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Measuring and Forecasting the Rise of China: Reality over Image

Jonathan D. Moyer, Collin J. Meisel and Austin S. Matthews

University of Denver, CO, USA


ABSTRACT

The rise of Chinese capabilities relative to those of the United States has received widespread attention. Some argue that a transition in relative capabilities has already occurred, others that it is unlikely within this century. This article presents a new multidimensional measure of relative national capabilities and forecasts using the International Futures model across 29 alternative scenarios. This article finds that Chinese capabilities surpass the United States in 26 scenarios before 2060, with the most frequent period of power transition being the early 2040s. This analysis offers an opportunity for leaders to reconcile national images with reality, potentially reducing the risk of conflict associated with great power transition.

Introduction

Chinese material capabilities, particularly relative to those of the United States (US), have received widespread attention in academic literature with many researchers concluding that Chinese resources will likely eclipse those of the US in the near future.¹ As a result, several recent studies on China-US relations have focused on the potential implications of such a transition. Some have made the case that any power transition between these states would likely occur peacefully.² Others have argued that a shift in relative capabilities could lead to disruptive systemic change and possibly armed conflict.³

While some argue that China is not on track to surpass the US as the leading superpower, others have highlighted that this expectation relies on forecasts utilizing existing measurements with major limitations. Particularly, they argue that measurements of power may be missing aspects of competition where the US may possess strategic advantages vis-a-vis China, such as the fields of technology, alliance networks, and advantages from the very structure of the international system.⁴

CONTACT Jonathan D. Moyer  jmoyer@du.edu  Frederick S. Pardee Center for International Futures, Josef Korbel School of International Studies, University of Denver, Denver, CO, USA

¹Aaron L. Friedberg, *A Contest for Supremacy: China, America, and the Struggle for Mastery in Asia* (W.W. Norton & Company 2012); Christopher Layne, 'This Time It's Real: The End of Unipolarity and the Pax Americana' (2012) 56(1) *International Studies Quarterly* 203; Minghao Zhao, 'Is a New Cold War Inevitable? Chinese Perspectives on US-China Strategic Competition' (2019) 12(3) *Chinese Journal of International Politics* 94.

²Steve Chan, *China, the US and the Power-Transition Theory: A Critique* (Routledge 2008); David Shambaugh, 'U.S.-China Rivalry in Southeast Asia: Power Shift or Competitive Coexistence' (2018) 42(4) *International Security* 85; Yuen Foong Khong, 'Power as Prestige in World Politics' (2019) 95(1) *International Affairs* 119.

³John J. Mearsheimer, 'The Gathering Storm: China's Challenge to US Power in Asia' (2010) 3(4) *Chinese Journal of International Politics* 381; Randall L. Schweller and Xiaoyu Pu, 'After Unipolarity: China's Visions of International Order in an Era of U.S. Decline' (2011) 36(1) *International Security* 41; Christopher Layne, 'The US-Chinese Power Shift and the End of the Pax Americana' (2018) 94(1) *International Affairs* 89.

⁴Hyung Min Kim, 'Comparing Measures of National Power' (2010) 31(4) *International Political Science Review* 405; Michael Beckley, 'China's Century? Why America's Edge Will Endure' (2011) 36(3) *International Security* 41; Joshua R. Itzkowitz Shiffrin and Michael Beckley, 'Correspondence: Debating China's Rise and U.S. Decline' (2012) 37(3) *International Security* 172; Sean Starrs, 'American Economic Power Hasn't Declined—It Globalized! Summoning the Data and Taking Globalization Seriously' (2013) 57(4) *International Studies Quarterly* 817.

These disagreements highlight the breadth of challenges in research seeking to measure and forecast national power. For example, simply identifying situations or periods where one state was more powerful than another is fraught with complexities. If power is the ability of *A* to get *B* to do what *B* otherwise would not have done, then knowing when power is expressed requires counterfactuals, along with understanding what any actor intends to or is willing to do.⁵ The challenge of identifying where state power is successfully used in international relations makes it difficult to measure what type of capabilities matter for expressing power. In addition to the difficulties of identifying power expressions and measuring capabilities with accuracy, uncertainty characterizes projections of these concepts.

Recognizing these challenges, this article seeks to accomplish three things. First, it aims to improve scholars' ability to measure the general material capabilities of states over time by introducing the DiME (Diplomacy, Military, Economy) Index. The DiME Index captures this concept for all members of the international system from 1960 to 2020 using economic production, population size, military investments and nuclear weapon counts, and diplomatic network variables. Second, this article forecasts this measure using the International Futures model.⁶ The authors project the DiME Index for 186 countries, providing a global perspective on changing material capabilities across space and time. This global perspective allows scholars to discuss the relative distribution of Chinese and American material capabilities over time, relative to changing global patterns of development.

Third, because this article is describing long-term futures characterized by uncertainty, it introduces 29 alternative scenarios. These scenarios model alternative assumptions about the future capabilities of China and the US across key drivers, including economic growth, military spending, diplomatic exchange, demographics, and nuclear weapons. These alternative futures offer the opportunity to further probe questions such as the following. How likely is it that China surpasses the US before 2060? When is China most likely to have greater material capability than the US? What will the global share of Chinese and American capabilities be in the future? Under what assumptions does this transition not occur?

This research can reduce uncertainty and provide discussions about China-US competition with a common frame of reference, one in which China's rise and power transition with the US is the most likely future rather than a surprise. Reduced uncertainty can lower the likelihood of conflict and decrease threat perception.⁷ As Boulding notes, 'it is one nation's image of the hostility of another, not the "real" hostility, which determines its reaction.'⁸ This article's intent is to encourage readers to reconcile images with reality, namely one where a China-US power transition is the product of structural trends rather than hostile intentions by either party.⁹

Power in International Relations: from Concept to Measurement

Within the field of international relations, state power is a central area of research. Realists claim that the distribution of relative material capability—their standard characterization of power—is *the* explanatory variable of state behavior.¹⁰ Liberal, Institutional, and Functionalist theorists instead

⁵Robert A. Dahl, 'The Concept of Power' (1957) 2(3) *Behavioral Science* 201.

⁶Barry B. Hughes, *International Futures: Building and Using Global Models*, (1st edn, Elsevier Academic Press 2019).

⁷D. Scott Bennett and Alan C. Stam, *The Behavioral Origins of War* (University of Michigan Press 2004) 23; Mark L. Haas, *The Ideological Origins of Great Power Politics, 1789–1989* (Cornell University Press 2005) 14.

⁸Kenneth E. Boulding, 'National Images in International Relations' (1959) 3(2) *Journal of Conflict Resolution* 120.

⁹This article acknowledges the limits of this 'nonintentional power concept,' as 'intentional attempts to prevent the emergence of a self-fulfilling prophecy may actually play an unintentional part in creating one.' See Linus Hagström and Bjorn Jerdén, 'East Asia' Power Shift: The Flaws and Hazards of the Debate and How to Avoid Them' (2014) 38 *Asian Perspective*.

¹⁰Kenneth N. Waltz, 'Political Structures,' in Robert O. Keohane (ed), *Neorealism and Its Critics* (Columbia University Press 1986), 70; Christopher Layne, 'Kant or Can't: The Myth of the Democratic Peace,' (1994) 19(2) *International Security* 5; John Mearsheimer, *The Tragedy of Great Power Politics* (W.W. Norton & Company 2001).

believe that affinity and institutional design shape the manifestations of power among states, speaking in terms of 'soft' or 'smart' power.¹¹ Marxists point to the power of economic structures and classes.¹² Post-Structuralists see power everywhere.¹³

In 1957, Dahl articulated a widely accepted definition of power: 'A has power over B to the extent that he can get B to do something that B would not otherwise do.'¹⁴ The foundational concepts in this definition are: power is expressed in relation; identifying the successful expression of power requires understanding the desires of both actors; and power can be identified in particular interactions. While this definitional framework is essential for understanding international relations, it is a challenge to measure. The challenges to operationalizing this definition point to the need for a multidimensional index of relative capabilities.

