

A Measure of Country Power: 1500-1945 AD

Peter Brecke
Sam Nunn School of International Affairs
Georgia Institute of Technology
Atlanta, GA 30332-0610

peter.brecke@inta.gatech.edu

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Abstract

This paper presents a measure of country power, defined in terms of capabilities, that extends back to 1500 AD for 10 countries. The measure consists of seven components, four defining military power and three defining economic power. The goal of this effort has been to create a measure of power that is at least equal if not superior to existing measures in two dimensions: the span of time encompassed and the breadth of the components of power included. The paper provides a justification for the effort, a description of the components of the measure and the data sources used, and the power trajectories that result.

Introduction

In order to study and understand long-term processes in the international system, it helps to have measures of different properties of the system and its components. Among the many possible properties we might want to know, it is difficult to believe that the level of economic influence and the military power of a country are not important long-term measures of the country's situation. Economic size, level of wealth, and interconnectedness combine to give us a sense of a country's economic power, its influence on the creation and maintenance of an economic regime beneficial to itself. Military power is probably what most theorists mean when they discuss power with respect to the outbreak or outcome of warfare. Economic power and military power in some way combine to give us a sense of a country's ability to influence the international arena. Similarly, the distribution of economic power and military power, systemic properties, almost certainly have an impact on events, although we have not yet discerned what that impact may be (Cashman, 1993).

If we indeed believe power and its distribution is a significant and long-term determinant of decisions with respect to going to war or attempting to reshape economic institutions or rules, we should be able to see that influence in large-N statistical tests. Until we get that, we are unlikely to be able to make theoretical breakthroughs as we have seen in other scientific disciplines.

We find assertions of success in finding a relationship contradicted by other findings in the same tradition. As evidence consider that scholars conducting very different overview surveys consistently lament the lack of cohesion, coherence, and progress in the sub-field of system-level analysis of international relations (Russett and Starr, 200x; Cusack and Stoll, 1990; Cashman, 1993). Small wonder that dyadic-level analysis in large-N studies and Constructivist and other approaches have eclipsed system-level analysis as popular and potentially fruitful avenues for research.

Other scholars proclaim insights relevant to system-level theorizing based on a small number of cases (Copeland, 2000). While the small-N studies move the debate forward by containing theoretical advances, findings based on those studies do not have the impact that confirmatory large-N studies would bring to the argument. Remember, people could and have for a long time made assertions that democracies were more peaceful than other government types. It was not until large-N studies, starting in the 1980s, demonstrated the democratic peace that the argument got real weight and was even used by President Clinton. To truly make the case, large-N determinations of theoretically-relevant findings are necessary.

There is the problem. The intuition of many scholars says that system-level effects are real even though they probably vary somewhat over time and across cases. But convincing evidence as to how those effects work is just not there. If system-level

theories are to show relevance and be part of the fuller explanation of political and economic behavior, we still need to demonstrate their effect with large-N analysis.

The purpose of this paper is help move forward the debate between structural realists and constructivists. It seeks to help determine the limit or extent of long-term and structural factors on a country's behavior and experiences. It does so by presenting and justifying the validity of a new measure of long-term country power and one of its components, economic power. Another paper does the same for the measure of another component of country power, military power (Brecke, in preparation).

And how do these new measures help move the debate forward? Notable changes in a country's relative level of economic wealth or power are typically quite slow, except for changes wrought by war. Some systemic properties take an even longer time to significantly change, for example, the spread of democratization or, barring a large war, the power polarity of the international system. In order to properly capture the behavior of these long-term processes, we benefit from extending our time series of variables germane to those processes. This paper provides two significantly extended measures: an index of economic power and an index of combined economic and military power for a number of countries going back to 1500 AD.

Longer time series provide the opportunity for greater variation in both the independent and dependent variables as well as more observations of any set of categories one may create for the variables. We can thus better test our theories. In particular, we can better test structural realist theories to divine when their explanatory power is best (if at all), and how much explanatory power they provide.

Of course, simply generating a longer time series does not help if the data are of poor or dubious quality. This paper gives the reader a sense of the validity and reliability of the variables created. It is my belief that these measures are as valid and reliable as is feasible if not possible at this time and that they capture fundamental characteristics of several countries in the international system. Besides the practical goal of trusted data, this exercise in validation is done to illustrate how to test for and hopefully improve the validity and reliability of different measures.

The paper follows a five-step logic.

