TransResearch Consortium

Assessing the Power of Nations

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Introduction

The measurement of power – that reflects the ability of a nation to influence others to pursue its goals – is a central concern of international relations. To substantiate claims, all competing power distribution theories require valid and reliable assessments of the capacity of nations to influence each other. While there is still no agreement whether a "balance of power" engenders stability or whether this condition relabeled as "power parity" sets the preconditions for global conflicts, no power distribution theory can be validated if we lack an assessment of how preponderance, asymmetry, or equality of power affects national interactions (Waltz 1979, Organski 1958, Organski and Kugler 1980, Gilpin 1981). Indeed, most macro-political analyses have been consistently concerned with the observations and measurements of power.

In this paper, we review three major attempts to approximate power in hopes of determining which estimate provides a better long-term indicator to assess the past and forecast the future political trajectories of great powers. This issue is increasingly pertinent because – as we show – major changes are underway in global interactions. Russia and Britain are both exiting from the global scene, while China and India are joining the United States as the great powers this century.

Power

Traditional scholars provide a very rich definition of power, but their arguments are difficult to measure consistently. Raymond Aron (1966) argued that power is a complex concept that incorporates economic, political, sociological, and military elements, including the "elan" of participants – among over 20 other factors. Martin Wight (1978) reduces the number of the key elements proposing that "... power is composed of many elements. Its basic components are the size of the population, strategic position and geographical extent, and economic resources, and industrial production. To these must be added less-tangible elements like administrative and financial efficiency, education, and technological skill, and above all moral cohesion" (p. 26).

Kenneth Waltz (1979) further cut down the specification of power, arguing that a state's "…rank depends on how they score on all of the following items: the size of population and territory,

resource endowment, economic capability, military strength, political stability and competence" (p. 131).

In the 1960s, systematical quantitative measures of power or national capabilities were finally advanced. In this evaluation, we start with the widely used Composite Indicator of National Capability (CINC) measure, introduced by David Singer, that reduced the complexity of powers to six measurable components representing military, demographic, and economic capabilities. Alternate measures based on sea power, territorial expansion, or those that rely on military capabilities alone are useful but do not provide consistent temporal coverage as the measures selected here (Modelski and Thompson 1988). We are interested in long-term measures and, for that reason, exclude measures that are based solely on military preparedness or comments that aim to measure "soft power," which rely heavily on short-term perceptions of instruments of power (Treverton and Jones, 2005).

Our main objective is to evaluate whether several recent power measurements bring forth additional parsimony and accuracy to our understanding of long-term power shifts.
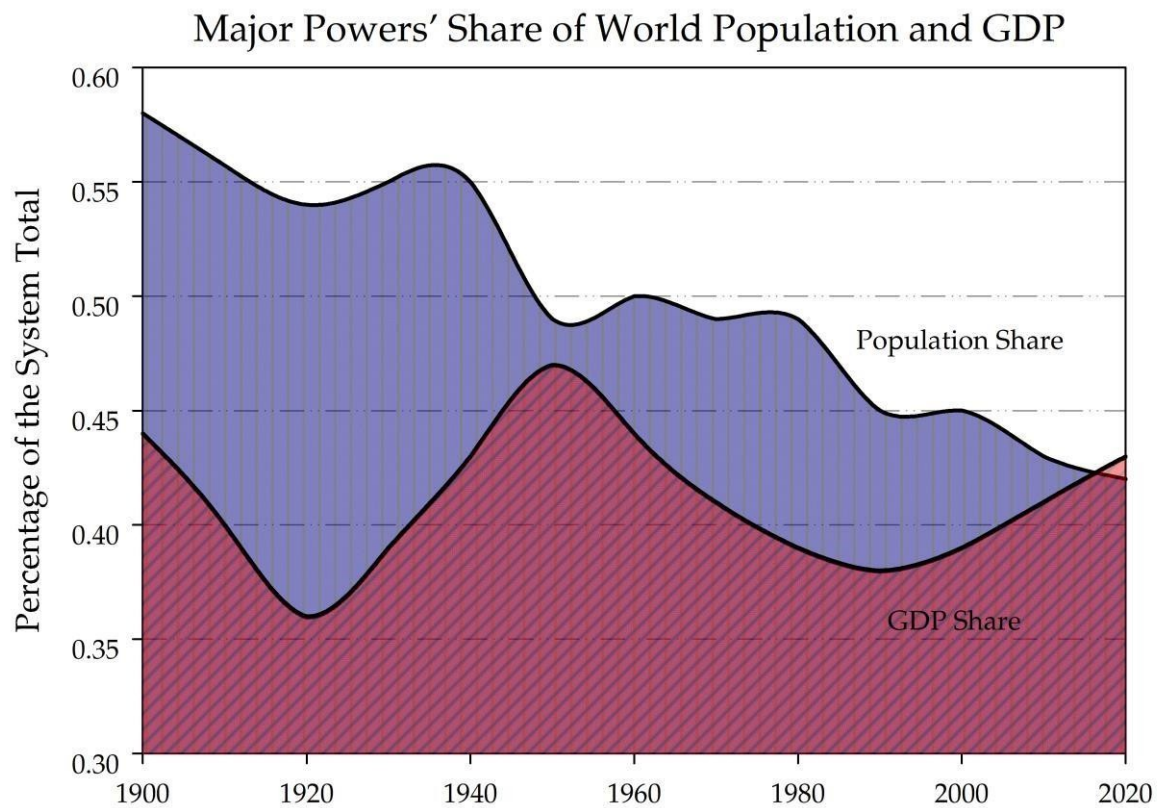

