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Research article

Polarity in the Context of U.S.-China Competition: Reassessing Analytical Criteria

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Abstract

How can polarity be used as a pertinent conceptual asset to inform the description of the distribution of military capabilities amongst the most powerful states in the international system today, especially in consideration of U.S.-China competition? Using the military power approach to polarity, this article analyses the literature that emerged in the 2010s to critically examine this concept. In order to enhance the analytical value of polarity and propose verifiable indicators of it, this study draws on Thompson's lead-sector model as well as Posen's and Lee and Thompson's research on the military foundations of polarity. When doing so, we distinguish latent enabling capabilities (as a secondary dimension of polarity) and the actual military power that primarily characterises polarity as a concept. When following this operationalisation of polarity, we show that the international system is still unipolar because the U.S. has unmatched global power projection capabilities and first-rate economic and technological might to sustain its military forces. In other words, the current distribution of military capabilities in the system reflects

that the contemporary international system is still U.S.-led and unipolar and that China's rise is still too confined by regional dynamics to constitute a preface of a military-hegemonic rivalry at a global level.

Keywords: *polarity, unipolarity, military power, U.S.-China competition*

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Introduction

In International Relations,[1] debates about polarity have constantly been rearranged according to how the discipline and relevant literature perceived historical changes. Since the end of the Cold War's bipolar system, a myriad of polarity-related topics has been studied: from examinations of the consequences of the post-Cold War U.S.-led unipolar world on war and peace to writings attempting to study whether China's rise is redefining the system's structure (Krauthammer 1991; Layne 2012; Monteiro 2012; Allison 2020; Zala 2021). Questions about whether the system today is unipolar, bipolar or multipolar remain unsettled (Græger et al. 2022). Moreover, several influential works have questioned the overall usefulness of polarity to assess the multifaceted nature of the international system (Legro 2011; Wohlforth 2022). Some of those scholars even decided to reject the concept altogether, alleging that it is too narrow to grasp the most significant variables that shape international politics (De Keersmaeker 2015; Brooks and Wohlforth 2016).

The goal of this paper is to enhance the operationalisation of polarity as a central concept for understanding relative military power (backed up by latent power) at the systemic level of international politics. More specifically, we assess this recent branch of criticism about polarity and suggest an evidence-based qualitative pathway to make the concept more analytically operational for the examination of the relative distribution of military capabilities between the most powerful states in the system. Two research questions will guide this article. First, in what way can polarity operate as a pertinent conceptual asset that helps describe the distribution of military capabilities amongst the most powerful states in the international system today, especially in consideration of U.S.-China competition? Second, is polarity still a useful concept despite the recent backdrop of increasing criticism and, to some extent, neglect of an in-depth analysis about it?

The article does not aim to address the usefulness of the central concept as a causal mechanism for explaining war and stability in the international system. Therefore, questions related to whether a certain type of polar arrangement tends to be more peaceful or stable than others are not the key focus of this

1 The text uses capital letters in International Relations while referring to the study area; international relations spelled with lowercase letters refers generally to international politics.

research. Instead, this article aims to assess the enduring feasibility, applicability and practicality of polarity to analyse the distribution of military capabilities in the international system today as well as the latent power that enables the construction, maintenance and strengthening of military power.

Given the focus on today's system, this article will also study whether China is changing the structure from unipolar to bipolar or if its rise is still too regionally confined to cause any significant change in the global polarity of the international system. Overall, the paper shows that, based on Posen's and Lee and Thompson's conceptual frameworks on command of the commons, the international system remains unipolar due to U.S. global military primacy. Measures of latent power inspired by Thompson's lead-sector approach also indicate a slight U.S. advantage over China, although the latter seems to be closing the gap in some specific innovation- and research-related areas.

This article is organised as follows. In the next section, we map out how different authors define polarity and choose our approach to the concept for this article. Then, we assess some of the most fundamental critiques of polarity that arose in the 2010s literature. After that, we trace possible indicators and analytical criteria to enhance our definition of polarity and apply the concept to describe the relative distribution of military power in U.S.-China competition as well as the latent power underlying it. Finally, we summarise the key results of this article in the conclusion.

Defining polarity

Scholars and policymakers have continuously expressed divergent and contradictory views about polarity, so there is hardly a consensus within the literature about what this key concept means and how to measure it. One of the few widely accepted premises is that polarity is used to determine the number of great powers in the international system. The myriad of scholars who have written about this subject can be divided into three groups contingent upon what they share in common regarding the definitions of polarity. These three groups are categorised as follows: first, the all-encompassing material approach, second, the inclusive approach and, third, the military power approach.

The *all-encompassing material approach* includes scholars such as Kenneth Waltz (1979), Christopher Layne (1993) Ikenberry, Mastanduno, Wohlforth (2011), Thompson (2018) and, to some extent, Michael Beckley (2018). They usually define polarity as a reflection of how states score compared to each other in multiple categories of power, namely, population, territory, economic wealth, military capabilities, technology and (sometimes) institutional maturity. It is noticeable that this branch of the literature considers polarity an objective metric of states' relative material capabilities.

Hal Brands (2016) and Benjamin Zala (2017) are the leading scholars of the *inclusive approach*. Unlike the all-encompassing material approach literature, they define polarity as more than a measure of states' relative material capabilities. For them, polarity also reflects a wider set of intangible variables such as ideological attractiveness and how other states perceive the role of the poles. Poles are not only militarily and economically superior to others, they also execute a social role in the system.

The military power approach has been proposed by Monteiro (2014) and, to a lesser extent, Barry Posen (2011). This approach suggests that polarity is a label for military power, not latent power, represented by the other components of power – including economic wealth – which can be converted into military capabilities (Mearsheimer 2001). As defined by this group of scholars, the only requirement is that the pole needs to have first-rate latent capabilities – a strong economy, innovation capacity, favourable geography, a relatively well-off population and so forth – to be able to sustain its military power. Still, polarity, according to this group, primarily measures the relative distribution of military capabilities.

For the purposes of this paper, the military power approach is adopted. This decision has implications of both a theoretical and technical character. From a theoretical standpoint, the use of a military-based definition of polarity implies that military power is an essential capability in inter-state relations, and that non-military variables of power are only as important inasmuch as they ultimately translate into military power. This military view of polarity does make sense especially when we follow the structural perspective on international relations.