- 1) It defines the concept of power, in particular the power of a country, and distinguishes between different types of power a country may possess.
- 2) It defines a measure of country power in terms of relative economic power and relative military power and defines economic power in terms of relative economic size and relative economic wealth.
- 3) It more precisely defines relative economic size and relative economic wealth.

- 4) It describes the best available empirical measures of GDP per capita and population, which combine to create GDP, one component of economic size, and the best available measures of international trade and exchange rates that are needed to make the second component of economic size.
- 5) It portrays the resulting measures of economic size, economic power, and total country power and compares them with our up to now rather impressionistic determinations of those variables.

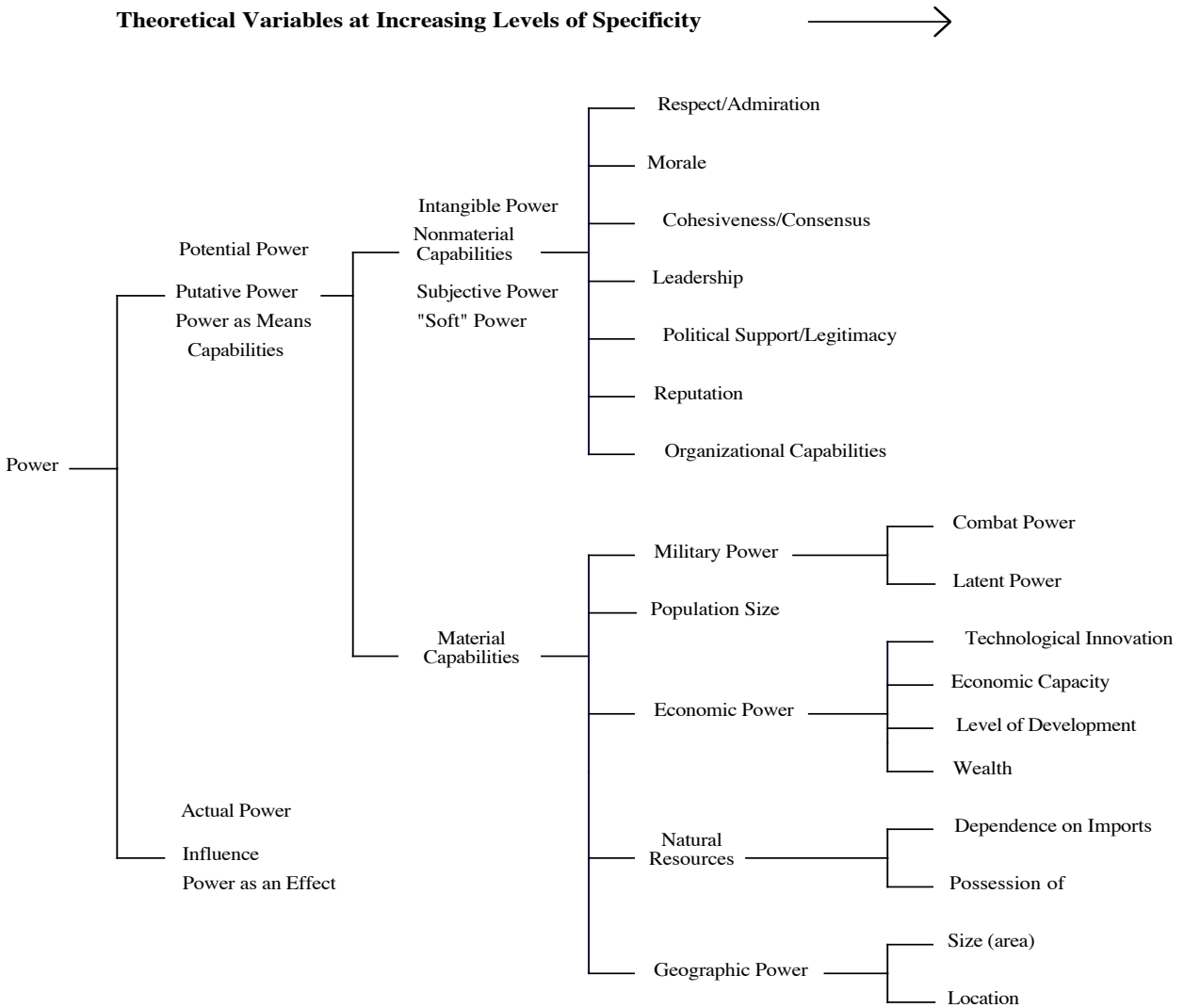
The Concept of Power

The starting point for this section is the desire to determine what aspect or type of power is most relevant to the question of the relationship of system structure to the amount of conflict in the system. We do this to provide a reference point for the design of or guidance as to the structure of the measure of power created later.