Great Powers

We focus on the relative power distribution among great powers because their policies and behaviors characterize the international system. As in the case of power, the definition of great powers is in dispute. Gilpin (1981) argues that "both individually and in interaction with one another, those states that historically have been called the great powers and are known today as the superpowers establish and enforce the basic rules and rights that influence their own behavior and that of the lesser states in the system" (p. 30). Kennedy (1987) defines a Great Power as "a state capable of holding its own against any other nation" (p. 539). Levy (1983) claims that "... a Great Power possesses a high level of military capabilities relative to other states" (p. 16).

Attempting to synthesize these arguments, we define great powers as those that have accumulated a considerable amount of power so that their total accounts for more than 50

percent of all available capabilities.[1] Accordingly, the number of great powers at any point in time is relatively small. In this analysis, we compare the capabilities United States as the dominant state since World War II and key competitors. The USSR was the principal adversary during the Cold War. After the collapse of the USSR in 1990, China emerged from its dormant stage to become the leading contender to US dominance. Today, India can be added to the set of potential great powers. If considered a unified block, the European Union could be added to this list – but we did not do so in this paper.

We will assess the existing measures of power, starting with the most frequently used CINC, to explore alternatives and evaluate their implications.

*Figure 1: Major Powers' Share of World Population and GDP*

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[1] Great powers dominate global resources. Adding the top largest four nations over time shows that these nations dominated total output and population share. After 1900 despite reducing the proportion of population these great powers hold, the total available material resources still exceed 50 percent of the global total. Size matters.

1. Composite Index of National Capability (CINC)

One of the most frequently used measures of power or national capabilities is the Composite Index of National Capability (CINC) (Singer, Bremer, and Stucky 1972). This measure is based on the combination of military, demography, and economic strengths. All power components are equally weighted since changing weights associated with each component does not produce meaningful differences (Small and Singer 1982). Introducing nuclear weapons as a seventh component alters outcomes only marginally (Doran 1991). For details of the calculation of CINC, see Appendix 1.
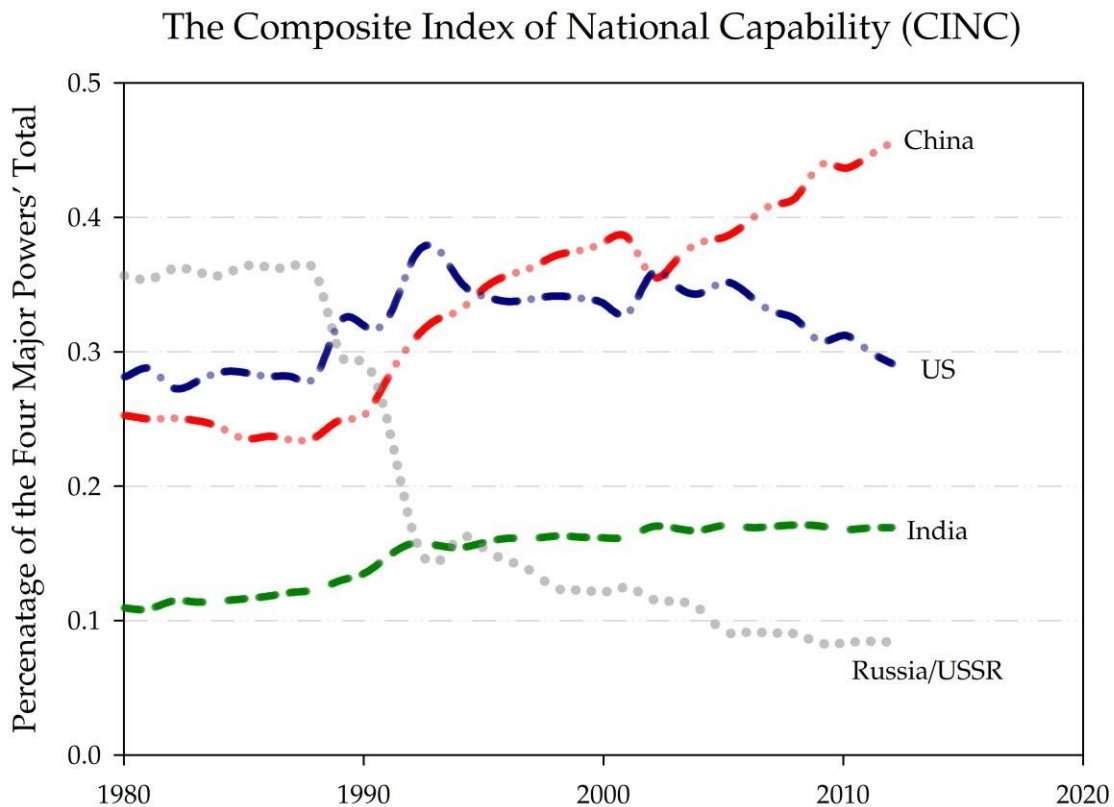
Figure 2: The Composite Index of National Capability (CINC)