As argued by structural realists, anarchy is the defining feature of the structure of the international system. The anarchical structure is defined by the absence of a higher authority above the states to enforce laws and norms of behaviour (Jervis 1978; Waltz 1979). In this environment, states possess offensive military capabilities which enable them to harm other states, making them potentially dangerous to each other. Given that states cannot be totally certain about the intentions of other states in an anarchic environment where they are militarily armed, especially considering that intentions may change radically, states tend to fear each other and their first and foremost concern becomes survival (Mearsheimer 1994-95). To assure survival and protect themselves from external threats, possessing military power is determinant. In other words, military capabilities are the *ultima ratio* of international politics (Mearsheimer 2001).

However, other theoretical strands would disagree with this perspective. On the contrary, they argue that capabilities in international politics are not an all-round factor, but instead, the utility of their components depends on sectorial

context. David Baldwin (2002) poses the question of fungibility of power. For Baldwin, military power does not necessarily attain successful results in all policy areas. Military power can rarely be used to gain influence in trade and is unlikely to persuade central banks to lower or raise their exchange rates (Drezner 2013). Thus, the structural realist emphasis on military power as a determinant factor of interstate relations is greatly exaggerated according to this perspective (Rosenau 2007). Although this thesis is plausible to a certain extent, it still fails to address the difference between strategic and security-related interests on the one hand, and auxiliary interests that are not directly associated with survival on the other hand (Mearsheimer 1994-95). When interests related to the survival and sovereignty of the state are at stake, military power remains one of the most – if not the most – indispensable assets for both deterrence and compellence. Thus, from a broader structural realist angle, treating the relative distribution of military capabilities as a fundamental object of analysis in International Relations enhances the study of international politics because of how important military power is for states to survive in an anarchical environment.

From a technical-conceptual standpoint, the non-military approaches to polarity present major deficiencies regarding their analytical criteria. The all-encompassing material approach's main deficiency is that it fails to specify the standard by which to measure the variety of capabilities incorporated in the model and indicate a method to merge them into an aggregate score of polarity (Schmidt 2005). To be considered a pole, should a state have superior scores in all components of power? Are some scoring factors more important than others? These questions are still largely unanswered. This problem is reinforced by an observable complexity that is revealed when the relative distribution of capabilities in each individual component presents different results. As Henry Kissinger noted, economic powers can be militarily weak, and military power does not always offset economic weaknesses (Waltz 1979).

The inclusive approach also has significant shortcomings. Brands and Zala did not outline a methodological proposition to measure the degree of ideological persuasion and social prestige of a pole, nor did they explain how the lack of such attributes would prevent a militarily strong and economically sophisticated state from being a pole. Therefore, the inclusive approach leaves the concept too vulnerable to subjective considerations rather than verifiable metrics. Although the increased role of subjective factors proposed by Brands and Zala is underscored as a distinguishing trait of their epistemologically interpretivist-oriented conception of polarity, their proposal does not quite fit our research, which is more predicated on a positivist epistemology and intends to address polarity as a measurable concept that describes an observable reality (Marsh & Furlong 2010).

On the other hand, the military approach is more history-grounded than the other two approaches. The data shows that when it comes to latent power, the U.S. was by far the most economically capable state on the eve of World War II, enjoying a higher share of global economic capacity than it does today. In 1937, the U.S. represented 35% of the absolute share of world manufacturing, while the Soviet Union had around 14%, Germany 11% and Japan 3.5%. Yet that period is considered multipolar (Posen 2011). The position that the USSR occupied in the global distribution of wealth was similar to that of Latin American countries: Soviet GNP per capita was approximately 25% of that of the wealthier Western countries in 1938 and it was at 18% in 1948. Latin American countries had comparable figures – 23% in 1938 and 16% in 1948 (Arrighi 2010). In 1945, the United States had a bigger share of the world GDP than in the 21st century; however, the post-World War II international system is largely defined as bipolar, because the Soviet Union had a powerful military capable of deterring America's ambitions worldwide, meaning that the concept of polarity reflects the distribution of military power and not latent capabilities (Monteiro 2014). Although the Soviet Union had income levels similar to Latin American countries, its military power was capable of limiting U.S. power projection worldwide.

However, GNP per capita metrics barely suffice for backing up the military-first conception of polarity. Throughout the Cold War, the Soviet Union had ups and downs. During the 1950s and 1960s, it could be argued that because of its cutting-edge achievements in space, the Soviet Union was not too far behind the United States technologically (Westad 2000). Nevertheless, despite acute Soviet economic decline and growing technological backwardness during the 1970s and (especially) the 1980s, the Cold War was only perceived to be over when Gorbachev relinquished strict military control over Eastern Europe and the Soviet military threat to Western Europe ceased to be a pressing concern (Wagner 1993). This corroborates the argument underlying Monteiro's and Posen's military-based conception of polarity: during the Cold War, the system was bipolar as long as the Soviet military threat to U.S. global interests stood firm.

Among the variety of reasons why the Soviet Union fell apart was its inability to compete with the United States economically and technologically, which left the former with few plausible options besides retrenchment (Patchen 1991; Brooks & Wohlforth 2000/2001). Fundamentally, the Soviet Union collapsed because its worn-out and resource-stressed latent power could no longer be translated into a technologically powerful military capable of competing against a wealthier and militarily advanced United States (Collins 2011; Wohlforth 2011). This historical evidence substantiates the thesis promoted by the military power approach to polarity: a pole needs top-notch economic capabilities to maintain and improve its military power, otherwise it may severely fall behind a peer competitor. But it

is possible to be militarily powerful and economically weak for a limited period, as the case of the Soviet Union displays. Latent power is a source of sustainable military strength, but it is not sufficient to be the determinant label of a pole.

Taking that into consideration, the conceptual body of polarity in our article rests on the military power approach. For the present scholarly work, latent power – meaning all non-military components of power (including technological prowess, economic capacity, geography and so forth) – are treated as enabling sources of military power. If states want to build and maintain sustainable and powerful military forces, they need top-tier latent power. However, latent power is not the primary defining label of a pole. States can be weak in latent power and strong in military power, even if for a limited period. Thus, military power is the number one defining variable of polarity. Essentially, polarity describes the relative distribution of military power among states in the system, providing a conceptual map to identify who the military great powers are.