The academic literature is replete with many different kinds or definitions of power and lists of the components of power (Spanier, 1975). A retelling or relisting of those definitions and components will not be done. Instead, Figure 1, The Components of Power, attempts to portray the structure of the concept of power. It combines the contributions of many authors and aspires to properly combine those terms that seem to be essentially the same and at the same time distinguish those unique terms that have been proposed as elements of what we think of as power. Reading the figure should begin at "Power" on the left side and move down the branches towards the right.

Figure 1

Components of Power



The most fundamental distinction in (or, alternatively, the first step for deconstructing) power is whether one is referring to actual power or putative power (Knorr, 1975).

Actual power is power as an effect; actual power is the degree of influence on events and outcomes that a social actor, in this case states, enjoys; actual power is something we know after the fact.

Putative power is power as means; putative power is potential power; putative power is defined in terms of a country's capabilities. Putative power is the power you and others perceive a social actor to have and can employ now or in the future.¹

If we move to the right on the path of components, the most important distinction relating the components (or types) of putative power is whether the power is material or nonmaterial. Can the factor be measured in terms of primarily physical, hopefully measurable, characteristics such as population or number of troops? If so, that factor is a component of material capabilities. Conversely, is the factor primarily nonphysical and resistant to measurement? Those factors comprise nonmaterial capabilities. They are essentially intangible. They help define subjective power, and they are often now referred to as components of "soft" power (Nye, 1990).

The third dimension on which to distinguish different types or components of power is the domain over which the power resides. For material capabilities those domains include natural resources or military power or economic power. For nonmaterial capabilities, those domains include leadership, morale, organizational skills, and cultural power.

The fourth level for distinguishing different types of power is the different variables used for determining the capability. These include a country's wealth or location or number of major naval combat vessels.

When one compares the right side of Figure 1 with what researchers typically employ in their analyses, one finds a disjoint. The gap between the theoretical

¹Another way to consider the distinction between actual and putative power is to consider the degree to which one knows the power of the other. If one knows with a high degree of certainty the power of the other and especially that other's power in comparison with oneself, the knowledge shapes behavior. If you know the other country, for example, is much more powerful than you, then you are more likely to cede some disputed object, such as control of territory, to the other because you know they can take it by force if they want, and you are likely to face greater sanction or punishment during or after they take it because of the cost to the other of your resistance. When one knows the level of power with a high degree of certainty; it is actual power.

If one does not know (or is at least more uncertain) about the power comparison, then one's behavior is likely to be very different. There is greater room for vagueness and maneuver. There can be very different responses depending upon the specific situation and the risk averseness of the actors, and there are likely to be more misjudgments resulting in costly mistakes. This situation, which is more common, places us in the realm of putative power.

variable and the empirical variable used in an analytical test is sufficiently large to cast doubt on the applicability of the analytical test.

Namely, a country's power is often equated with relative share of GDP and the closely related variable GNP in a number of quite disparate studies. These include Organski and Kugler (1980) and subsequent work in the power transition literature such as Kugler and Lemke (1996), as well as the Landis (2001) and Frank (2002) debate, Mearsheimer (2001), and Genna and Hiroi (2004).

Is a definition of power using an economic size variable adequate to the task of representing a country's power? It does not seem so after looking at Figure 1, and we will see evidence supporting that conclusion later. Power is more than economic power defined in terms of a country's GDP as a share of the world total GDP. GDP share is at best a reasonable measure of a country's economic power. A better measure of a country's power at minimum combines economic power with military power because those two variables only in part covary (Brecke, in preparation). They provide independent measures of a country's material capabilities and thus its putative power.

The project then becomes one of creating measures of economic power and military power. As stated earlier, another paper by me develops a measure of military power following Mearsheimer's (2001) definition of power as a combination of military forces and latent power. This paper develops the measure of economic power and combines the economic power with the military power variable into an index of country power using the simple equation:

$$\text{Country Power} = \text{Military Power} + \text{Economic Power}$$

As there are no theoretical reasons for favoring either type of power, they are weighted equally.