The value of CINC is sensitive to the addition or subtraction of national units, limiting its ability to provide effective cross-temporal assessments (Kadera and Sorokin 2004). The path of great

powers remains comparable in this analysis because we include the same set of countries of this short time period. Using CINC in long-run comparison will reduce its validity, particularly when nations join in or disappear from international membership.[2]

The figure 2 shows the relative distribution of power since 1980. CINC grossly exaggerates the capability of the USSR prior to 1990, as it became clear following its collapse. The main reason for this distortion is the huge military allocation chosen by USSR. As Klaus Knorr (1975) correctly pointed out, the potential capabilities should be distinguished from the actual strengths. This is particularly important when military capabilities disproportionately rise during conflict (Kugler and Domke 1986). Turning to US-China relations, we believe the CINC's indication of China's global status as a preponderant power is incorrect. Few would argue that China overtook the United States in 1995 and now dominates the global politics towering over the United States. Rather, we will show below that alternative measures of power are far more consistent with expectations.

2. Gross Domestic Product (GDP)

A.F.K. Organski (1958) argued that Gross National Product (GNP) could serve as an effective indicator of national capabilities. The core idea is that power is determined by the ability of the population to produce national resources. It is further assumed that per capita output implies the level of individual productivity. Like CINC, GNP is a measure of actual current power. Proponents argue that money is fungible, and elites can readily mobilize and allocate their resources as needed (Organski and Kugler 1980). There is no need to distinguish between military and civilian capacity. This idea implies that the policy choice of reallocation for warfighting resources is a direct response to perceived external threats.

GNP was replaced by Gross Domestic Product (GDP) because the former excludes the revenues generated outside of the local economy.[3] Currently, GDP valued at common international prices is the most widely accepted measure. The purchasing power parity (PPP) adjustment is

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[2] We argue elsewhere that Russia (along with Britain after it left the EU) are no longer great powers – but retain Russia after the collapse of the USSR in this analysis to minimize temporal distortions.
[3] For a detailed formulation of GDP, please see Appendix 1.

appropriate for cross-country comparison since some goods and services are cheaper in developing societies than developed ones (Maddison 2007; Feenstra, Inklaar and Timmer 2015).

One advantage of GDP is its extensive availability, encompassing 2000 years of history, largely due to the effort put in by Angus Maddison. Additionally, the simple accounting-based formula used for GDP calculation can be applied to subnational economies or other disaggregated levels. It is important, however, to understand what GDP cannot tell us. GDP was originally developed by Kuznets (1934) to capture national capabilities. As GDP evolved over time, it increasingly centered on market activities and the monetary output of the public sector. Politics plays no role in the calculation or interpretation of GDP. We believe this exclusion hides the capacity of the government to mobilize the resources in response to foreign-policy needs and diminishing the capacity of governments to manipulate total output in response to international or domestic policy demands.
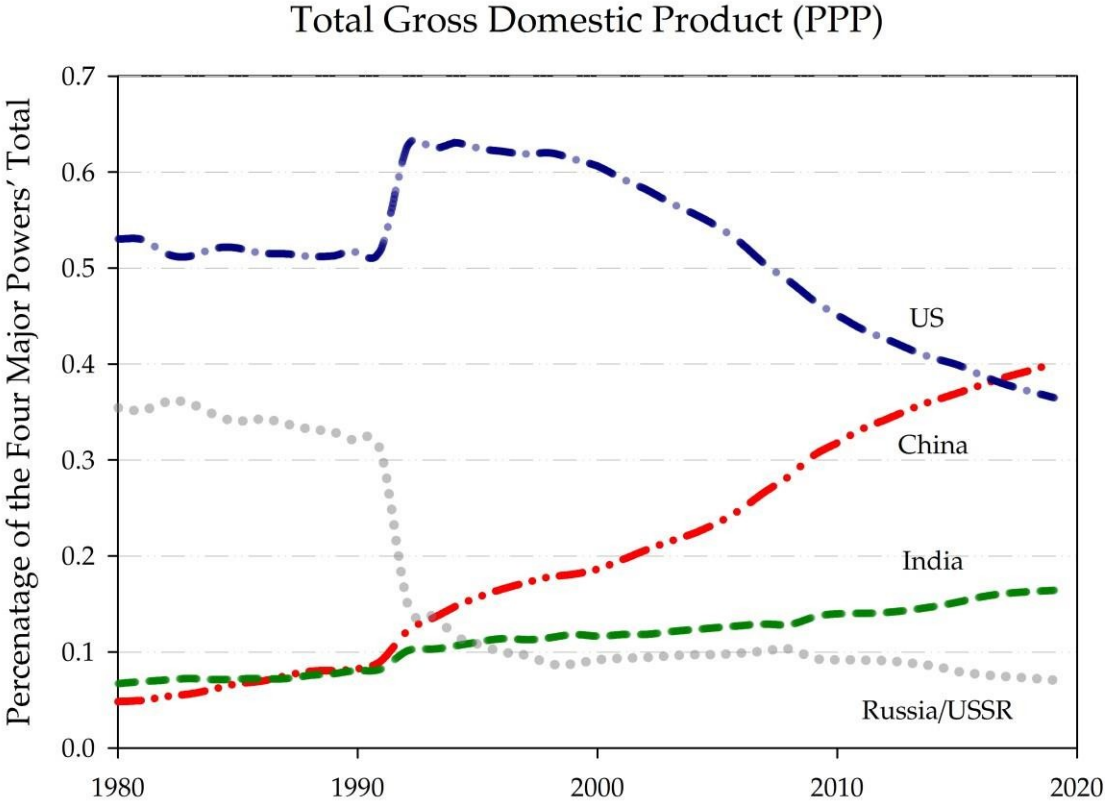
Total Gross Domestic Product (PPP)