Dahl's definition highlights the relational foundations of power, requiring (at least) two actors. This highlights the importance of relativity as a concept needed to understand and measure power relations.¹⁵ In other words, it matters little how much one actor's abilities change across time if they are not understood in context of the development of another state's ability to act. To understand the general power of one country, one needs to understand the general power of all countries.

Dahl's definition also highlights the importance of understanding the intentions and desires of actors in determining whether power is expressed. The ability of the US to get the Iraqi government in 2003 to do what it would not otherwise do (collapse) is clearly an expression of power. But short of invasion and collapse, the particular expression of the power of A over B is more difficult to identify, especially systematically across space and time. What does Actor A want Actor B to do? Is it stated or unstated? What does Actor B want in the interaction? For interactions in the international system where it is not clear what two states desire, this is a problem that grows by factors as one moves from dyadic interactions to multiple dyads and eventually networks of state and non-state actors.

This leaves scholars with a variety of measurement challenges. Because there is no systematic database—nor could there be—measuring when Actor A expresses power over Actor B, there is no variable that can be used to calibrate a measure or index. Because of this epistemological constraint, measurement of power must focus on the 'power of being,' defined as the *general* ability of an actor to achieve outcomes in the international system.¹⁶ The power of being is conceived as equivalent to the overall *potential* of a country, '... or an actor's general ability to produce successful performances.'¹⁷

A second decision that emerges from the challenges to operationalizing the particular expression of power in a systematic way is the use of an index. Indices are used to measure things that cannot be directly measured and are used across a range of fields of research measuring human development, governance characteristics, and other important aspects of international relations and development, including a widely used measure of power: the Composite Index of National Capabilities (CINC).¹⁸

Index-based approaches to measuring the 'power of being' of a state require the identification of variables that appear to 'matter' for the expression of power. The CINC approached this by measuring population, urban population, military spending, military personnel, energy consumption, and iron and steel production. States with great quantities of resources were more likely to achieve their foreign policy goals in the international system. These variables were measured for all states in the

¹¹Robert Keohane and Joseph S. Nye, *Power and Interdependence: World Politics in Transition* (Little, Brown and Company 1977); Joseph S. Nye, *Soft Power: The Means to Success in World Politics* (PublicAffairs 2004).

¹²Immanuel Wallerstein, *The Capitalist World-Economy* (Cambridge University Press 1979).

¹³Michel Foucault, *Power/Knowledge: Selected Interviews and Other Writings, 1972–1977* (Pantheon Books 1980); David Campbell, *National Deconstruction: Violence, Identity, and Justice in Bosnia* (University of Minnesota Press 1998).

¹⁴Dahl (n 5).

¹⁵Robert Powell, 'Absolute and Relative Gains in International Relations Theory' (1991) 85(4) *American Political Science Review* 1303.

¹⁶Ashley J. Tellis and others, *Measuring National Power* (RAND Corporation 2005).

¹⁷Dennis H. Wrong, *Power, Its Forms, Bases, and Uses* (Harper and Row 1979) 1.

¹⁸Harald Trabold-Nübler, 'The Human Development Index—A New Development Indicator?' (1991) 26(5) *Intereconomics* 236; OECD, *Handbook on Constructing Composite Indicators: Methodology and User Guide* (OECD Publishing 2008); Nazifa Alizada and others, *Autocratization Turns Viral: Democracy Report 2021* (University of Gothenburg: V-Dem Institute 2021).

international system, and a country's share of the global total was used as a measure of its 'power.' Implied through the CINC's theoretical framework, larger populations allow states to field larger armies; greater military spending facilitates access to more materiel; larger urban populations equate to faster conscription.¹⁹

The movement from a Dahlian definition to a general measure of relative capabilities in an index is an abstraction that misses much. General measures of capabilities as a proxy for power neglect agency, norms, political will, and the myriad supranational, subnational, and non-state actors that shape and shove international relations in essential ways.²⁰ While these approaches to measuring power are broad, the authors argue that they can help the reader understand how the tectonic plates of international relations are shifting, and that these macro-level shifts form the context for the particular, the non-state, and the dense networked relationships that make up the international system.

Quantifying Relative National Capabilities

As the Organisation for Economic Cooperation and Development (OECD) articulates, indices 'are useful in identifying trends and drawing attention to particular issues ...'—especially where 'multi-dimensional concepts' are concerned.²¹ Often, quantitative research using measures of national power rely on one of two indices: the CINC; or Gross Domestic Product (GDP) at Market Exchange Rates (MER) or Gross National Product (GNP) at MER.²² Despite its prominent use, the CINC incorrectly measures key relationships in recent decades, most notably the relative capabilities of China and the US. The CINC shows China surpassing the US as the world's leading power in 1995.²³ At that point, China was still in the process of reworking its national security strategy in the wake of 'the ascent of the United States as the monopolar superpower.'²⁴ As Volgy and Imwalle noted, 'China presents interesting possibilities [as a candidate for bipolar status], but it may take decades of sustained economic growth before the Chinese can upgrade their domestic infrastructure or their military superpower status.'²⁵

The primary critique of the CINC is its emphasis on the amount of and continuation of state power attributed to iron and steel production.²⁶ As capital mobility has increased and military technology has changed, the domestic production of steel and iron are no longer essential for the projection of power. The use of a broader economic measure, such as GDP, allows researchers to sidestep this issue and meaningfully compare the strengths of agrarian, industrial, and post-industrial economies.

¹⁹This paper does not attempt to account for all efforts to quantify national power, of which there have been many. See Höhn for a summary of 69 measures of national power: Karl H. Höhn, 'Geopolitics and the Measurement of National Power' (Doctoral dissertation, University of Hamburg 2011).

²⁰Hagström and Jerdén argue that power can only be measured in 'specific situations, relationships, or contexts,' and that power's effects 'are produced through discourses and practices.' Hagström and Jerdén (n 9) 338.

²¹OECD (n 18) 13.

²²J. David Singer, Stuart Bremer, and John Stuckey, 'Capability Distribution, Uncertainty, and Major Power War, 1920–1965' in *Peace, War, and Numbers*, ed. Bruce M. Russett (Sage 1972); James Lee Ray and J. David Singer, 'Measuring the Concentration of Power in the International System' (1973) 1(4) *Sociological Methods & Research* 403; J. David Singer, 'Reconstructing the Correlates of War Dataset on Material Capabilities of States, 1916–1985' (1988) 14(2) *International Interactions* 115; John R. Oneal and Bruce M. Russett, 'The Classical Liberals Were Right: Democracy, Interdependence, and Conflict, 1950–1985' (1997) 41(2) *International Studies Quarterly* 267; Erik Gartzke, 'Preferences and the Democratic Peace' (2000) 44(2) *International Studies Quarterly* 191; D. Scott Bennett and Allan C. Stam, *The Behavioral Origins of War* (University of Michigan Press 2004); Benjamin O. Fordham and Victor Asal, 'Billiard Balls or Snowflakes? Major Power Prestige and the International Diffusion of Institutions and Practices' (2007) 51(1) *International Studies Quarterly* 31; Alexandre Debs and Nuno P. Monteiro, 'Known Unknowns: Power Shifts, Uncertainty, and War' (2014) 68(1) *International Organization* 1.

²³Using version 5.0 of the Correlates of War Project's National Military Capabilities dataset (n 22).

²⁴James C. Hsiung, 'China's Omni-Directional Diplomacy: Realigning to Cope with Monopolar U.S. Power' (1995) 35(6) *Asian Survey* 573.

²⁵The authors also contend, 'Nor do there seem to be other viable candidates for bipolar status.' See Thomas J. Volgy and Lawrence E. Imwalle, 'Hegemonic and Bipolar Perspectives on the New World Order' (1995) 39(4) *American Journal of Political Science* 823.

²⁶Chan, *China, the US and the Power-Transition Theory: A Critique* (n 2); Carsten Rauch, 'Challenging the Power Consensus: GDP, CINC, and the Power Transition Theory' (2017) 26(4) *Security Studies* 642.