Economic Power

The definition of economic power is more complicated. We can easily formulate two alternative formulations of economic power:

Economic power in terms of relative economic size

or

Economic power in terms of both relative size and level of development

Which is better? Relative economic size measured in terms of relative share of GDP enjoys widespread use. It is easy to explain and, especially for recent decades, is easy to assemble and of relatively high quality. While relative GDP share may not be a good choice for questions relating to warfare, as a measure of economic power, it is not bad. The question is can we do better? Might alternative measures better capture a country's economic clout?

There are two aspects to a possible reformulation: Is relative GDP share a sufficient measure of economic size and should economic power include a measure of relative level of economic development?

Economic power should be determined in terms of the more detailed formulation wealth as well as size because a country that acquires GDP (GDP per capita * population) through wealth (GDP per capita) as opposed to size (population) also has significant clout in the international arena. Witness Germany or South Korea having influence in international arenas comparable to China or India. There clearly is more than one path possible for a country to have influence in international affairs, even if it does not have significant military power.

What we will almost certainly find is the different types of power, military and economic, will best apply to different situations.

Economic Power thus is:

Economic Power = Relative Economic Size * Relative Level of Development

To make that more concrete, the measured variables comprising Economic Power would be:

Relative Economic Size = GDP as a share of world GDP

Relative Economic Wealth = GDP per capita as a share of the highest GDP per capita at that time

These two admittedly crude measures possess the essential virtue for this endeavor that they can be calculated for a variety of countries and regions over a long timespan. We can thus compare a number of countries' relative economic power with our sense of who had economic power when through history. If the variable, in either formulation, corresponds with our intuitive sense, then we have at least face validity that the variable is appropriately capturing economic power.

But should we stop there? As a measure of economic size, GDP share is not everything. With regard to influence in the international arena, there exists a significant difference between countries of similarly sized GDPs whose economic

activities are almost entirely self-contained and those whose economies are open to and engaged with those of the rest of the world. The latter wield more influence.

Thus, we need a measure of economic size that includes the degree to which the country interacts with the rest of the world. Trade or investment flows capture this notion of interaction. However, given our constraint that we need a long time series, only trade flows are feasible. This leads to the following equation for economic size:

$$\text{Relative Economic Size} = (\text{GDP as a share of total GDP} + \text{Trade as a share of total trade}) / 2$$

where Trade = Imports + Exports and sheer size and interaction are weighted equally.

GDP as a share of world GDP and Trade as a share of total trade both range from effectively 0 to 1, with the practical upper limit of both much less than that. GDP per capita as a share of the highest GDP per capita at that time also ranges from near 0 to 1 with most of the range occupied.

If we look back at Figure 1, we can see both the breadth and limitations of the measure of power presented here. This measure of power is the material capabilities component of a country's putative power. More precisely, those material capabilities consist of military power and economic power directly and population size indirectly. Military power consists of combat power and latent power. Economic power consists of economic capacity and wealth. More precisely, and not on the diagram, combat power consists of relative navy size and relative army size. Latent power consists of relative population size and relative industrial production potential. Economic capacity is represented by relative economic size as defined above, and wealth is captured through the relative level of wealth of the country.

As complicated as Figure 1 may appear, it is also clear that many possible components of power are not included in this definition of power. It lacks some material capabilities such as natural resources and all of the non-material capabilities. The trade-off, naturally, is between parsimony (and comparative ease of effort) versus having the empirical variable adequately address or represent the theoretical variable. In comparison with relative GDP share or, to a lesser degree, the CINC (composite index of national capabilities) measure of the Correlates of War project, as measures of country power, the power variable developed here offers a much closer and more nuanced approximation to the theoretical variable, power.

As for why these measures, the reader must remember that a key consideration for this project is the timeframe over which the data are available. In order to test the

impact of long-term, possibly cyclic properties of the international system such as power preponderance or power bipolarity, we need a very long time frame in order to get sufficient sample size. This paper gives us an empirical measurement of power that combines a closer adherence to the theoretical variable power with a much longer time span, back to 1500 AD. The empirical variables are not perfect, but they are a reasonably close approximation, are of quite high quality, and generate different results than other widely-used measures. This paper will try to convince the reader of that.

The Empirical Measures

In order to make the variables of economic size and wealth described earlier, we need measures of GDP per capita, population, and trade. GDP per capita serves as the measure of wealth, even though it is an imperfect measure because it does not incorporate the distribution of wealth or income. A perhaps superior measure of wealth would be GDP per capita divided by the Gini coefficient, but there are very few estimates of the Gini coefficient for any country before 1950, making long time series impossible.