Figure 3: Total GDP (PPP)

When we look at the GDP of great powers in Purchasing Power Parity after 1980 in Figure 3, we observe that, unlike CINC, the USSR never approached the Power of the United States. This reality was confirmed after the collapse of the Soviet Union disclosed the real economic standing of that society that was covered over by excessive military allocation. GDP suggests that China overtook the United States around 2015 – although we do not observe this when we employ GDP without the PPP. Nevertheless, the relative decline of the US is driven in large part by China's fast growth and by the rise of developing economies. We anticipate this gap between China and the US will widen further. The relative positions of Russia and India are like those provided by CINC.

3. Surplus Domestic Product (SDP)

A recent, significant effort to measure power is Surplus Domestic Product (SDP), which was advanced by Anders, Fariss, and Markowtiz (2020). The key difference between GDP and SDP is that the latter subtracts the subsistence income from GDP. The authors argue that isolating the surplus income reflects the real ability of nations to acquire military resources when needed. Supporting this argument, Paul Kennedy (1987) claimed that "... since most of (product) is immediately consumed, it is far less likely to lead to surplus wealth or decisive military striking power (p. 152)." From this perspective, GDP as a measure of power overestimates the military potential of low-income states, particularly when a large proportion of its population lives on the edge of subsistence. This idea is influenced by some criticism of GDP as a measure of power resources from several economic historians.

A second component added to SDP is a control for the distance between competitors, but this can be externally applied and is not part of the SDP estimation (See Appendix 1 for details). Clearly, power is reduced with distance (Boulding 1962). However, it is difficult to argue that the great powers considered here cannot reach each other. Russia and the United States signaled many times that they have the capabilities to reach each other – potentially with great lethality. China's ability to destroy India or Russia and vice versa is not impaired, for they share a common border. India's capacity may still be in question, but all these nations have or are soon going to acquire global nuclear capabilities that should diminish the importance of distance.
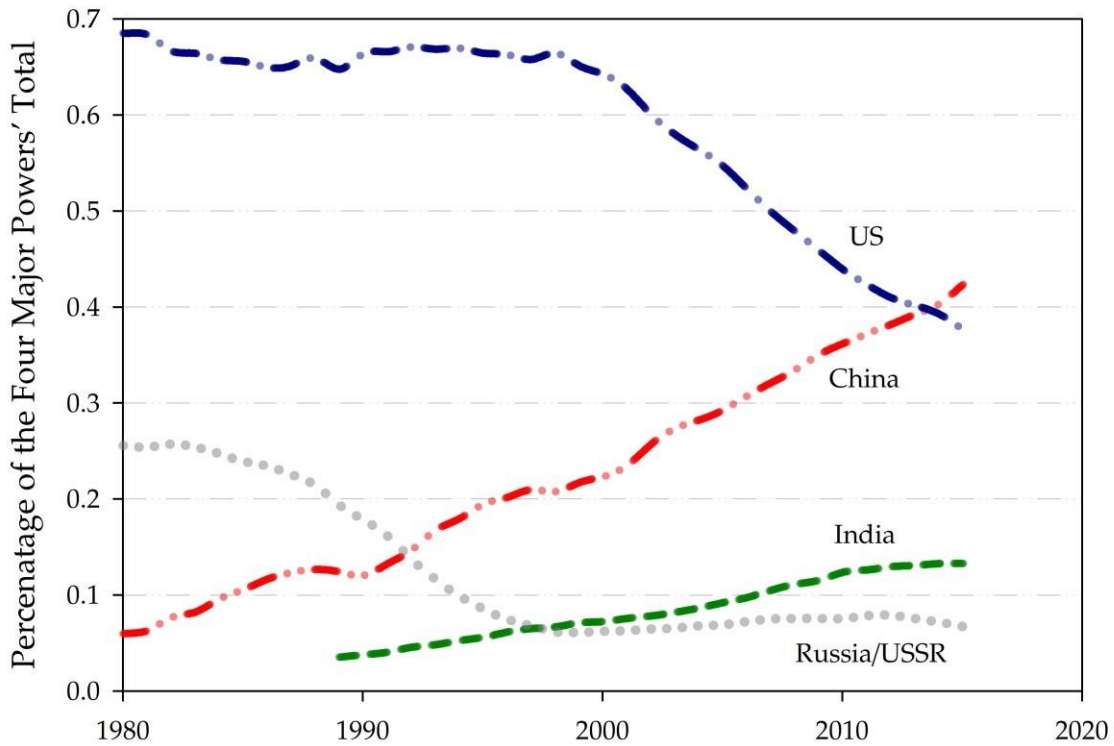
Surplus Domestic Product (Anders et al. 2020)

Figure 4: Surplus Domestic Product

Empirically, SDP's measure for comparing the relative strengths of great powers is, in our view, superior to CINC but not much different from GDP. Figure 4 shows that the rank order and the timing of overtaking are similar. Massive changes – like the collapse of the USSR – are somewhat masked by averaging several years. Compared to GDP, China is performing slightly better when SDP is used. India – the one society affected by persistent poverty – shows a relatively sluggish pace. This marginal but noticeable difference reflects that a large proportion of India's population still lives in poverty.