The relative share of a country's GDP strongly correlates with CINC scores and can be a useful proxy for the 'power of being' of a country. But it can also produce results that are implausible. Using GDP at MER, North Korean power in the international system—and the expected level of attention it receives from the US—would likely be vastly understated, given its representation of less than one-tenth of one percent of the global economy today. This univariate measure of power fails to account for the fact that North Korea has long dedicated a sizeable share of its economy to military expenditures, in recent years acquiring nuclear weapons and most likely the technology necessary to deliver them via ballistic missiles.

These limitations have driven the development of new measures of national power. Beckley introduced a parsimonious measure of national power claimed to more accurately measure power transitions than CINC or GDP by measuring the relative distribution of the product of GDP and GDP per capita at purchasing power parity (PPP).²⁷ Beckley argues that this measure overcomes the shortcomings of the CINC by moving beyond a tabulation of 'gross' resources, which 'systematically overstate the power of populous countries.'²⁸

Beckley argues that his measurement successfully demonstrates Germany's greater share of power relative to Russia in 1905, Japan's relative to China in 1930, and the US's relative to the Soviet Union in 1975—country-pair power dynamics that CINC measures as the opposite. In an effort to predict the outcomes of wars and militarized interstate disputes (MIDs), his comparison of the balance of net resources using the GDP times GDP per capita measurement also outperforms the CINC, accurately classifying the outcomes of 78% of the former and 70% of the latter (vs. 70% and 64% for war and MIDs, respectively, for CINC).²⁹ Beckley's measure offers two key insights: there is a distinction between gross and net resources—where a large economy only contributes significantly to a country's power if it has resources to leverage beyond those required to provide for a population's basic needs—and that broad measures like GDP allow for power comparisons across time.

Despite improving upon the CINC, Beckley's measure fails to hold up when key pairs of states are evaluated. For example, Beckley's measure shows Saudi Arabia to be ten times more powerful than Iraq in 1990.³⁰ In that same year, his measure suggests that Kuwait was 30% more powerful than Iraq, a questionable conclusion given the initially decisive outcome of the Iraqi invasion of Kuwait the following year. As another example, Singapore's power is overinflated, being measured as a peer competitor of Turkey (despite Turkey possessing a military nearly ten times as large, an economy twice as large, and maintaining three times as many diplomatic missions abroad). North Korea also proves problematic, assessed by Beckley's measure as constituting less than 0.0001% of global power in 2019.

While the CINC has not stood the test of time in a post-Cold War world, and since Beckley's measure misestimates power for small wealthy states and nuclear powers, other measures that can approximate state capabilities should be considered. Military spending stands out and 'can cautiously be treated as a crude and distant proxy for military capacity and strength, and hence states' hard power.'³¹ Volgy and Imwalle use a country's share of global military spending as a foundation for their definitions of superpower status.³²

²⁷Michael Beckley, 'The Power of Nations: Measuring What Matters' (2018) 43(2) *International Security* 7.

²⁸*Ibid.* 14, 19.

²⁹*Ibid.* 38.

³⁰When using World Bank estimates for GDP per capita. Beckley in some instances uses Maddison's estimates for GDP per capita, which can vary notably from World Bank estimates.

³¹Franklyn D. Holzman, 'Soviet Military Spending: Assessing the Numbers Game' (1982) 6(4) *International Security* 78; Paschalis Arvanitidis and Christos Kollias, 'Zipf's Law and World Military Expenditures' (2016) 22(1) *Peace Economics, Peace Science, and Public Policy* 41. See also Tellis and others, who concede that military spending 'conveys a general sense of the size of the military establishment in absolute terms.' Ashley J. Tellis and others, *Measuring National Power in the Postindustrial Age* (RAND Corporation 2000) 36.

³²Volgy and Imwalle (n 25).

However, relying upon military spending alone is misguided. Saudi Arabia, ranked in the top six of military spenders globally as of 2020, receives disproportionately low returns on its investment in military capabilities.³³ North Korea has for more than a half century been in a stand-off with South Korea, despite spending nearly ten times less on its military in 2017.³⁴ Dividing military spending by the number military personnel is one means that has been used correct for this disparity,³⁵ though its effect is the opposite for Saudi Arabia and North Korea, exaggerating the power of the former and underestimating that of the latter.³⁶

Nuclear weapons are another variable that appear to be relevant for a measure of general capabilities.³⁷ When states intentionally forego or abandon the pursuit of nuclear weapons, such acts of 'nuclear forbearance' are intentional sacrifices of military power in return for economic gains.³⁸

Diplomatic engagement is another important tool states use to exert influence.³⁹ Diplomatic posts demonstrate 'the political capability both to mobilize human and material resources and to use these resources coherently in the pursuit of national objectives.'⁴⁰ However, diplomacy and its infrastructure are inadequate for assessing a state's power. This approach omits a range of hard power metrics and leads to over-inflation of power estimates for some states that have invested heavily in diplomatic recognition and foreign engagement. Using a weighted measure of diplomatic representation, France would have been considered the leading power at the end of the Cold War, ahead of the US.⁴¹ By this same measure, Cuba would be ranked as a top-20 world power since 2005.

Trade volume as a share of global trade describes a country's embeddedness within the international system. Also, to an extent, it captures other countries' reliance upon their economic activity and their vulnerability to what Hirschman called 'economic aggression.'⁴² However, as a single-indicator measure of power, trade is inadequate, particularly for *entrepôt* countries. Examining shares of global trade in goods in 2018, Hong Kong ranks 13th, Taiwan 15th, and Singapore 20th.⁴³ The additional capabilities that trade provides depend on the size and balance of a country's trading portfolio, both in terms of partners and goods and services, where countries that are highly dependent upon a limited range of goods and services with few partners are vulnerable to 'weaponized interdependence.'⁴⁴

³³Kenneth M. Pollack, *Armies of Sand: The Past, Present, and Future of Arab Military Effectiveness* (Oxford University Press 2019).

³⁴The U.S. State Department's World Military Expenditures and Arms Transfers 2019 report estimated that North Korea's military expenditures equaled \$4.17B in 2017 relative to South Korea's \$39.3B. See: <https://www.state.gov/world-military-expenditures-and-arms-transfers-2019/>.

³⁵Erik Gartzke and Dominic Rohner, 'The Political Economy of Imperialism, Decolonization and Development' (2011) 41(3) *British Journal of Political Science* 548.

³⁶By this measure, in 2018 Saudi Arabia's military power would be equal to \$67.6B divided by 227,000 (active duty military personnel), or roughly 297,797. Meanwhile, Russia would measure up as having one-fourth this amount of military power (\$61.4B divided by ~900,000 personnel). Military spending estimates from the Stockholm International Peace Research Institute. Active duty military personnel estimates from the International Institute for Strategic Studies' 2018 *Military Balance* report.

³⁷Nuclear weapons arguably increase domestic power, as well. See Scott D. Sagan, 'Armed and Dangerous: When Dictators Get the Bomb' (2018) 97(6) *Foreign Affairs* 35. Also see Joseph P. Masco, 'The Nuclear Borderlands: The Legacy of the Manhattan Project in Post-Cold War New Mexico' (Doctoral dissertation, University of California—San Diego 1999) 86.

³⁸T.V. Paul, *Power versus Prudence: Why Nations Forgo Nuclear Weapons* (McGill-Queen's University Press 2000).

³⁹Benjamin O. Fordham, 'Who Wants to Be a Major Power? Explaining the Expansion of Foreign Policy Ambition' (2011) 48(5) *Journal of Peace Research* 587.

⁴⁰Ted Robert Gurr, 'The Political Dimension of National Capabilities' (1988) 14(2) *International Interactions* 133.

⁴¹A measure introduced in: Jonathan D. Moyer, Sara D. Turner, and Collin J. Meisel, 'What Are the Drivers of Diplomacy? Introducing and Testing New Annual Dyadic Data Measuring Diplomatic Exchange' (2021) 58(6) *Journal of Peace Research* 1300.