GDP as a measure of economic size is slightly more complicated. While it may seem obvious to use available GDP figures, for the purposes of this project that is not desirable. The problem is that the available figures pertain to the territories encompassed by current (late 20th century) boundaries. For the purpose of comparing the power of countries at any given year over the past few centuries, we want the GDP of the countries given the territories and populations at each year. For those countries whose borders did not change over the centuries such as Japan, it is not an issue, but for the long timespan of this project, borders have seldom remained fixed. Consequently, GDP has been calculated by multiplying GDP per capita by population where the population figure takes into account border changes.

Trade as the other measure of economic size is simply the sum of a country's imports and exports. One qualification about the imports and exports data deserves mention. Most of the available figures describe or measure special trade as opposed to general trade. The difference is that special trade does not include goods that are simply shipped through a country on their way to another country. Because of this, entrepôts such as the Netherlands appear smaller, trade-wise, than one might expect given the quantity of goods entering and leaving them.

The source of the GDP per capita data is Maddison (2003) and the associated Excel spreadsheets available for download once one has purchased the book. Maddison has made a serious attempt to derive cross-country-comparable GDP per Capita, Population, and GDP data for a large number of countries and regions that go back to 1500 AD (Maddison 1995, 1998, 2001, 2003).

The sources of population data include Maddison (2001, 2003), de Vries (1984), McEvedy and Jones (1978), and Martinsson (www.tacitus.nu/historical-atlas/population/germany.htm). These data go back as far as 1400 AD. Importantly, many of the McEvedy and Jones estimates take into account changes in the character and expanse of the countries as they have changed over the years for which we are concerned. Appendix A contains more detailed information about how the population data were assembled for each country. The criteria driving this effort were consistency of estimates, maximization of observations, and incorporation of boundary changes.

The sources of the trade data include Barbieri (2002 with the dataset available at [cow2.la.psu.edu/Affiliate Data/ITrade/ITrade.ZIP](http://cow2.la.psu.edu/Affiliate%20Data/ITrade/ITrade.ZIP)) for 1870 and later, *Statesman's Yearbook* (1864 to 1877 editions), Mulhall (1899, republished 1969), and Mitchell (2003, 2003, 2003). Extending the trade data back before 1870 entailed working through two related problems. The first involved merging the three sources of trade data. The second involved converting them to a single currency. The Mitchell data, which are by far the most comprehensive, are only in the local currencies of each country. The Mulhall data are in Pounds Sterling. The *Statesman's Yearbook* data are a varying mixture of local currency and Pounds. To achieve comparability for determining relative trade share, the data had to be converted into Pounds.

Unfortunately, even astonishingly, there does not appear to be a dataset of exchange rates for the period prior to 1870 that scholars believe is of high quality. There exists no equivalent to, for example, Bidwell's *Currency Conversion Tables: A Hundred Years of Change* (1970). The closest candidate is the exchange rates in the Polity II dataset available from ICPSR (Gurr, 1990). Those data come from a collection effort by the Correlates of War project done many years ago that was augmented by the Polity II researchers with data from Pick and Sedillot (1971).

While the Polity II/COW exchange rate data for the countries in this project are reasonably comprehensive, they were not sufficient. Consequently, I attempted to verify and augment them with data from Banks (1976) for France (the one country for which there are exchange rates before 1946), Shaw (1895), Officer (1996) for the UK-USA exchange rate, Cunningham (www.cyberussr.com/hcunn/gold-std.html), and the *Statesman's Yearbook* (1864-1877 editions).

Extensive effort was put into cross-checking the different trade data figures and exchange rates to ensure that the time series were consistent. Mitchell's data served as the starting point and would be used as far back as they would go. Then Mulhall's data would be employed to take the data back to 1720. The degree to which the two sources would smoothly splice into each other was much higher than I expected. When figures were available from the *Statesman's Yearbook* that were more precise than those from Mitchell (within rounding error), the more precise

figures were used. As Mitchell did not provide figures before 1880 for Germany, Mulhall's data were used for the period prior to 1870. To verify their accuracy, they were compared to a time series for 1836-1870 for the Zollverein created from data in the *Statesman's Yearbook* (1865 edition) and Hoffman (1965). Again, happily, the agreement between the sources was very high.