SDP can be updated like GDP does since SDP simply subtracts $3 times the population from the total GDP. We do not completely disagree with the theoretical value of the subsistence-surplus decomposition but remain concerned with the assumption that relatively poor societies cannot mobilize human resources effectively. The effectiveness of North Vietnam – a far poorer society

than South Vietnam – raises serious questions about the ability of developing societies to mobilize their populations. The main concern with this plausible measure is that it is more difficult to construct and does not provide apparent advantages over GDP.

4. GDP Weighted by Politics

Based on previous works (Organski and Kugler 1980, Kugler and Domke 1986, Arbetman and Kugler 1997, Kugler and Tammen 2012), we argue that the measurement of power should explicitly include political capacity for an adequate comparison. Relying on the measure of economic performance or adjusted for income levels is insufficient to capture the ability of societies to utilize their population effectively.

Paul Barioch (1976), we believe, accurately argued, "it is obvious that by itself the volume of total GNP has no important significance, and that the volume of GNP is not by itself the expression of the economic strength of a nation (p.282)." We concur and propose that a measure of national capabilities that approximates the ability of a nation to exercise its influence on others must include an explicit measure of political capacity.

Organski and Kugler (1980) proposed that GDP can be weighted by the relative political capacity of states to approximate their power. A major shortcoming of RPE is that it is a relative, not an absolute measure. Values of RPE are only comparable for countries with similar levels of income and similar economic structures. Because of its relative quality, RPE can effectively compare the UK with Germany, but it is significantly less accurate when the US is compared with China. Indeed, due to its relative nature, higher RPE values do not necessarily indicate directly the capacity of a government – but does measure the capacity of a government compared to another government with similar economic characteristics.

To alleviate these shortcomings, we developed the new measure of Absolute Political Extraction (APE). APE captures the quality of government performance by including extractive and mobilization capabilities. Like RPE, the theoretical origins of APE rely on the concept of tax extraction. Since there is an absolute limit to the percentage of taxes a government can collect, raising additional tax revenues becomes increasingly more difficult as the tax rates increase. Achieving the same amount of increase is easier for countries with lower levels of initial tax

revenues than countries with higher levels of initial tax revenues. For instance, it will be easier for Guatemala to raise its tax revenues from 10% of GDP to 15% of GDP than for Belgium to increase its tax revenues from 45% of GDP to 50% of GDP. It implies that there is more policy space for lower-income countries than higher-income countries. APE is designed to avoid RPE's tendency to penalize more developed societies by construction.
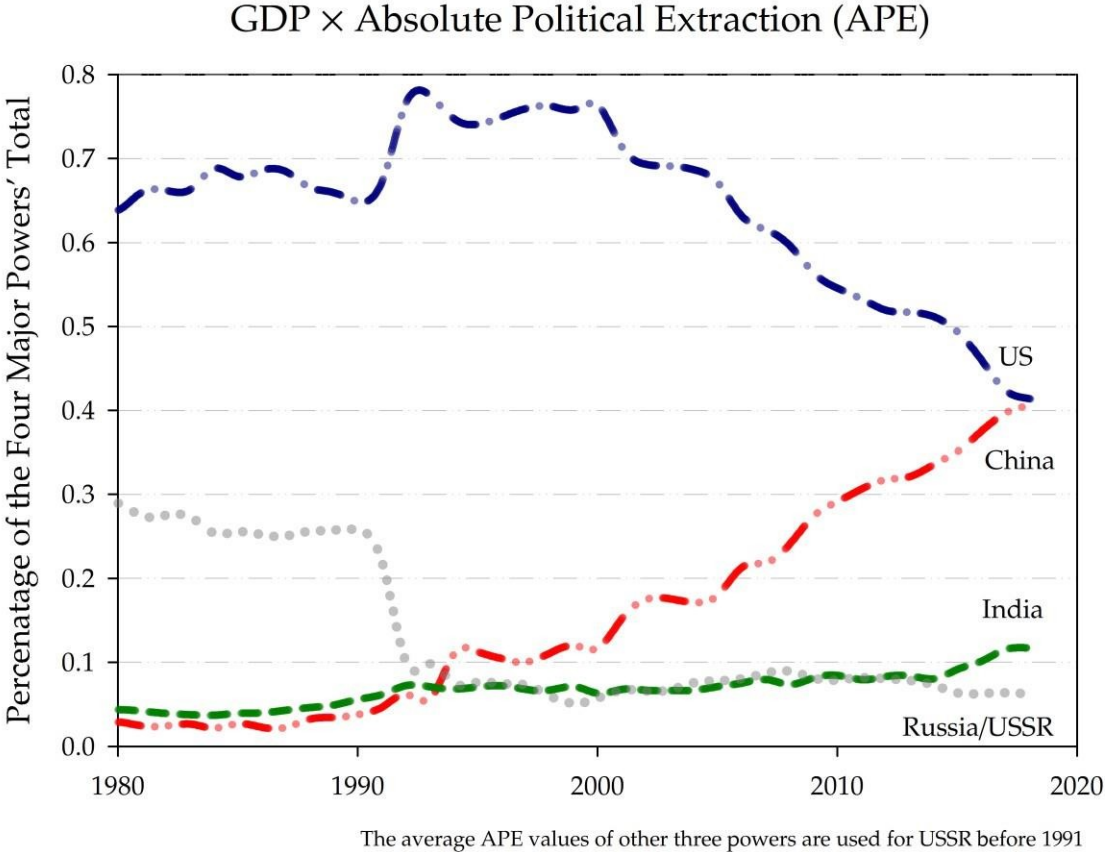