⁴²Though this dynamic is better captured bilaterally. For a survey of nineteenth century acts of 'economic aggression' along with a broader explanation of trade's centrality to national power, see Albert O. Hirschman, *National Power and the Structure of Foreign Trade* (University of California Press 1945).

⁴³This article attributes the World Integrated Trade Solution coding of 'Other Asia, nes' to Taiwan. 'Other Asia, not elsewhere specified' data are primarily for Taiwan, though a small share comes from other territories.

⁴⁴Henry Farrell and Abraham L. Newman, 'Weaponized Interdependence: How Global Economic Networks Shape State Coercion' (2019) 44(1) *International Security* 42.

The factors that contribute to a country's capabilities come from a variety of sources outlined above, and include 'gross' or 'net' economic output, as well as additional factors such as military capabilities, diplomacy, and trade. A composite measure that combines these elements of national power and the unique insights they provide is introduced in the following section.

Beyond the theoretical and empirical considerations to measuring power, practical considerations must also be made. When measuring national power, parsimony is important. As Merritt and Zinnes articulate, 'For policymakers desiring the most efficient way to assess the likelihood that a nation-state can achieve its goals, the key issues are parsimony in the selection of variables, stability over time, combinatorial patterns enabling successful prediction, and applicability across a range of situations.'⁴⁵ More to the point, 'needless additional data and arithmetic computation have been introduced without an increase in payoff.'⁴⁶ The elements of relative national capabilities that this article introduces below reflect key components of contemporary international relations: diplomatic, military, and economic instruments.⁴⁷

The DiME Index

The DiME Index builds upon Beckley's measure while adding equally weighted representations of diplomatic presence, military spending, nuclear weapons, and trade in goods and services.⁴⁸ These dimensions, their associated weights, and the DiME Index's calculation procedure are described in *Equation 1*, where: country *i*'s value for each variable in a given year (*t*) is divided by the sum for that variable for all countries (*i* to *n*) in a given year; this global share is weighted by 0.2 to provide equal weighting; and it is summed with country *i*'s global share for all other variables to give country *i*'s share of global power in year *t*.

Equation 1. DiME Index calculation

$$\begin{aligned} Power_{it} = & \left(\left(\frac{Diplomatic\ representation_{it}}{\sum_{i=1}^n Diplomatic\ representation_{it}} \right) \times 0.2 \right) + \left(\left(\frac{Military\ spending_{it}}{\sum_{i=1}^n Military\ spending_{it}} \right) \times 0.2 \right) \\ & + \left(\left(\frac{\ln(\text{Count of nuclear weapons} + 1)_{it}}{\sum_{i=1}^n \ln(\text{Count of nuclear weapons} + 1)_{it}} \right) \times 0.2 \right) \\ & + \left(\left(\frac{GDP \times GDP\ per\ capita_{it}}{\sum_{i=1}^n GDP \times GDP\ per\ capita_{it}} \right) \times 0.2 \right) + \left(\left(\frac{Trade_{it}}{\sum_{i=1}^n Trade_{it}} \right) \times 0.2 \right) \end{aligned}$$

In its measure of the economic dimension of power, this article departs from Beckley in one key way: it utilizes a metric of GDP times GDP per capita measured in MER rather than PPP terms, as PPP captures levels of human development and domestic consumption (whereas MER is better for examining the globalized value of economic production).⁴⁹

The equally weighted approach used to build the DiME Index allows for a transparent construction and assessment of the composite index and the contributions of each of its subcomponents. So that the effect of changes in each sub-component are comparable, this article combines each

⁴⁵Richard L. Merritt and Dina A. Zinnes, 'Validity of Power Indices,' (1988) 14(2) *International Interactions* 141.

⁴⁶Richard L. Merritt and Dina A. Zinnes, 'Alternative Indexes of Power' in Richard J. Stoll and Micheal D. Ward (eds), *Power in World Politics* (Lynne Reinner Publishers 1989) 26.

⁴⁷Gregory F. Treverton and Seth G. Jones, *Measuring National Power* (RAND Corporation 2005) 6; Amos A. Jordan and others, *American National Security* (Johns Hopkins University Press 2009). See also Shiffrinson's emphasis on 'military, diplomatic, and economic policies' in his development of 'predation theory.' Joshua R. Itzkowitz Shiffrinson, *Rising Titans, Falling Giants: How Great Powers Exploit Power Shifts* (Cornell University 2018) 10.

⁴⁸While this article's inclusion of nuclear weapons may become antiquated, the authors suspect this day will be long from now. See James Woods Forsyth Jr., B. Chance Saltzman, and Gary Schaub Jr., 'Remembrance of Things Past: The Enduring Value of Nuclear Weapons' (2010) 4(1) *Security Studies Quarterly* 74.

⁴⁹PPP methods are not appropriate for measuring relative international wealth and power that is based on internationally traded goods and services ... Nor are PPPs designed to measure advanced industrial, technological, or military power, because substantial elements of these are comprised of manufactured goods and components sourced from international markets at international market prices.' George J. Gillboy and Eric Higinbotham, *Chinese and Indian Strategic Behavior: Growing Power and Alarm* (Cambridge University Press 2012) 120.

measure using a country's relative share of the global total. For example, a country's diplomatic power increases only when its global share of weighted embassies increases, not necessarily when the absolute sum of embassies increases—the conceptual basis for the approach being the relative nature of power.

This equal weighting of variables does not imply that all *dimensions* of power are weighted equally.⁵⁰ While diplomatic power is important, a country's economic and military might underwrite it. Diplomacy 'is rarely used in isolation; it often serves as a precursor or a complement to other foreign policy tools.'⁵¹ Thus, the authors feel justified in providing the diplomatic dimension of this new index, embodied by a measure of diplomatic representation, with slightly less weight (20%) than the military (40%) or economic dimensions (40%).⁵² Data sources and definitions for input variables are provided in the supplementary dataset available in the online appendix.

Potential critiques of this index include the high degree of correlation between each input, as well as the fact that trade and military spending are themselves elements of GDP. While these are valid critiques, the article argues that each variable captures a conceptually and theoretically important element of national power, as described above. Indeed, one should *expect* variables to co-vary within a measure that successfully triangulates around a concept.⁵³ Moreover, as Beckley's measure illustrates, assuming that GDP and population alone adequately capture national power may produce misleading results.

There are several strengths of this new measure. It provides policymakers a single, easy-to-understand measure of relative national power, contemporarily and across time.⁵⁴ In regression analysis, the use of this index, rather than its individual variables, saves several degrees of freedom—a crucial quality when analyzing small sample sizes. Finally, and most importantly, this index captures power's multi-dimensional and relative nature.

A comparison of the DiME Index with CINC and Beckley's measure for China and the US is presented below, with a line graph in [Figure 1](#) and through varying state ranking lists in [Table 1](#).⁵⁵ Note that CINC shows China surpassing the US as the world's leading power in the mid-1990s, holding one-and-a-half times the global power of the US by 2010. Meanwhile, Beckley's measure is slower to capture China's relative rise while suggesting it was greater than the DiME Index.⁵⁶

Forecasting DiME

The DiME Index is forecast using the International Futures (IFs) model. IFs is a long-term forecasting tool that models 186 countries through 2050. The model forecasts within and across systems including agriculture, climate, demographics, economics, energy, governance, health, and technology. IFs has been used widely across academic and policy-relevant disciplines and is maintained by the Frederick S. Pardee Center for International Futures at the University of Denver.⁵⁷

⁵⁰OECD (n 18) 31.

⁵¹Jordan and others (n 47) 234.

⁵²For a complete description of this diplomatic representation measure, see Moyer, Turner, and Meisel (n 41). To supplement this publication, this article also includes a 'sandbox' dataset, which allows users to adjust weights based on subjective assessments. This 'sandbox' dataset is available online as an appendix to this article.

⁵³D. Stephen Voss, 'Multicollinearity' in Kimberly Kempf-Leonard (ed) *Encyclopedia of Social Measurement, Volume 2* (Elsevier 2005) 766.

⁵⁴OECD (n 18) 13.

⁵⁵This article uses World Bank estimates for GDP at PPP to recreate Beckley rather than those created by Angus Maddison, which are used by Beckley in some iterations of his measure.