As the data collected for 1720 to 1870 were calculated in British Pounds, and the Barbieri data used for 1870 to 1992 were in US Dollars, I also cross-checked the two sets of data by recalculating the Pounds figures into Dollars and comparing them for their trajectories and for the year they overlap, 1870. Once again, the numbers dove-tailed very nicely.

One more aspect of the data must be mentioned. For each of the countries for each of the three variables: GDP per capita, population, and trade, there are years with no values. This occurs for GDP per capita before 1820, for population before 1820 if the Maddison data are used and more recent than that if the McEvedy and Jones data are used in order to have figures commensurate with changing political boundaries. For trade, the transition to annual data varies depending upon when the Mitchell data end. This ranges from 1790 for the United States to 1870 for Germany.

In the interest of maximizing the time span for which we have a measure of economic power, I opted to interpolate between observations when there are gaps. While this is far from a preferred option, I felt it was worth interpolating because it is not clear that we can ever do more than marginally better in terms of filling in the gaps unless there is a truly major data collection effort. Moreover, while the interpolated values possess error, that error is probably not very large on a percentage basis, especially for population. Fully aware of the problems of interpolation, I took two steps to minimize the error. The first was to maximize observations in order to minimize the length of the gaps.

The second was to minimize distortions caused by the interpolation process. Namely, a linear interpolation procedure such as the *ipolate* command in Stata creates a discontinuous change of slope at an observation. To eliminate that source of error, the common logarithm operator (\log_{10}) was applied to each of the data points, interpolation was done between the logged values, and then the entire series had the anti-log operator (10^x) applied. The resulting numbers served as the year-by-year figures.

Different Views of the Power Data

The first test for evaluating the validity of the resulting measure of combined country power must be whether it captures the periods for which observers believe

certain countries were the most powerful in the international system. If the measure fails this test, the exercise has been in vain. Figure 2 presents the results for three countries and one emperor (Charles V) that each had their moment in the sun.