Figure 5: GDP x Absolute Political Extraction (APE)

APE is based on the difference between the theoretical frontier level and the actual level of tax extraction for each society, given the key determinants of tax revenues - mining, agriculture, exports, education, economically active population, and OECD membership status. Since the frontier assessment establishes the maximum feasible extraction levels for each society, APE can overcome the limitations of other relative measures. The final APE index is the product of tax extraction efficiency from the frontier analysis and the degree of socioeconomic well-being

10

based on life-expectancy. All components are standardized so that the values of APE ranges between 1 as the maximum capacity and 0 as the minimum. We believe that relatively poor and affluent societies have similar opportunities to mobilize populations, and APE reflects this expectation. Contrary to the assumptions of SDP, we argue that that populations can be effectively mobilized regardless of income levels. The correlation between GDP per capita and APE is only .43 (R^2= .18) reflects our expectations. (See the Appendix for estimations).

Figure 5 reflects variations of current power distributions. Consistent with GDP and SDP, but contrary to CINC, the USSR was a far weaker state than the U.S. India, and China do not emerge until the collapse of the USSR. As many of our colleagues contend, the US emerges as the single superpower following the collapse of the USSR. China's challenge emerges after 2000 and approaches parity with the US around 2019. The gap closes rather fast in part because of the APE decline of the US that accelerated after 2010.

We posit this assessment of power shifts in the last 40 years reflects reality far better than alternate measures of power. Further exploration that includes all states is a useful next step.

Conclusion

The specification, validity, and reliability of power indicators of power have progressed enormously in the last half-century. Scholars now have a set of alternate indicators that allow effective evaluation of shifting power distributions globally (and regionally).

CINC – potentially the still most widely used measure of power – is, in our view, the least effective. Over time variations are frequently caused by the inclusion or exclusion of states, the ranking of societies is not accurate, variations do not reflect relative capabilities accurately, and changes are driven by temporary mobilization of resources rather than because of underlying capabilities. Alternate measures are more effective.

The remaining power measures reviewed - GDP, SDP, and GDP weighted by APE - show a relatively similar and realistic picture of power shifts in the international system since 1980. There is no evident difference between SDP and GDP estimates. Both can be used for long-term estimates.

The GDP weighted by APE provides the most accurate assessment of power distributions. SDP has potential but undermines the potential of less-developed societies. In practice, for real-time assessment of current affairs, the weighted GDP is preferred because of accuracy and constant updating. We recommend the use of GDP for longer-term assessments because of simplicity, availability, and forecasting potential.

Bibliography

Anders, Therese, Christopher J. Fariss, and Jonathan N. Markowitz. 2020. "Bread Before Guns or Butter: Introducing Surplus Domestic Product (SDP)." *International Studies Quarterly* 64 (2): 392-405.

Arbetman, Marina, and Jacek Kugler. 1997. *Political Capacity And Economic Behavior.* Boulder: Westview Press.

Aron, Raymond. 1966. *Peace and War: A Theory of International Relations.* Garden City, NY: Doubleday & Company.

Bairoch, Paul. 1976. "Europe's Gross National Product: 1800-1975." *Journal of European Economic History* 5 (2): 273-340.

Boulding, Kenneth E. 1962. *Conflict and Defense: A General Theory.* New York: Harper and Brothers.

Doran, Charles F. 1991. *Systems in Crisis: New Imperatives of High Politics at Century's End.* Cambridge: Cambridge University Press.

Feenstra, Robert C., Robert Inklaar, and Marcel P. Tiimmer. 2015. "The Next Generation of the Penn World Table." *American Economic Review* 105 (10): 3150-3182.

Fenochietto, Ricardo, and Carola Pessino. 2013. "Understanding Countries' Tax Effort." *IMF Working Paper* 13/244: 1-29.

Gilpin, Robert. 1981. *War and Change in World Politics.* Cambridge: Cambridge University Press.

Kadera, Kelly M., and Gerald L. Sorokin. 2004. "Measuring National Power." *International Interactions* 30: 211-230.

Kennedy, Paul. 1987. *The Rise and Fall of the Great Powers: Economic Change and Military Conflict from 1500 to 2000.* New York: Random House.

Knorr, Klaus. 1975. *The Power of Nations.* New York: Basic Books.

Kugler, Jacek, and Ronald Tammen. 2012. *The Performance of Nations.* New York: Rowman & Littlefield.

Kugler, Jacek, and William Domke. 1986. "Comparing the Strength of Nations." *Comparative Political Studies* 19 (1): 39-69.