⁵⁶In general, Beckley is dubious on China's prospects to surpass the US as the world's leading power. Beckley, 'China's Century? Why America's Edge Will Endure' (n 4); Michael Beckley and Hal Brands, 'The End of China's Rise' (*Foreign Affairs*, 1 October 2021) <<https://www.foreignaffairs.com/articles/china/2021-10-01/end-chinas-rise>> accessed 10 March 2022.

⁵⁷Hughes, *International Futures: Building and Using Global Models* (n 6).

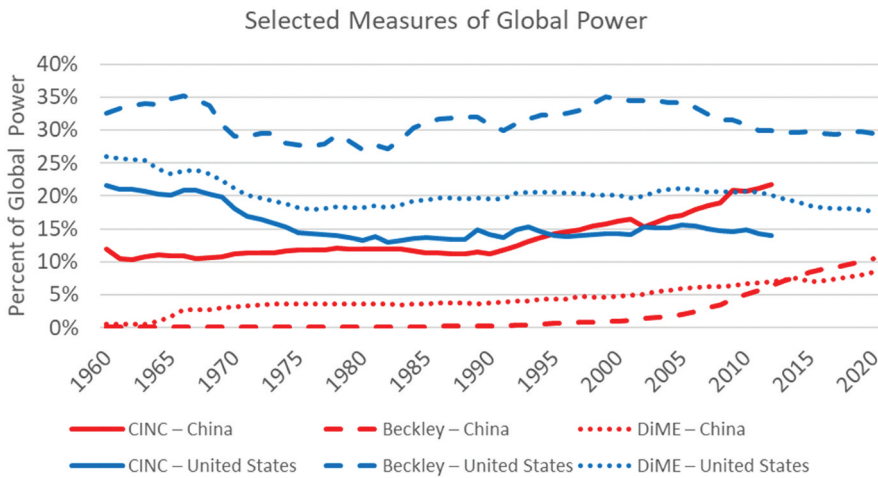


Figure 1. Comparison of Chinese and US global power according to the DiME Index, Beckley's measure, and the CINC.

The authors' long-term forecasting using IFs follows in a long tradition of this methodology within the study of international relations.⁵⁸ The authors generate alternative forecast scenarios as 'tools for thinking about the future and for helping to understand global change, and thus should be viewed as one supporting element in the search for interventions to create more desirable futures.'⁵⁹ By contrasting the results of each scenario, this article seeks to narrow a gap in the power transition literature, where studies 'often do not provide an adequate account of the reasons behind the relative performance of states,' according to Chan.⁶⁰

Much like Keohane and Nye, this article does not regard its structurally-based analysis of power in the international system to be an end; rather, it should be interpreted as a beginning.⁶¹ This article's structural forecasts are meant to provide a quantitative foundation upon which qualitative or more micro-level assessments can build. Through the use of a mathematical model to forecast national power, the authors are forced to adhere to the 'strict grammar' of mathematics, where concepts and relationships must be clearly defined and assumptions clearly stated.⁶² This is in contrast to purely qualitative foresight exercises, where, absent the use of a formal model, it is 'more difficult ... to assure consistency of assumptions and arguments from one issue area to another and to integrate the argument fully.'⁶³

The central forecast model structures used in this analysis are demographic, economic, and government finance. The demographic system uses a standard age-sex cohort component model endogenously driven by fertility, mortality and migration sub-modules that account for changing age structures, urban/rural divide, and changing population structures.⁶⁴ The economic system is driven by a recursive dynamic computable general equilibrium model and a Cobb-Douglas

⁵⁸See, for example, Nazli Choucri and Thomas W. Robinson, *Forecasting in International Relations: Theory, Methods, Problems, Prospects* (W. H. Freeman and Company 1978); Barry B. Hughes, *World Futures: A Critical Analysis of Alternatives* (Johns Hopkins University Press 1985).

⁵⁹Hughes, *International Futures: Building and Using Global Models* (n 6) 26.

⁶⁰Steve Chan, 'So What About a Power Shift? Caveat Emptor' (2014) 38(3) *Asian Perspective* 381.

⁶¹Keohane and Nye (n 11) 45. Regimes are referred to here in the sense of regimes of world order (e.g. the era of US hegemony) rather than individual nation-states' regimes.

⁶²John V. Gillespie, 'Why Mathematical Models?' in Dina A. Zinnes and John V. Gillespie (eds), *Mathematical Models in International Relations* (Praeger 1976) 49.

⁶³Hughes, *World Futures* (n 58) 18.

⁶⁴Barry B. Hughes and others, *Reducing Global Poverty*, vol 1, Patterns of Potential Human Progress (University Press India 2009); Barry B. Hughes and others, *Improving Global Health: Forecasting the Next 50 Years*, vol 3, Patterns of Potential Human Progress (Paradigm Publishers 2011).

Table 1. Comparison of global power rankings using the CINC, Beckley's measure, and the DiME Index

		1960			1990		
Rank	CINC	Beckley	DiME	CINC	Beckley	DiME	
1	US	US	US	US	US	US	
2	Soviet Union	West Germany	Soviet Union	Soviet Union	Japan	Soviet Union	
3	China	Soviet Union	France	China	Germany	France	
4	India	United Kingdom	West Germany	India	Soviet Union	United Kingdom	
5	United Kingdom	France	Italy	Japan	Italy	Japan	
6	West Germany	Italy	Japan	Germany	France	Germany	
7	Japan	Japan	Switzerland	United Kingdom	United Kingdom	China	
8	France	Switzerland	Netherlands	Brazil	Saudi Arabia	Italy	
9	Italy	Canada	Canada	France	Canada	Israel	
10	Brazil	Saudi Arabia	Poland	Italy	United Arab Emirates	Canada	
Rank				1960–2020 Average			
	CINC	Beckley	DiME	CINC	Beckley	DiME	
1	—	US	US	US	US	US	
2	—	China	China	China	Japan	Russia/Soviet Union	
3	—	Japan	Russia	Russia/Soviet Union	Russia/Soviet Union	United Kingdom	
4	—	Germany	France	India	France	France	
5	—	United Kingdom	United Kingdom	Japan	Italy	Japan	
6	—	France	Japan	(West) Germany	United Kingdom	China	
7	—	Russia	India	United Kingdom	(West) Germany	Germany	
8	—	Saudi Arabia	Germany	Brazil	Saudi Arabia	Italy	
9	—	Canada	Pakistan	France	Canada	Israel	
10	—	Italy	Israel	Italy	Kuwait	Canada	

production function representing agents (households, firms, and government), capital (agriculture, energy, information communication technology, manufacturing, materials, and services), and productivity (with human development, knowledge systems, governance, and physical infrastructure represented).⁶⁵ The government finance system tracks government revenue (broken down by tax revenue across multiple categories and net foreign aid) and government spending broken into categories representing government consumption (across administrative, education, health, infrastructure, and military categories) as well as government transfers (for welfare and pensions).⁶⁶ The core data series used for this analysis are sourced from the Frederick S. Pardee Center for International Futures (embassies), Federation of American Scientists (nuclear warheads), and World Bank World Development Indicators (all others).⁶⁷

The model produces a 'middle of the road' scenario called the *Current Path*, which models a 'most likely' scenario within and across the sectors and countries introduced above. This scenario represents development without large-scale wildcards but that includes non-linear behavior and dynamic developments; key outputs are reported in the results section depicted in Table 2.

The *Current Path* models a continued reduction in GDP growth in China, from an average annual peak in the years 2000–2009 of 10.3% growth to a nadir of 2.3% by 2050–2059. Economic growth in the US also declines, from 3.2% in the 1990–1999 period to a low of 1.1% in both 2020–2029 and

⁶⁵Jonathan D. Moyer and Barry B. Hughes, 'ICTs: Do They Contribute to Increased Carbon Emissions?' (2012) 79(5) *Technological Forecasting and Social Change* 919; Barry B. Hughes and others, 'Estimating Current Values of Sustainable Development Goal Indicators Using an Integrated Assessment Modeling Platform: "Nowcasting" with International Futures' (2021) 37 *Statistical Journal of the IAOS*.