Rising backlash: Assessing the fundamental critiques of polarity

Recently, especially in the 2010s, an increasing wave of criticism emerged to challenge the core assumptions and reasoning underpinning polarity. A handful of scholars called into question the inconsistencies and lack of operable metrics in the study of polarity, and some even suggested dropping the term altogether, alleging that its incongruences made it unfeasible and unworkable as an analytical asset.

This nuanced stream of criticism was relatively multifactorial. It focused on different, and sometimes unrelated, sustaining components of polarity. Nonetheless, this article will select and evaluate three types of criticism that can be considered a misconception or a misunderstanding of the core assumptions behind polarity to a certain degree. These are: first, *polarity as an all-explaining category*, second, *the overall utility of polarity as a conceptual asset*, and third, *objectivity, threshold and measurements*. Alongside that, we will also acknowledge the following two critiques that deserve rigorous scrutiny to reduce the susceptibility of the concept to misjudgment and subjectivity. These are: first, *treating polarity as a linear category*, and second, the debate on differentiating *regional dynamics from global dynamics*.

Polarity as an all-explaining category

A common criticism towards the polarity literature is that it has tended to reduce multicausal elements such as system stability and levels of conflict to a single variable, – that is, the number of great powers in the system – emphasising an univariate explanation that impoverishes the understanding of the complex nature of international politics (Thompson 2018). According to Legro (2011), the

significance of the distribution of material capabilities as an explanatory category should not be totally rejected, but other variables – including geography, alliances, arms race, regimes and norms – should have precedence over polarity. When the weight of those variables is considered, the influence of polarity seems to phase down in comparison (Legro 2011). Therefore, the literature has allegedly overstated the central role of polarity in shaping great power strategies, and it has used the number of great powers in the system as a single all-explaining variable that overshadows other explanations.

However, this criticism seems to overlook not only the diversity of approaches to polarity, but also some of the most influential scholarships that study the linkage between the number of great powers and other variables. Hopf (1991), for example, explained that the defence dominant balance during the Cold War deriving from the ability of the two superpowers to mutually destroy each other with nuclear weapons was more important than polarity in preventing a direct war between the United States and the Soviet Union. Despite criticising Waltz by asserting that bipolarity had little to do with the absence of direct war between the two superpowers, polarity remained an important concept in Hopf's analysis.

Moreover, Stephen Walt (2011) examined how geography, offensive capabilities, and aggressive intentions influence alliances in a unipolar world, suggesting that small and middle powers are more likely to ally with a distant unipole against their own regional rivals rather than create a broad coalition to balance against the superpower. This contradicts Waltz's (1979) and Mearsheimer's (2001) prediction of a global alliance to counter the power accumulated by the unipole. Walt relied on different variables besides polarity to explain regional powers strategy in a unipolar system. In short, the polarity literature is neither uniform nor does it share a homogenous line of research.

The overall utility of polarity as a conceptual asset

The most acute criticism of polarity questions whether the concept is helpful at all and even suggests the literature get rid of it. The outstanding and renowned work by Brooks and Wohlforth (2016) claims that polarity is blunt and ill-suited to capture change. According to them, the inconsistencies and confusions in the unipolarity literature suggests that an alternative approach would be more viable to explain America's shifting place in the world. Besides, polarity forces an all-or-nothing dichotomy that neglects the complexity of the leading variables of international politics. Instead of debating whether unipolarity is over or intact, it could be more fruitful to analyse how the rise of China, the resurgence of Russia and the challenges posed by non-state actors are making U.S. leadership more complicated. This criticism is in line with De Keersmaeker's (2015) assess-

ment. De Keersmaeker asserts that polarity does not help explain profound technological, military, economic, ideological, or geopolitical changes and challenges in the international system. It is only one factor among many, and probably not the most important one. Additionally, the previously mentioned scholar claims that polarity is self-serving: the description of today's world polar structure varies in conformity with biased national interests. It is no coincidence that most unipolarists are in America whilst multipolarists are usually dispersed across the world. Therefore, according to De Keersmaeker, polarity should be dropped as a conceptual instrument.

The aforementioned authors' criticism is somewhat misguided. In assuming that polarity is too limited to capture the multilayered dynamics of international change, the authors assign polarity a role that goes beyond what concepts can do. Polarity is a concept – that is, a cognitive representation – designed to describe and give meaning to an observed reality, which is the number of great powers in the international system (Bousso, Poles & Cruz 2013; McGregor 2018). In other words, polarity is a passive describer rather than a theory (Kelly 2017). Studying the causes of international change or shifts in the number of great powers is a different endeavour, generally suited for theory, which relies on concepts but offers broader causal propositions for the operation of a particular domain (Mearsheimer & Walt 2013). Nevertheless, there is no indication on how the effort of building a theory that measures or tests the causal importance of polarity at the systemic level would invalidate the concept altogether.

Brooks and Wohlforth do make a great point when declaring that polarity should not force an exclusive all-or-nothing dichotomy. However, their proposal for an alternative approach to polarity possesses inconsistencies and unclarities that hamper its analytical viability. They adapt Buzan's classification and depict the current system as a 1 + Y + X world, where 1 represents the superpower – the United States – that coexists with a rising superpower – China – represented by Y, and an undefined number of great powers represented by X (Brooks & Wohlforth 2016). Brooks and Wohlforth failed to make indispensable stipulations to elucidate their conceptions: what are the specific material capabilities that distinguish great powers from rising superpowers? At what point do great powers become rising superpowers and do rising superpowers reach the status of actual superpowers? Without these explanations, Brooks and Wohlforth's proposal lacks rigor and has no objective benchmark for the most essential concepts of their approach (superpower, rising superpower and great power), weakening the applicability of the model outside the scope of imaginative abstraction without much basis in material reality. In this model, it would be up to the imagination of each individual analyst to arbitrarily set the standards that characterise a superpower, a rising superpower and a great power.

One of the most valid criticisms about the polarity literature is the habit of analysing polar structures through linear angles, neglecting the presence of variation within the same structure (Thompson 2018). For example, Cold War bipolarity lasted from 1945 to 1989. However, bipolarity did not always operate the same way throughout this period. From the 1970s onwards, the United States was cementing an economic transition based upon high-tech innovation, including fiber optics, internet, commercial satellites and personalised computers rather than manufacturing. At the same time, the Soviet Union was unable to capitalise on those trends and remained increasingly left behind in economic competition (Reynolds 2010). This backwardness eventually led to the rise of Gorbachev and reformers to power, characterised by a cognitive restructuring modulated on the rejection of Stalinist-like institutions and growth-impairing policies (Kotkin 2001; Snyder 2003). This period stands in a stark contrast to past Soviet achievements based on megaprojects in aeronautics, space and nuclear weapons, including the launch of Sputnik. Hence, bipolarity did not operate linearly, and it did not always mean near-parity in latent and military power between the U.S. and the Soviet Union.