Kuznets, Simon. 1934. "National Income, 1929-1932." *Senate Document No. 124, 73d Congress, 2d Session.*

Levy, Jack. 1983. *War in the Modern Great Power System: 1495--1975.* Lexington: University Press of Kentucky.

Lotz, Jorgen R., and Elliott R. Morss. 1967. "Measuring "Tax Effort" in Developing Countries." *Staff Papers (International Monetary Fund)* 14 (3): 478-499.

Maddison, Angus. 2007. *The World Economy, Volume 1: A Millenial Perspective, Volume 2: Historical Statistics.* Paris: Organization for Economic Co-operation and Development.

Modelski, George, and William Thompson. 1988. *Seapower and Global Politics, 1494-1993.* Seattle: The University of Washington Press.

Montez, Jennifer Karas, Jason Beckfield, Julene Kemp Cooney, Jacob M. Grumbach, Mark D. Hayward, Huseyin Zeyd, Woolf, Steven H. Koytak, and Anna Zajacova. 2020. "US State Policies, Politics, and Life Expectancy." *The Milbank Quarterly* 98 (3): 668-699.

Morgenthau, Hans. 1948. *Politics Among Nations: The Struggle for Power and Peace.* New York: Alfred A. Knopf.

Organski, A. F. K., and Jacek Kugler. 1980. *The War Ledger.* Chicago: The University of Chicago Press.

Organski, AFK. 1958. *World Politics.* New York: Alfred A. Knopf.

1988. "Prediction of Firm-Level Technical Efficiencies with a Generalized Frontier Production Function and Panel Data." *Journal of Econometrics* 38 (3): 387-399.

Reynolds, Megan M., and Mauricio Avendano. 2018. "Social Policy Expenditures and Life Expectancy in High-Income Countries." *American Journal of Preventive Medicine* 54 (1): 72-79.

Singer, David J., Stuart Bremer, and John Stuckey. 1972. "Capability Distribution, Uncertainty, and Major Power War, 1820–1965." In *Peace, War, and Numbers*, by Bruce M. Russett, 19-48. Beverly Hills: Sage.

Small, Melvin, and David J. Singer. 1982. *Resort to Arms: International and Civil Wars, 1816–1980.* Beverly Hills: Sage.

Treverton, Gregory F., and Seth G. Jones. 2005. *Measuring National Power.* Santa Monica: RAND Corporation.

Venkataramani, Atheendar S., Rourke O'Brien, and Alexander C. Tsai. 2021. "Declining Life

Expectancy in the United States: The Need for Social Policy as Health Policy." *JAMA* 325 (7): 621-622.

Waltz, Kenneth. 1979. *Theory of International Politics.* Boston: Addison- Wesley.

Wight, Martin. 1978. "Power Politics." By Hedley Bull and Carsten Holbraad. New York: Holmes and Meier.

Appendix 1. Measurement Procedures

1. The Composite Index of National Capability (CINC) includes the six subcomponents for each state on demographic (total and urban population), military (military expenditures and personnel), and industrial dimensions (iron/steel production and energy consumption), weighing each of the six components equally:

$$CINC = \frac{the\ sum\ of\ six\ individual\ subcomponents}{6}$$

Each subcomponent is measured in the individual country's share of the system total, which makes the CINC measure the overfall share of a nation's material capabilities in terms of the proportion between 0 and 1.

2. Out of the travails of the Great Depression, the original formulation of Gross Domestic Product (GDP) was suggested by Simon Kuznets (1934), who intended to capture all economic production by individuals, companies, and the government in a single measure. GDP can be measured in three theoretically equivalent methods: (1) the expenditure approach (adding up all the money spent by the different groups that participate in the economy), (2) the production approach (adding up the total value of economic output and deducting the cost of intermediate goods), and (3) the income approach (adding up all the money earned by all the factors of productions in forms of wage, rent, and capital return). The US GDP is primarily measured based on the expenditure approach by using the following formula:

$$GDP = C + I + G + NX$$

where C= consumption, I= investment, G=government spending, and NX=net exports.

For cross-national comparison, each country's GDP must be converted into a common currency, which is the most complex task. The main methods of conversion include the use of market exchange rates and of purchasing power parity (PPP), each of which has its advantages and disadvantages. For our purpose, the PPP-adjusted GDP is preferred since it is less sensitive to market exchange rate volatility and more appropriate to capture purchasing power of emerging and developing counties by considering the costs of both traded and non-traded goods.

3. Surplus Domestic Product (SDP) takes into account the basic subsistence needs of the population, and distinct surplus income states can devote to military build-ups from total GDP by deducting the subsistent minimum allowing the individual to survive:

$$SDP = GDP - the\ minimum\ subsistence\ value$$

$$The\ minimum\ subsistence\ value\ = 365\ \times\ \$3\ \times\ population$$

Note that SDP uses the $3 per day (in 2011 PPP dollars) threshold as the necessary level of income to sustain the population's basic living, which is higher than $1.90 set by the World Bank as the absolute poverty line. The authors emphasize the continued importance of Boulding's (1962) adjustment of the loss of strength gradient for evaluating the distribution of power in their validation exercises, while the measure of SDP is based on the adjustment of subsistence income only.