⁶⁶Barry B. Hughes and others, *PPHP 5: Strengthening Governance Globally*, vol 5, Patterns of Potential Human Progress (Frederick S. Pardee Center for International Futures 2014); Devin K. Joshi, Barry B. Hughes, and Timothy D. Sisk, 'Improving Governance for the Post-2015 Sustainable Development Goals: Scenario Forecasting the Next 50 Years' (2015) 70 *World Development* 286.

⁶⁷IFs is freely available at <https://korbel.du.edu/pardee>. To learn more about the forecasting logic and algorithms for the model's submodules, see: <https://korbel.du.edu/pardee/international-futures-platform/demos-topic>.

2050–2059. These shifts reflect contemporary understandings of structural transitions in how economies grow, where higher levels of economic sophistication will likely lead to lower levels of future growth.⁶⁸

In this scenario military spending as a share of GDP is projected to remain flat in China while declining slightly in the US driven by current trends in economic growth. Historical spending on the military in China has been lower than the US as a share of total economic activity though measurement issues abound.⁶⁹ Current spending as a share of GDP in the US is projected to decline because it is expected to run into overall government spending constrained by increasing sovereign debt as a share of GDP.

Chinese trade as a share of GDP is greater than that of the US, a trend projected to continue through the end of the forecasted time horizon in this article's *Current Path* scenario. Trade as a share of GDP in China is projected to remain lower than in the 2000–9 period throughout the time horizon. Trade openness in the US also grew after the end of the Cold War but plateaued at over 28% of GDP (measured by decade) between 2010–2029. The *Current Path* projects this level to remain relatively flat through mid-century and Chinese trade openness to remain higher than the US throughout the period of study.

Nuclear weapon stockpiles in China have grown slowly throughout this period; the *Current Path* scenario does not project a significant increase in overall stockpiles, nearly doubling warheads from the 1990–1999 period compared with 2050–2059.⁷⁰ In the US, nuclear warhead stockpiles declined significantly since the end of the Cold War, though from very high levels previous to this epoch change (still 56 times the level in China in the 1990–1999 period). The *Current Path* scenario projects that this will decline to a level that is just over nine times greater than China by the end of this period. The US had more foreign embassies than China through the period 1990–2009, then was passed by China. The *Current Path* scenario projects that Chinese foreign embassies will continue that trend with 13 additional foreign embassies compared with the US by the 2050–2059 period.

The results of this scenario show that, in 2021, 8.5% of global capabilities are distributed to China with 18.2% distributed to the US. Over time, the share of Chinese capabilities grows to 11.4% by 2030, 13.9% by 2040, 15.6% by 2050, and 16.5% by 2060. In 2021, the share of US global capabilities

Table 2. *Current Path* projections for key indicators for China and US

		1990–1999	2000–2009	2010–2019	2020–2029	2030–2039	2040–2049	2050–2059
<i>GDP Growth Rates</i>	China	10.0%	10.3%	7.7%	5.7%	4.4%	3.2%	2.3%
	US	3.2%	1.9%	2.3%	1.1%	1.4%	1.3%	1.1%
<i>Military Spending % GDP</i>	China	2.0%	2.0%	1.9%	2.0%	1.9%	1.7%	1.7%
	US	4.1%	3.9%	3.9%	2.8%	2.2%	2.0%	2.0%
<i>Trade % GDP</i>	China	32.1%	52.4%	43.1%	38.2%	40.7%	42.9%	45.0%
	US	21.5%	25.2%	28.5%	28.0%	29.8%	32.0%	33.7%
<i>Nuclear Warheads</i>	China	233	235	243	315	412	440	440
	US	13,083	8,247	4,985	4,625	4,140	4,000	4,000
<i>Embassies Abroad</i>	China	140	156	163	169	176	181	185
	US	154	160	162	164	166	169	172

⁶⁸Robert J. Barro, 'Economic Growth in a Cross Section of Countries' (1991) 106(2) *Quarterly Journal of Economics* 407.

⁶⁹Michael Brzoska, 'The Reporting of Military Expenditures' (1981) 18(3) *Journal of Peace Research* 261; Nicole Ball, *Security and Economy in the Third World* (Princeton University Press 1988); Shaoguang Wang, 'Estimating China's Defence Expenditure: Some Evidence from Chinese Sources' (1996) 147 *China Quarterly* 889.

⁷⁰In contrast to the integrated assessment-based forecasts for all other variables explicitly and implicitly referenced in this analysis, the *Current Path* forecasts for nuclear weapons stockpiles amount to educated guesses. Because the counts are logged and their input into the DiME Index is considered as a global share, it would require a large change in a country's stockpile without a similar shift by other countries for the index to change significantly. China's very recent acceleration of its stockpiling of nuclear warheads according to US Department of Defense estimates, which are not incorporated into this analysis, would modestly increase China's share of global power according to the DiME Index. Additionally, the *Current Path* assumes that no non-nuclear powers acquire nuclear weapons within the forecast horizon.

was 18.2%, declining to 16.2% in 2030, 14.7% in 2040, 13.5% in 2050, and 12.6% by 2060. This scenario suggests that there will most likely be a bipolar international system for multiple decades, with Chinese gains in relative capabilities outstripping the US in the early 2040s but not significantly exceeding US capabilities through 2060.

In addition to the *Current Path*, the authors created alternative scenarios that frame optimistic and pessimistic development trajectories for both countries across variables that make up the DiME Index. The authors made scenario adjustments—described in Table 3—based on historical data where possible. For each variable listed in the second column in Table 3, the authors created four alternative scenarios modeling high and low interventions (values noted in the *Adjustment* column) for each country. In addition, the authors created four *Composite* scenarios that modeled high and low values for all variables at once, framing most the optimistic and pessimistic future development scenarios for both China and the US.

Rather than attempting to synthesize the entire universe of *possible* alternative futures, this article presents a broad range of *plausible* scenarios. This follows the general guidance of Helmer, who highlights the merits of selecting ‘a relatively small set of “representative scenarios.”’⁷¹ The logic behind this argument is that ‘any actual scenario is sufficiently close, for planning purposes, to one of the representative ones so that policies and plans designed to cope with these representative contingencies can reasonably be expected to be adequate for any contingency that may arise.’⁷² To support this study, the authors created 28 scenarios, in addition to the *Current Path*.⁷³

Table 4 summarizes the impact of these alternative scenarios on the distribution of relative capabilities between China and the US in 2030 and 2060 relative to the *Current Path* scenario, described above. It reports the minimum, maximum, average and standard deviation impact measured as a percentage point of the global distribution of capabilities by scenario intervention. So, for example, low GDP growth scenarios in China reduce their relative share of global capabilities by 1.2%-points by 2030 and 5.7%-points by 2060. Lower economic growth in the US reduces its material capabilities by 0.9%-points by 2030 and 2.7%-points by 2060.

Table 3. Scenario assumptions

Country	Variable	Adjustment	Justification
China US	GDP Growth	1.37%-points 0.81%-points	The country-specific standard deviation of a 10-year moving average of GDP growth rates at market exchange rates (2011 dollars, real terms) from 1990–2020.
China US	Military Spending % GDP	0.22%-points 0.64%-points	The country-specific standard deviation of military spending as a percentage of GDP from 1990–2020.
China US	Number of Embassies	10% over five years	Neither country is likely to increase or decrease its foreign embassy presence by greater or less than 10% over the foreseeable time horizon.
China US	Trade volume	10% change in tariffs	Neither country is likely to increase or decrease its total global foreign tariffs by greater or less than 10% over the foreseeable time horizon.
China US	Total fertility rate	10%	A 10% increase or decrease of fertility rates over the Current Path trends is unlikely for either country over the foreseeable time horizon.
China US	Nuclear Warheads	500 warheads	This represents a 10% reduction of the US stockpile across time and a nearly doubling of Chinese warheads by the end of the time horizon relative to the <i>Current Path</i> value.