Another point that deserves serious scrutiny is the difference between regional and global polarity. In many instances, regional security complexes do acquire a substantial degree of autonomy from the global system. Most threats travel more easily over short distances than long ones, establishing security interdependence in regionally based clusters with their own dynamics (Buzan & Wæver 2003). Although regions are porous and open to interventions from global powers, sometimes this openness is not exploited too frequently, which generates a prevalence of strictly local security issues (Kelly 2007). This creates a sort of regional polarity detached from the global structure, entailing a difference between the regional and the global system.

It is important to realise that polarity often refers to the distribution of power at a global level rather than a regional level (Wæver 2022). If a regional struggle does not extend into the global level to cause a system-wide disturbance, it does not affect the broad structural arrangement of international politics or the polarity of the system (Tizzard 2017).

Objectivity, threshold and measurements

Thompson writes that 'we simply lack consensual understanding of what counts for power purposes or where the threshold for promotion might lie even' (Thompson 2018: 15). The lack of consensus on how to measure polarity and which capabilities should be prioritised for analytical purposes is a considerable challenge for the furthering of the usability of the concept beyond an abstract or intuitive latitude.

When seeking to fill that gap, Thompson proposed a quantitative threshold to classify different polar structures. For example, in unipolarity, one state holds more than 50% of available power. In bipolarity, two states hold no less than 50% of the available power, with each holding at least 25%. In multipolar systems, power is concentrated in three or more states possessing at least 5% of available power, but with no states holding more than 25%. To identify the leading poles, Thompson suggests a three-indicator index consisting of energy consumption, energy consumption per capita and power projection capabilities. The third indicator is composed of naval, air and missile assets, including aircraft carriers, nuclear attack submarines and strategic bombers.

The central shortfall of Thompson's metric rests on the complication of strictly quantifying the modern-day military foundations of a pole, which may result in misleading propositions. For example, some sophisticated weapons systems and components, especially those related to software, are not always clearly quantifiable. Quantification can understate the significance of such components, because they tend to be in the background of hardware and require a detailed cognisance of the complex systems within which they are incorporated. For instance, how feasible is it to quantify the stealth technology and the system of advanced radar and sensors that set the F-35 apart from other fighter jets (Osborn 2021; Congressional Research Service 2022a)? In those cases, a qualitative assessment seems more befitting than a quantitative analysis to compare and judge the military technological capabilities of poles. Although coming up with agreed-upon objective measures of a pole is a necessary undertaking, Thompson's proposal underperforms in that regard.

Therefore, one of the enduring challenges is making polarity more reliant upon objective, verifiable indicators that are permeable to change when the context demands a different approach to military power. To address these challenges, the existing literature can be a guiding light towards reformed propositions.

Measuring polarity: Reassessing analytical criteria to enhance the concept of polarity in the context of U.S.-China competition

We understand polarity as a label for depicting primarily the distribution of military power. As suggested in this paper, top-notch economic conditions are required for a state to be a strong and technologically sophisticated military power because latent power is an enabler of military power. The building blocks of latent power in the 21st century are manifested through the variables that reflect a country's capacity to discern the appropriate sociotechnical production choices to augment its power in the face of international competition and prospective challenges, as well as to develop the necessary technology, human resources and physical infrastructure to dominate the processes of innovation (Tellis et al. 2000).

Thompson's analytical model – characterised by a strong Schumpeterian tendency that emphasises the role of organisational, technological and infrastructural novelty as the fundamental impulse of capitalism – asserts that mastery of the current and emerging lead sectors of the global economy is the latent foundation of system leadership (Thompson 2020). The Fordist mode of production and innovations in the aerospace, automobile and petrochemical industries, for example, made the U.S. the chief economy from the 1930s to the 1980s. Then, the role of the U.S. in pioneering the information and communication industries enabled it to maintain its global economic primacy from the 1990s until today.

The premise behind the leading-sector approach is that states that acquire proficiency and prominence in cutting-edge technological and productive innovations that transform how critical human activities are conducted tend to be economic leaders in the international system. In this case, it is relevant to analyse U.S.-China competition in terms of relative latent power as manifested in leading sectors of the global economy, because latent power is the enabling source of military power according to the military approach to polarity.

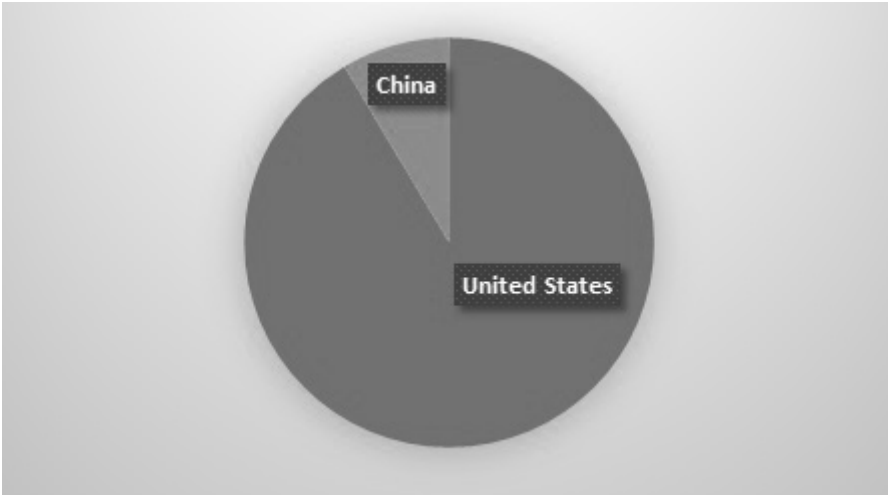
At the beginning of the 21st century, analysts started identifying an array of emerging disruptive technologies that had the potential to revolutionise the global economy. This transformation can be defined as the fourth industrial revolution and is based on the confluence of emerging technological breakthroughs covering a wide range of fields such as artificial intelligence (AI), robotics, the internet of things (IoT), autonomous vehicles, 3D printing, nanotechnology, biotechnology, materials science, energy storage and quantum computing (Schwab 2016). Given that these technologies can be considered the emerging leading sectors of the global economy and might have a substantial impact on military capabilities – from precision striking by unmanned aerial vehicles and autonomous weapons to command, control, communications, computers, intelligence, surveillance and reconnaissance systems – it is possible to assume that mastering them will be decisive for any state intending to be at the top of the system hierarchy in relative latent power, and possibly military power (Hammes & DiEuliis 2020).