Relative Power 1500-1945

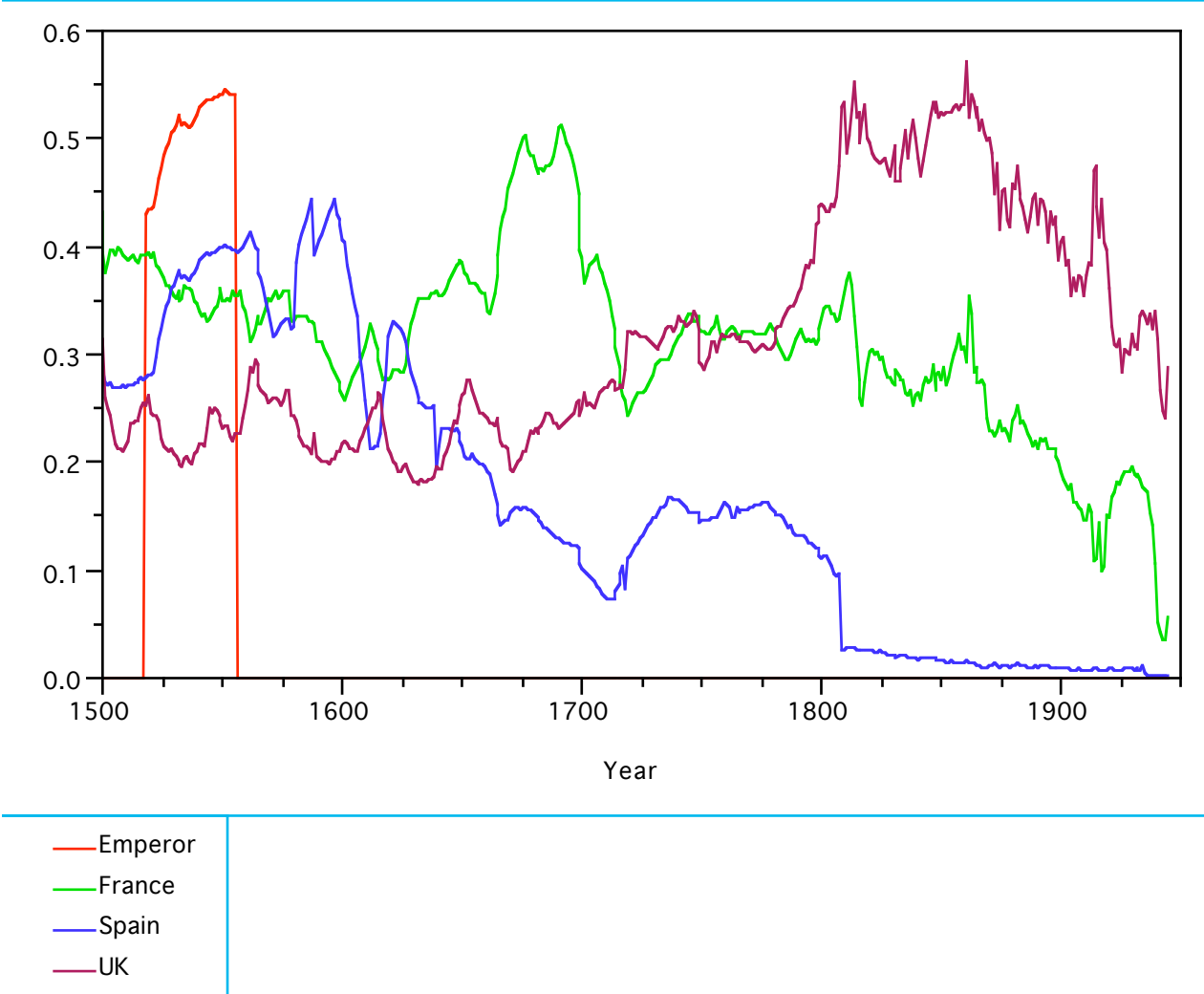
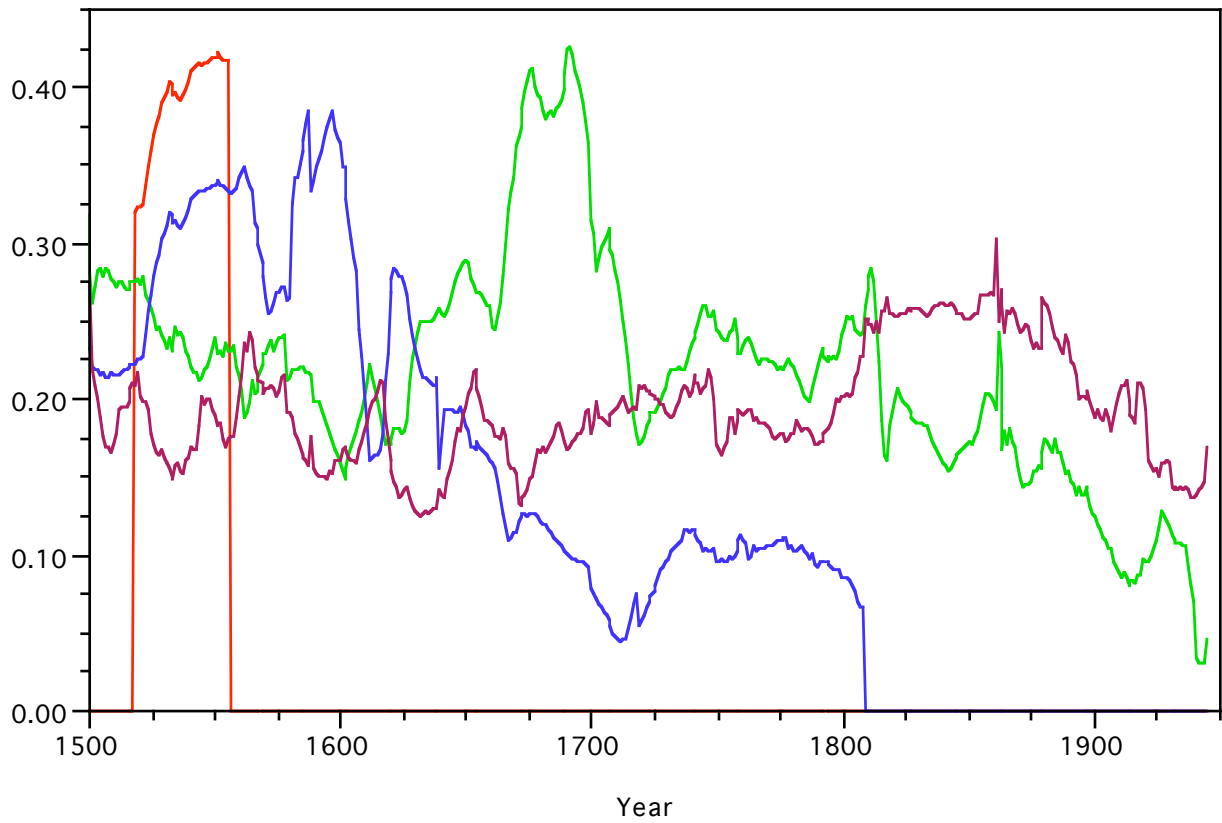


Figure 2

The periods of dominance of Charles V, Spain, France, and the United Kingdom, respectively, fit well with non-quantitative assessments.