⁷¹Olaf Helmer, ‘The Use of Expert Opinion in International Relations Forecasting’ in Nazi Choucri and Thomas W. Robinson (eds), *Forecasting in International Relations: Theory, Methods, Problems, Prospects* (W.H. Freeman and Company 1978) 123.

⁷²Ibid.

⁷³For each scenario intervention, this article created one scenario that increased or decreased the variable described in Table 3 for one country. For example, to create scenarios for GDP growth, this article created four alternative scenarios that vary Chinese economic growth by 1.37%-points each year across time and another scenario that varies US economic growth by 0.81%-points across time. For each variable intervention, this article created four alternative scenarios.

Table 4. Summary of scenario analysis

		China	US	China	US	China	US	China	US
		Min.		Max.		Average		Std Dev.	
<i>GDP Growth</i>	2030	-1.2	-0.9	1.3	1.0	0.0	0.0	1.0	0.8
	2060	-5.7	-2.7	6.3	3.0	0.1	0.0	4.9	2.6
<i>Military Spending</i>	2030	-0.3	-0.6	0.3	0.5	0.0	0.0	0.3	0.4
	2060	-0.3	-0.3	0.2	0.3	0.0	0.0	0.2	0.2
<i>Trade</i>	2030	-0.2	-0.2	0.2	0.2	0.0	0.0	0.2	0.2
	2060	-0.9	-0.4	1.1	0.6	0.0	0.0	0.8	0.4
<i>Fertility Rates</i>	2030	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2060	-0.1	-0.1	0.4	0.3	0.1	0.1	0.2	0.2
<i>Nuclear Warheads</i>	2030	-0.3	0.0	0.1	0.1	0.0	0.0	0.2	0.0
	2060	-2.4	0.0	0.3	0.4	-0.5	0.1	1.2	0.2
<i>Diplomatic Exchange</i>	2030	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2060	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Composite</i>	2030	-1.8	-1.7	2.1	1.7	0.1	0.0	1.6	1.4
	2060	-6.8	-3.3	8.7	4.5	0.4	0.2	6.4	3.5

All values reported are the difference between the *Current Path* and alternative scenarios reported in percentage points of global capabilities. Scenario interventions are listed across rows, reported in 2030 and 2060. Vertical columns reflect the minimum, maximum, average, and standard deviation change for China and the US for four scenarios for each intervention (e.g. China GDP growth high, China GDP growth low, US GDP growth high, US GDP growth low).

GDP growth is the single most significant intervention that shapes differences in future relative capabilities, with Chinese GDP growth being particularly impactful as a future uncertainty driving the distribution of capabilities. While GDP growth is certainly not the only factor influencing the future distribution of capabilities, its centrality to this article's analysis is consistent with international relations theory's 'power transition model,' which 'holds that differences in national growth and development lead to shifts in the relative power of the world's major nations.'⁷⁴

Other scenario interventions have less effect on the future distribution of capabilities. Altering military spending in either country changes outcomes, but only by less than one percentage point of global capabilities across any scenario or time horizon. Changing patterns of trade have similar effects on the distribution of capabilities through 2030, but larger effects by 2060, with optimistic trade scenarios increasing Chinese capabilities by 1.1%-points of global resources relative to the *Current Path*. Increased fertility rates do indeed increase Chinese capabilities relative to the *Current Path*, but not until after 2030, and by 0.4%-points by 2060. A proliferation in nuclear warheads has a slight positive impact on the relative capabilities of either country by 2060 (similar to the effect of increasing fertility rates in China). A nuclear reduction assumption in the US has no effect on capabilities but does have a greater effect on China, where the scenario assumption eliminates nuclear capabilities by the end of the time horizon. Changing investments in diplomatic exchange have no effect on the capabilities of either country, as both countries already enjoy near global coverage.

The final row shows that a worse-case scenario for China would reduce its relative capabilities by 1.8%-points in 2030 and a 6.8%-points in 2060, while a worse-case scenario for the US lowers relative capabilities by 1.7%-points in 2030 and 3.3%-points in 2060. A best-case scenario for China shows significant gains in relative capabilities in 2030 and 2060—more than the potential gains for the US in a similarly optimistic scenario.

The drivers behind China's rise and relative US decline in these scenarios are structural. While the outcomes are similar, this is distinct from Wang's theory of American decline described in *America Against America*.⁷⁵ Wang's role as a key leadership adviser and position as a thought leader behind prominent top-level policies in China in recent years, such as Xi's 'Chinese Dream,' has undoubtedly inspired much

⁷⁴A.F.K. Organski and Jacek Kugler, *The War Ledger* (University of Chicago Press 1980); Joshua S. Goldstein, 'War and the Kondratieff Upswing' (International Studies Association 25th Convention, Atlanta, GA, March 1984) 10.

⁷⁵Wang Huning, *America Against America* (Fudan University 1991).

dialogue among the Chinese elite.⁷⁶ However, in contrast to the structural drivers in this analysis, including core demographic and economic trends, Wang credits cultural values and practices, such as individualism and an ‘insular and self-indulgent’ lifestyle that he perceives to be pervasive in the American middle class, as the sources of US decline.⁷⁷ The results also highlight a *relative* US decline rather than an absolute decline, where growth in US material capabilities continues but at a slower rate than the growth the authors forecast for China across the majority of scenarios.

Another way to understand the impacts of alternative scenarios is to explore how they change the cross-over point in relative material capabilities for both China and the US. Figure 2 explores the year in which China surpasses US capabilities across scenarios. Of the 29 scenarios the authors modeled for this article, 26 suggest a transition between China and the US occurring prior to 2060, with the vast majority of transitions occurring in the early 2040s. According to these projections, the earliest transition in capabilities between China and the US occurs in the early 2030s.

As Zha has noted, China’s rise has for the past few decades faced many obstacles, including ‘reliance on labour-intensive industries, being on the receiving end of post-Fordism’s global “flexible production” chain, a lack of rigour in structural reform (particularly in the financial sector), and serious corruption.’⁷⁸ Recent Chinese leadership has sought to address these issues, at least partially. Among other scholars, Pettis, Pei, Li, and others have continued to highlight the various economic, political, and demographic challenges that China’s leaders must overcome to maintain the expected rate of China’s growth.⁷⁹ While this article’s forecasts will not capture the micro-level nuances of inter-party strife, IFs forecasts incorporate macro-level economic, political, and demographic factors (along with extensive agriculture, education, energy, environment, technology, health, and infrastructure systems).

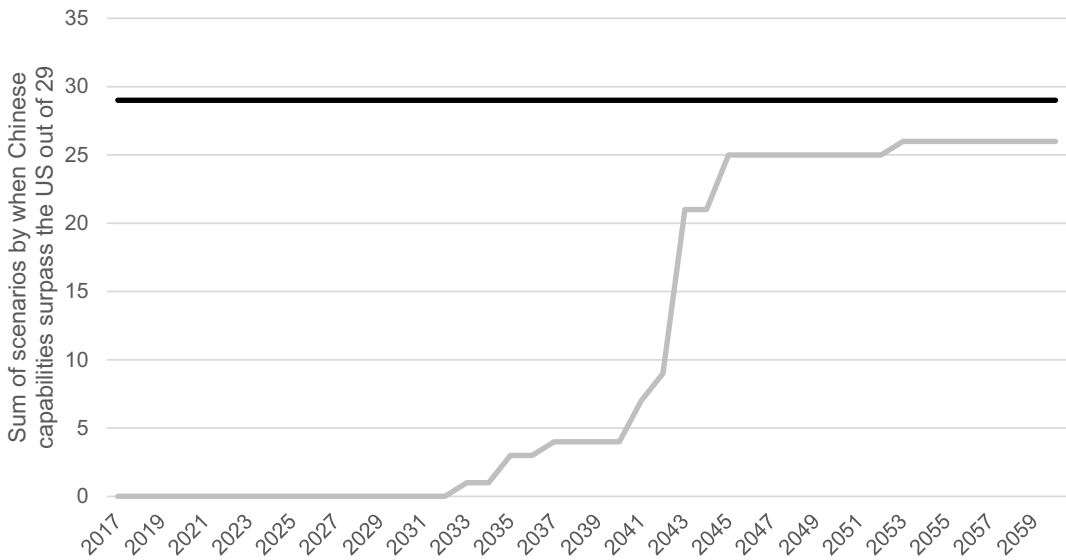


Figure 2. Count of scenarios across time (out of 29 total) by the year in which Chinese capabilities surpass the US.