One way to measure relative latent power in emerging lead-sectors is patents. Although quantifying the objective quality of patents is an imprecise, complicated science, the number of protections granted to an invention can offer a basic – but significant – insight into some areas of innovation.

Patents granted by the European Patent Office, Japan Patent Office and United States Patent and Trademark Office are a source of more reliable data than those coming from China. China's National Intellectual Property Administration equates patent generation with innovation, and its development strategy called for the government to bolster the number of domestically filed patents,

which resulted in patents being granted for small and incremental changes compared to entirely new innovations. This inflates Chinese patent numbers. Moreover, given the low regulatory threshold for application and granting, patent data from China might not be as reliable as data from U.S., European and Japanese offices, which are stricter in terms of quality evaluation standards and more expensive to apply for (China Power Team 2016; Liang 2012).

Figure 1. Patents granted by the European, Japanese and U.S. patent offices to U.S. and China inventions in artificial intelligence-shaped technologies from 2009 to 2019



Source: Five IP Offices Statistical Data Resources (2020)

As Figure 1 demonstrates, inventors from the U.S. have been granted more intellectual property protection in artificial intelligence-related technologies than inventors from China. From 2009 to 2019, the trend was largely more favourable to the United States.

Moreover, as illustrated by Table 1, American companies are single-handedly widespread as top providers in AI, IoT, big data, 3D printing, and biotechnology and nanotechnology. Meanwhile, Chinese companies do constitute serious competitors in the market areas they are present in, but they only unilaterally dominate solar PV.

In the semiconductor industry, manufacturing capabilities have remained concentrated among key industry players located in South Korea and Taiwan. Samsung and TSMC are the only companies manufacturing semiconductors at the most advanced process nodes – specific generation of the manufacturing process named according to its smallest feature size (Eurasia Group 2020). China remains far behind the global cutting edge of semiconductor manufacturing.

Table 1. Top Global Technology Providers in Fourth Industrial Revolution-Related Sectors

AI	**IoT**	**Big Data**
Alphabet (U.S.)	Alphabet (U.S.)	Amazon Web Services (U.S.)
Amazon (U.S.)	Amazon (U.S.)	Dell (U.S.)
Apple (U.S.)	Cisco (U.S.)	HP Enterprise (U.S.)
IBM (U.S.)	IBM (U.S.)	IBM (U.S.)
Microsoft (U.S.)	Microsoft (U.S.)	Microsoft (U.S.)
Blockchain	Oracle (U.S.)	Oracle (U.S.)
Alibaba (China)	PTC (U.S.)	Splunk (U.S.)
AWS (U.S.)	Salesforce (U.S.)	Teradata (U.S.)
IBM (U.S.)	**5G**	**3D Printing**
Microsoft (U.S.)	Huawei (chip and network) - (China)	3D Systems (U.S.)
Oracle (U.S.)	ZTE (China)	Exone Company (U.S.)
Robotics	Intel (U.S.)	HP (U.S.)
KUKA (China)	Qualcomm (U.S.)	Stratasys (U.S.)
Alphabet/Waymo (U.S.)	**Drones**	**Biotechnology and Nanotechnology**
GM (U.S.)	3D Robotics (U.S.)	Appel Sciences (U.S.)
Tesla (U.S.)	DJI Innovations (China)	Agilent (U.S.)
Solar PV	Boeing (U.S.)	Intel (U.S.)
Jinko Solar (China)	Lockheed Martin (U.S.)	
JA Solar (China)	Northrop Grumman (U.S.)	
Trina Solar (China)	Yuneec (China)	

Source: United Nations Conference on Trade and Development (2021)

One of the fields in which China has shown consistent advances is quantum science, displayed by the launch of the world's first quantum satellite in 2016 (Micius). This may enable its transformation into a global technological powerhouse, especially in areas where quantum technology has relevant application: imaging, navigation, meteorology, information processing and energy (Kania & Costello 2018). Nevertheless, U.S.-based Google and IBM have been at the forefront of the first wave of quantum computers (LaPedus 2021).

Scientific publications and cultivation of qualified human capital in China seem to be heading to a prominent direction. In 2020, China had 32,925 research publications about AI, maintaining the first position, seconded by the U.S., which had 14,944 (OECD AI 2021). Additionally, since 2007, China has outproduced the United States in science, technology, engineering and mathematics (STEM) graduates. In 2019, Chinese universities awarded 49,498 Ph.D. degrees in STEM, whereas the U.S. produced 33,759 Ph.D. graduates (Zwetsloot et al. 2021). Approximately 45 percent of China's STEM graduates come from elite universities. However, according to the QS Rankings 2020, the U.S. is home to the first (MIT), second (Stanford)

and fifth (University of California, Berkley) universities with the best overall score in engineering and technology. The highest ranked Chinese university (Tsinghua University) is ranked ninth. Besides, as the Highly Cited Article Index reveals, from 2010 to 2018 U.S. publications were more cited and impactful than China's (National Science Board 2022). Other great researchers such as Brooks and Wohlforth (2015-16) have compared U.S. and China performances in royalties and license fees for innovative technology registration and in the geographic distribution of Nobel prizes winners in science. In their own conclusion, the United States maintains a competitive edge in scientific and technological proficiency over China in the aforementioned indicators, which is a source of advantage in the knowledge-based economy undergoing a fourth industrial revolution.

Although limited and far from exhaustive, Thompson's lead-sectors approach can provide an elementary picture of the relative distribution of latent power between the U.S. and China in the emerging paramount areas of the global economy. In this preliminary analysis, the U.S. does not appear to be declining, but China's performance suggests it has the required latent capabilities to match and even surpass the U.S. in critical fields, including quantum computing, expertise and research.

