermediate solutions, and both sufficient (coverage) and necessary (relevance) causal conditions. I also run two robustness tests to grasp any variance that might have been observed by changing external alliance logistical capacity causal conditions.

Finally, Chapter 5 proceeds with a historical-comparative analysis to identify the causal mechanisms explaining the occurrence and the non-occurrence of successful military diffusion. I focus on successful and non-successful cases, such as Argentina (fall), India (stall), and Japan (rise). The causal conditions for different outcomes are further scrutinized, considering the cases' political and strategical particularities. By explaining these cases, I can shed light on other meaningful ones.

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