⁷⁶Haig Patapan and Yi Wang, ‘The Hidden Ruler: Wang Huning and the Making of Contemporary China’ (2018) 27(109) *Journal of Contemporary China* 47.

⁷⁷Niv Horesh and Ruikun Xu, ‘CCP Elite Perception of the US Since the Early 1990s: Wang Huning and Zheng Bijian as Test Cases’ (2017) 48(1) *Asian Affairs* 56.

⁷⁸Zha Daojing, ‘Comment: Can China Rise?’ (2005) 31(4) *Review of International Studies* 782.

⁷⁹Michael Pettis, *Avoiding the Fall: China’s Economic Restructuring* (Carnegie Endowment for International Peace 2013); Minxin Pei, *China’s Crony Capitalism: The Dynamics of Regime Decay* (Harvard University Press 2016); Li Hongbin, Prashant Loyalka, Scott Rozelle, and Binzhen Wu, ‘Human Capital and China’s Future Growth’ (2017) 31(1) *Journal of Economic Perspectives* 25.

There are three scenarios where Chinese capabilities do not surpass those of the US through 2060. These include the *Composite* scenario for China that is negative, the *Composite* scenario for the US where all interventions are positive, and the *GDP Growth* scenario for China that is negative. This reinforces the finding above that the single most impactful uncertainty that will shape the future distribution of capabilities between China and the US is Chinese economic growth. Additionally, this finding highlights that the transition in relative capabilities between China and the US is likely in almost any scenario, except those scenarios that are extremely unlikely to manifest.

Conclusion

This analysis shows that a coming transition between China and the US in relative material capabilities is extremely likely over the next four decades, occurring in 89.7% of scenarios analyzed. The only scenarios explored in which this transition does not occur rely upon forecasting multiple-decade reductions in Chinese economic growth that averages just over three percent from now through 2040 and remains lower than two percent per year through 2060. Conversely, the only scenario in which the US maintains its advantage in relative capabilities vis-à-vis China is one where its economy grows at an average rate of over four percent per year through 2040 and maintains growth above two percent per year through 2060, coupled with increases in military spending as a share of GDP, increased fertility rates, reduced tariffs, increased stockpiling of nuclear warheads, and increased diplomatic representation.

The foreign policy implications of this potential transition will be significant, shifting and realigning interstate dynamics for decades to come. In anticipation of any expected transition, some will question whether China will behave more aggressively, seeking to assert its rising power, and how the US will respond to a geopolitical landscape where it is no longer able to behave as hegemon. Possible lessons can be drawn from previous transitions between world powers in the late 19th and early twentieth centuries. Although the US was a rising power according to most metrics, it sought to consolidate regional influence rather than act as a revisionist actor. This suggests that possessing power does not guarantee its use and that rising powers are not always aggressively motivated, demonstrating behaviors referred to as *status inconsistency*, which China may choose to pursue.⁸⁰

Meanwhile, research suggests that the notable ideological gap between the leadership in China and the US will contribute toward increased threat perception.⁸¹ Thus, US policymakers may choose to act more aggressively toward China. However, 'the typical behavior of declining powers appears to resemble that of their non-declining counterparts. They tend to display or threaten to display force rather than actually use it.'⁸² Still, reckoning with declining power often requires retrenchment to avoid conflict. The US is arguably well-positioned for retrenchment and burden-shifting to allies.⁸³ Whether such a retrenchment will take place will to some extent be determined by domestic political considerations. Nationalism and hawkish public opinion are factors that have helped push countries to war in the past.⁸⁴

Modifying this article's analyses to include the broader defense alliance of NATO further expands upon this conclusion. Under *Current Path* development, China alone is likely to be more powerful than the combined members of an un-expanded NATO alliance before mid-century. Although further expansion of NATO would likely delay the power transition, the only modification that would significantly change the likelihood of the transition would be the inclusion of India in the alliance system. India's forecasted power growth in combination with NATO levels can offset China's forecasted increases, helping to

⁸⁰Renato Corbetta, Thomas J. Volgy, and J. Patrick Rhamey, 'Major Power Status (In)Consistency and Political Relevance in International Relations Studies' (2013) 19(3) *Peace Economics, Peace Science and Public Policy* 291.

⁸¹Mark L. Haas, *The Ideological Origins of Great Power Politics, 1789–1989* (Cornell University Press 2005).

⁸²Paul K. MacDonald and Joseph M. Parent, *Twilight of the Titans: Great Power Decline and Retrenchment* (Cornell University Press 2018) 62.

⁸³Paul K. MacDonald and Joseph M. Parent, 'Graceful Decline: The Surprising Success of Great Power Retrenchment' (2011) 35(4) *International Security* 7.

⁸⁴Jack S. Levy, 'Domestic Politics and War,' (1988) 18(4) *The Journal of Interdisciplinary History* 664.

counterbalance an immediate rising power with one likely to emerge in the long-term. However, the extent to which India is willing to form closer ties with NATO and the depth of partnerships which the alliance is willing to form remain to be seen and hold their own set of consequences.

Finally, it is important to reiterate that these changes in the distribution of state power are not occurring in a vacuum. The international system is increasingly a dense lattice of overlapping structures within legal, institutional, and normative frameworks.⁸⁵ So, while the rise of China seems likely and a transition with the US will most likely occur in the 2040s, it will happen in an international system that is complex and distinct in character from previous international systems. It is very likely that this dense overlapping system will increasingly constrain state behavior. The power measures introduced here take an important, but small, step toward representing the broader conceptualizations and measurement of power that such system changes may require. Future research should focus on quantifying, forecasting, and understanding how these systems are changing, and how these changes will likely impact state power and behavior.

Power transitions do not deterministically cause conflict.⁸⁶ As Wendt observed, nations need not be confined to a Hobbesian 'culture of anarchy,' where states compete for dominance in a zero-sum fashion.⁸⁷ Rather, they can build toward a Kantian culture where friendship and cooperation form the basis of international interactions. How the United States and China manage their shared futures remains to be seen, but the expectation of one side's position vis-à-vis the other does not require the relationship to become predicated on animosity. Interdependency between these two geopolitical giants may help assure a future of managed competition rather than conflict, supposing leadership on both sides recognize the reality of the unfolding situation.

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Notes on contributors

Jonathan D. Moyer (ORCID: 0000-0002-6947-0663) is Assistant Professor at the Josef Korbel School of International Studies at the University of Denver and Director of the Frederick S. Pardee Center for International Futures and nonresident senior fellow at the Atlantic Council's Scowcroft Center for Strategy and Security. His Twitter handle is @moyerjonathan.

Collin J. Meisel (ORCID: 0000-0002-0051-1623) is a senior research associate and Diplometrics program lead at the Frederick S. Pardee Center for International Futures at the University of Denver. He is also a subject matter expert at the Hague Centre for Strategic Studies. His Twitter handle is @collinmeisel.

Austin S. Matthews (ORCID: 000-0001-8972-8329) is a research scientist at the Frederick S. Pardee Center for International Futures at the University of Denver and an incoming (Fall 2022) Assistant Professor of Political Science at East Carolina University. His research focuses on dictatorships, international security, and the politics of Russia and Eastern Europe. His Twitter handle is @austinsmatthews.

⁸⁵Jack Donnelly, 'Rethinking Political Structures: From "Ordering Principles" to "Vertical Differentiation"—and Beyond' (2009) 1(1) *International Theory* 49.

⁸⁶Chan, 'So What About a Power Shift? Caveat Emptor' (n 60) 368.

⁸⁷Alexander Wendt, *Social Theory of International Politics* (Cambridge University Press 1999).