To measure the military foundation of polarity, Barry Posen (2003) proposed the understanding of the command of the commons – that is, getting more use out of the sea, air and space than one's adversaries, and having the ability to project military power and engage in trade at times and places of its choosing, while denying the same privilege to others. According to Posen, the command of the commons is built on four dimensions:

1. Command of the sea: based upon superior stealth submarine fleets, aircraft carriers, amphibious assets and destroyers.
2. Command of the air: depends on precision-guided weapons and stealth aircraft that can strike out of the opponent's air defence range, as well as reconnaissance and electronic warfare capabilities.
3. Command of space: formed by reconnaissance, and navigation and communication satellites to conduct operations worldwide.
4. Infrastructure: ports, bases, airlifters, large-scale ships to transport assets, and regional commands to watch over the globe.

Sameer Lalwani and Shifrinson (2011) consider that the modern commons also include cyberspace.

According to Lee and Thompson, specialisation in long-distance projection and command of the commons is a defining feature of global powers:

> These states build powerful navies, air forces, and command and control capabilities, wielding influence by gaining command of the com-

> mons. The vast majority of international trade and communication flows through the oceans and skies. Controlling global sea lanes thus confers a great deal of influence on such states. In times of conflict, global powers can shut off access to trade to their enemies, forcing costly economic adjustments abroad. Sea power is also immensely useful for the construction of effective military alliances. Reach capabilities can be used to help allies join distant battles (Lee & Thompson 2017).

They proposed the following indicators to compare the relative capabilities of global powers: naval power, measured in aircraft carriers and nuclear submarines, and air power, measured in long-range strategic bombers, long-term military satellites and long-range land-based nuclear missiles. It is a similar but simpler analytical model compared to the one that Posen suggested.

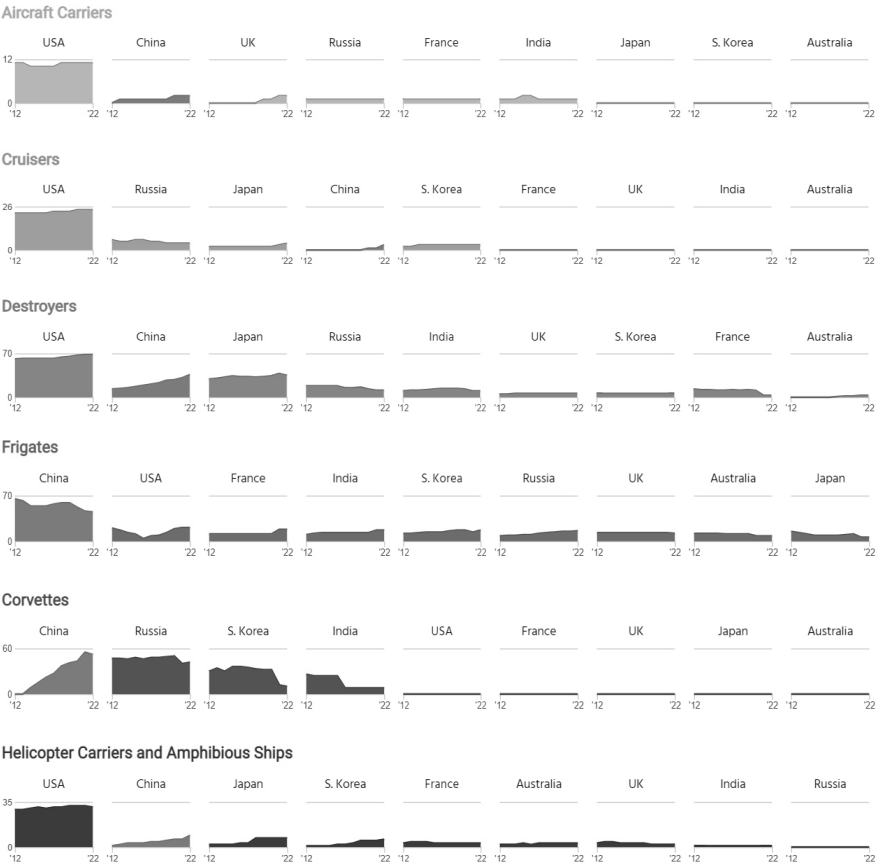
Currently available data on military power displays U.S. quantitative superiority over all other major powers in the number of aircraft carriers, cruisers and destroyers possessed by each, as Figure 2 shows.

As demonstrated by Figure 3, this superiority extends to submarine fleets for nuclear-powered ballistic missile submarines (SSBNs) and nuclear-powered cruise missile submarines (SSGN).

However, the sheer quantity of surface combatants and submarines is an unreliable metric of naval power for command of the commons. Many factors other than ship and submarine numbers seem to have a greater contribution to naval capability, including types of ships, submarines and aircraft, the sophistication of sensors, weapons and C4ISR systems, networking capabilities, logistics and maintenance, doctrine and tactics, the level and quality of the education and training of personnel, and the plausibility of exercises (Congressional Research Service 2022b).

The United States' qualitative superiority is noticeable in many critical areas of command of the commons-wise naval power. Compared to their Chinese counterpart, U.S. Navy aircraft carriers are larger, nuclear-powered (giving them greater cruising endurance than a conventionally powered carrier), able to embark and operate a larger number of aircraft, and launch fixed-wing aircraft using catapults, which allows those aircraft to have a greater range/payload capability than that of aircraft launched with ski ramps. Liaoning, China's first aircraft carrier, entered service in 2012. China's second and first indigenously built aircraft carrier, Shandong (type 002), entered service in December 2019. They both launch fixed-wing aircraft using a ski ramp at the ship's bow, one of the factors which puts them behind U.S. Navy carriers (Congressional Research Service 2022b).