4. Absolute Political Extraction (APE) is a political indicator comprising two key subcomponents, (1) political extraction capacity and (2) life expectancy. The former is related to the mobilization of governmental inputs while the latter to the value governments return to society through the provision of public goods. As such, the index is intended to capture the product of the interplay between governmental inputs and outputs.

$$APE = political\ extraction\ \times\ life\ expectancy$$

By normalizing both subcomponents to the decimals between 0 and 1, the values of APE are scaled between 0 for the least capable government and 1 for the most capable one.

First, for political extraction capacity, we follow the earlier discussions for using the tax effort to measure government performance (Lotz and Morss 1967, Organski and Kugler 1980, Arbetman and Kugler, 1997, Fenochietoo and Pessino 2013). Followingly, we estimate the proximity of the actual level of taxation to the maximum feasible (or "frontier") performance as political extraction capacity with which governments pursue their objectives:
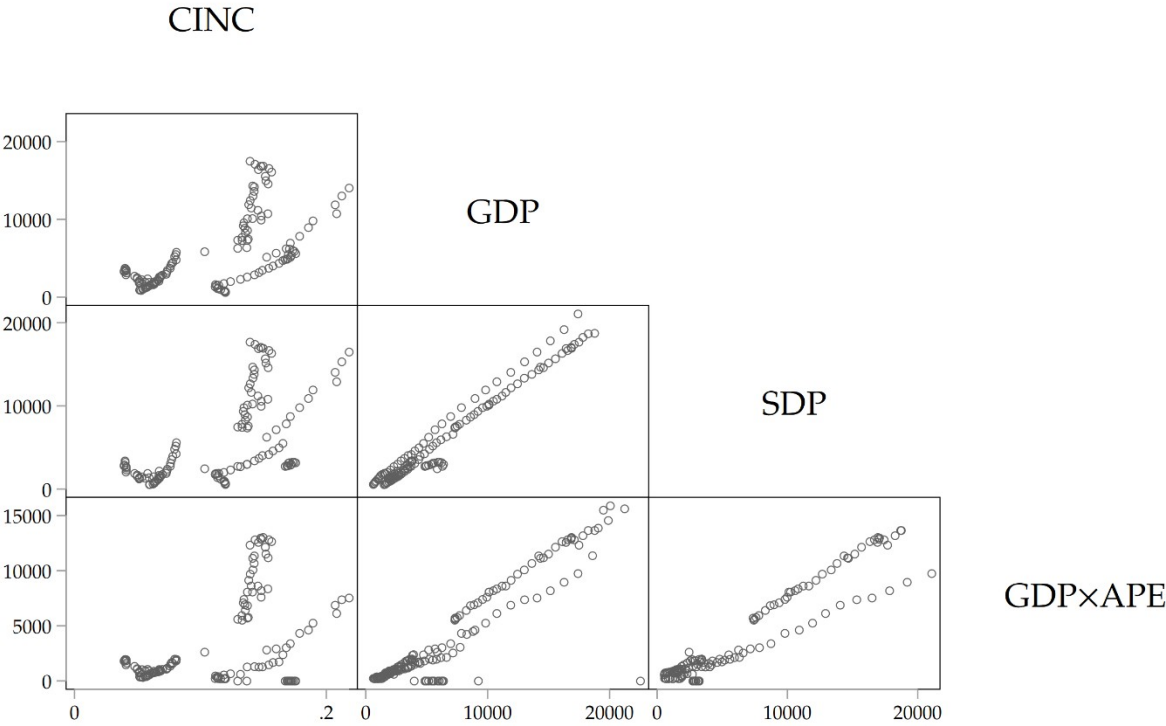
$$y_i = \dot{x}\beta + \mu - \nu$$

16

where y = tax revenues, x = the determinants of tax revenues (mining, agriculture, exports, education, economically active population, and OECD membership), u = the normally distributed noise terms such as measurement errors or external shocks, and v = the governmental inefficiency of taxation. Note that the second disturbance, v, represents the one-sided residual that measures individual departures from the frontier tax level, attributable to their political environments. By applying Battese and Coelli (1988) 's solution, we derive estimates of political extraction capacity as $exp\ \left(-v\right)$ ranging 0 for the least efficient government and 1 for the most efficient government in terms of tax extraction.

Second, we use life expectancy since it is the valid available metric for assessing socioeconomic conditions. Life expectancy expansion is a result of, among other things, improvement in social care that gives populations the right support to stay healthy and independent. Recent empirical results showing the link between life expectancy and the quality of government policies are documented in Reynold and Avendano (2017), Montez et al. (2020), and Venkataramani et al. (2021). We transform the values of life expectancy to 0 for the minimum longevity society and 1 for the maximum.

Appendix 2. The Correlations among the Different Measures of Power

Correlation between the Power Measures				
	CINC	GDP	SDP	GDP*APE
CINC	1			
GDP	0.6246	1		
SDP	0.6109	0.981	1	
GDP×APE	0.6235	0.9807	0.9532	1

Correlations between the First-Differences of the Powers				
	Δ.CINC	Δ.GDP	Δ.SDP	Δ.GDP*APE
Δ.CINC	1			
Δ.GDP	0.5822	1		
Δ.SDP	0.4189	0.7322	1	
Δ.GDP×APE	0.1147	0.5935	0.4576	1