Figure 2. Quantity of Surface Combatants by Country



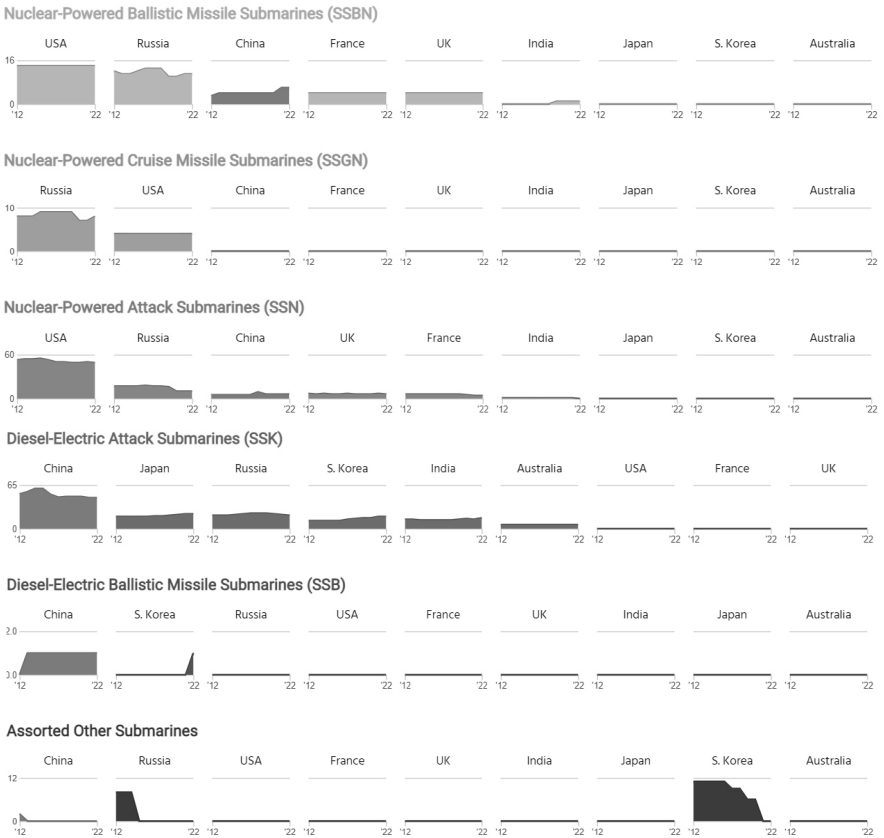
Source: China Power Team at https://chinapower.csis.org/china-naval-modernization/

All of China's six SSBNs are Jin-class submarines (International Institute for Strategic Studies 2021). One of the main challenges for the PLAN to establish a credible sea-based conventional and nuclear deterrence is operational stealth. The stealth and effectiveness of the Jin-class has been put into question due to the amount of radiated noises it generates in operation (China Power Team 2020).

The Type 094 is reported to be two orders of magnitude louder than current U.S. and Russian boomers, and according to the U.S. Office of Naval Intelligence, the Type 094 is noisier than the Delta III SSBN first launched by the Soviet Union in 1976. The Type 094A variant is believed to feature design improvements aimed at reducing the submarine's detectability (Funaiole et al. 2021).

This would make the Chinese submarine more vulnerable in antisubmarine warfare, which prioritises detection and tracking of adversary SSBNs.

Figure 3. Quantity of Submarines by Country



Source: China Power Team at https://chinapower.csis.org/china-naval-modernization/

In addition, China has faced some lingering difficulties in producing certain domestically manufactured military aviation equipment. Between 2015 and 2019, China was the fifth world's largest arms importer, behind Saudi Arabia, India, Egypt and Australia. During this period, Russia supplied approximately 75 percent of China's total arms imports, including aircraft and engines (China Power Team 2021b).

Data on raw naval capabilities that make commanding the maritime commons possible points to a significant qualitative lag between U.S. military power and China's, especially in aircraft carriers and submarines, two core instruments of power projection. The U.S. superiority in infrastructure of command is even more patent. While the U.S. has military facilities and strategic commands spanning all continents of the world, China's first military base abroad, in Djibouti, was built alongside U.S., Japanese and French forces (IISS 2021). Currently,

among the key challenges confronting China's ability to be ranked as a global military counterpower to the United States, two of them appear to stand out.

The first is related to systems integration. The increasing complexity of systemic integration of components along with testing and verification of those components has extended the requirements for comprehensive expertise and know-how and for tacit knowledge-based organisational experience for designing weapons systems, shrinking the backwardness advantage that allowed Germany to emulate and match British naval capabilities pre-World War I (Gilli & Gilli 2018-19). If aviation design up to the 1930s consisted primarily of aerodynamics structure and efficient hydraulic pilot controls, from World War II and the rise of electronics during the Cold War onwards, aircraft acquired new weapons and more technologically sophisticated components in a structurally coherent system which required firms to learn and develop new skills in a variety of disciplines and processes (Johnson & Hobday 2003). Nowadays, know-how about weapons systems is embedded in the collective memory and experiences of defence organisations, which severely inhibits its diffusion (Johnson 2021). The reliance on Russian technology for some of China's advanced defence systems remains a reality, as illustrated by many J-20 stealth fighters which still employ Russian Saturn AL-31 engines. In 2019, Russian defence firm Rostec accused China of illegally reverse engineering a wide range of Russian weaponry and military hardware, including aircraft engines, Sukhoi planes and air defence systems (Simes 2019). This suggests that China is struggling to close the military-technological gap with the United States in state-of-the-art base of indigenous innovation for advanced weapons systems (Raska 2019). This hampers China's ability to contest U.S. command of the global commons in the air and shatter the U.S.-led system.

The second challenge concerns geography. Unlike the United States, which is effectively isolated from other powerful states in Eurasia by two oceans and surrounded by weak unthreatening neighbours, China's rise is shaped by a regional environment crowded with potential adversaries who are suspicious of its aggrandisement efforts (Shifrinson 2020). The potential for multifront conflicts and strategic encirclement characterises the regional geography surrounding China (Ross 1999). The so-called first island chain and its outer ring is relatively encircled by U.S. military facilities in South Korea, Japan and Australia (Kaplan 2010). Other regional states such as Singapore and Indonesia are also wary of China's quest for regional leadership, as evidenced by the first's building of a pier at its Changi Naval Base to accommodate visiting U.S. aircraft carriers, and Indonesia's destruction of allegedly encroaching Chinese fishing boats on Indonesian waters (Roy 2020). China's land-based territorial disputes with India also diverts Chinese military resources away from the Indo-Pacific theatre (Krepinevich 2017). Moreover, India's centrality in the Indian Ocean poses particular problems for China's su-

premacy in the Indo-Pacific. India's advantage in the Indian Ocean area is manifested by shorter lines of communication to its own bases and resources, whereas China, in case of a conflict, would have to deploy naval forces through dangerous chokepoints and cope with uncertain logistical support (Brewster 2016).

Threats are a function of geography, offensive capabilities and perceived aggressive intentions (Walt 1987). China's military buildup in the South China Sea and the East China Sea in the vicinity of other regional states is likely to be interpreted as a major threat. For Taiwan, the threat might be existential. Therefore, regional states turn to the U.S., located on the Western Hemisphere, to balance against China's aspirations, given that China's proximity, as well as its growing offensive capabilities, could facilitate military aggression against them. The QUAD partnership between the United States, Australia, India and Japan is a possibly interesting illustration of Walt's alliance theory.

Nevertheless, China's A2/AD capabilities could inflict damaging costs onto U.S. forces. A RAND Corporation study showed that Chinese forces would enjoy the advantage of proximity were a crisis or war against the United States to break out in the immediate periphery of the Chinese mainland. In spite of that, the longer the forces moved away from the mainland, the more Chinese advantages would shrink (Heginbotham et al. 2015). As James Lebovic (2017) puts it 'China makes for a formidable opponent in any battle fought in and around the Chinese mainland but lacks air and naval power to extend its global reach'. In summary, the data indicates that the world today is unipolar, led by the U.S., which has unmatched military power projection capabilities and first-rate economic and technological might to sustain its military forces.

Still, there may be dissenting perspectives regarding the interpretation of the data. According to Øystein Tunsjø (2018), the world today is bipolar, because the two top states – the United States and China – are much more powerful than any third state, therefore, the structure of the international system has recently changed from unipolarity to bipolarity again. China is not as powerful as the United States and is far from having similar global power projection capabilities. The Soviet Union was never as powerful as the United States during the Cold War. It only deployed its first aircraft carrier in the 1970s and had no power projection capabilities in the aftermath of the Second World War. Despite this power disparity, scholars and practitioners – including Kenneth Waltz (1964) and Reynolds (1992) – considered the Soviet Union a superpower composing a bipolar structure alongside the United States because both were much more powerful relative to all other states.

In Tunsjø's analysis, the power gap between the second and third ranked power is more important than the one between the former and the leading state when it comes to determining the polarity of the system. Thus, Tunsjø con-

cludes that the current structure of the international system is bipolar. However, Tunsjø overlooks the role of geography in each context. Although China's economy is stronger, geography and military power make its status much more precarious compared to the Soviet Union in the Cold War. The Soviet Union had mostly a weak economy, but enough military power to undermine U.S. interests in Eurasia. Not only was the Soviet Union a land-based hegemon in Eastern Europe and Central Asia, but it also had some footprint in East Asia. Geography combined with its military capabilities made the Soviet Union a global rival of the United States. The geographical spread of the Soviet Union – from Eastern Europe in the west of its territory and the Middle East in the south to China and Japan in the east – made it a primary factor of security considerations in different areas. Operating from internal lines of communication, the USSR was a power to be reckoned with in Europe, Asia and the Middle East. It was not equally powerful everywhere, nor was its power unchallenged. Still, the Soviet Union was a continental force that transcended different regional boundaries (Dibb 1986). China, on the other hand, has no similar continental or maritime hegemony in its region.

Adopting Tunsjø's definition of the current system as bipolar would ignore the significant disparity between the U.S. and China in military power, and such disparity was not as vivid during the Cold War given the Soviet Union's geography and military capabilities. By applying the military conception of polarity, we can identify that geography was largely an enabler of the military capabilities of the Soviet Union. For China, geography is more of a hindrance that constrains China's power projection capabilities to one regional sphere.

Consequently, it is also important for analytical models that deal with polarity to consider the possibility of variation. Some processes and definitions are generalisable; for example, the concept of polarity is a category for describing the distribution of military power and identifying the top states in this domain. But some variables that act to produce a certain outcome in a given circumstance might not operate the same way (or at all) in a different context (Tilly 1995). In this case, although America and China are significantly stronger than all other states in the system, there is a massive disparity between both that makes a Cold War analogy too imprecise. China does not have the partial military interregional hegemony that the Soviet Union had, nor does it have the same geographical extension in Eurasia to harm U.S. military power. Hence, we argue that the world today is still unipolar.

Conclusion

The measure proposed in this article to make polarity more operational can inform scholars and practitioners about the current state of the relative distribu-

tion of military power in the world, as well as the latent power that enables it. The U.S. is still ahead of China in military competition according to indicators of power projection capabilities proposed by Posen and Lee and Thompson. Economically and technologically, based on a leading-sector model tailored for the analysis of fourth industrial revolution areas, U.S. superiority is also present. China has accomplished some successful results in research, expertise and mastery of certain innovation areas, such as quantum science. However, the U.S. has the highest-ranked universities, the highest-cited articles, the main top global providers of emerging technologies, and has the edge over China on patents and royalties for innovative technology.

We still live in a unipolar world where the U.S. has unmatched global power projection capabilities. Unipolarity is not omnipotence. The rise of regional powers and second-tier competition is still possible under a unipolar system. Unipolarity does not imply the end of all conflicts or the absence of complex state and non-state actor-driven challenges for the unipole and for the international system. Unipolarity simply means that there is no military-hegemonic rivalry at a global level (Wohlforth 1999; Jervis 2011). Regional powers can operate beyond their region sometimes, but their reach will be very limited compared to that of the United States. As long as their military-technological capabilities for power projection and infrastructure of command reflected in military bases around the world remain far inferior to those of the U.S., and their geography does not enable much extra-regional extension to harm U.S. interests worldwide, the world is likely to remain unipolar.

Polarity is not exclusive. It cannot by itself explain political, technological, economic, ideological, geopolitical or even military-technological transformation in the system. Despite this, knowing the relative distribution of military power in the world and keeping track of the indicators that matter is elucidating. It allows us to know who the great powers are, or who the superpower is, and whether the rising power poses a military global threat or is, at the moment, circumscribed by regional challenges. This is not an all-or-nothing dichotomy. It is more of a description of each state's military power projection capability, which coexists with the enabling economic power that underpins it and the favourability or disadvantages provided by geography.

There are some questions that need further study in the literature, especially regarding the regional and global differences of a structure. When do regional frictions and wars turn into system-wide disturbances that have the potential to alter the structural arrangements of the international system? In summary, when do regional conflicts acquire the ability to change global polarity? Overall, studying polarity through categories that can be objectively defined, without overstating or understating its role as a causal mechanism, can

be a source of an interesting understanding about the military hierarchy in the international system.

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