The second issue to explore is whether military power and economic power follow the same trajectories. Figure 3 replicates Figure 2 except that it presents only military power. Figure 4 does the same except that it portrays only economic power.

Relative Military Power



- EmperorM
- FranceM
- SpainM
- UKM

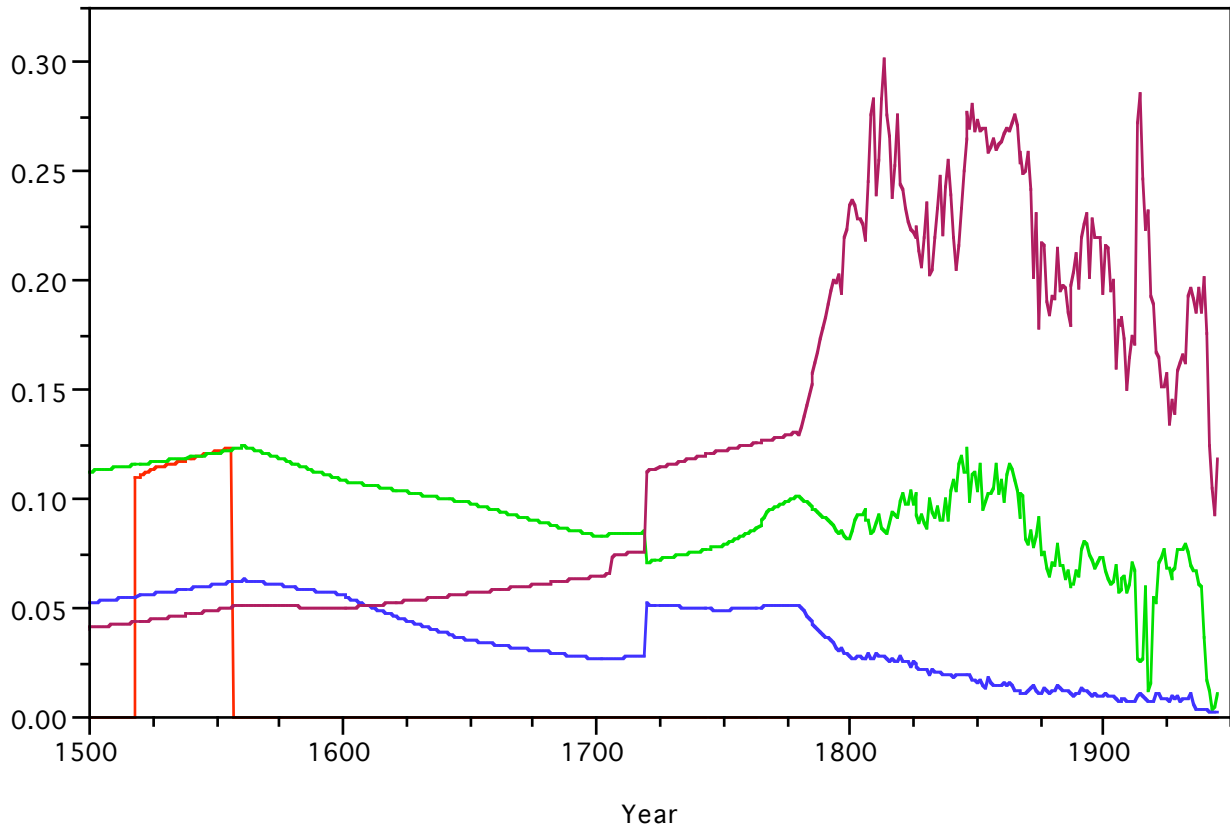
Figure 3

Comparison of the three figures demonstrates that military power is indeed distinct from economic power. As explained in my paper describing the military power measure, military power (or capabilities) consists of: relative seapower, relative landpower, relative population size, and relative industrial production potential. Seapower is measured in terms of the share of major naval combat vessels, and landpower is measured in terms of the share of field combat troops.

Britain's period of dominance in Figure 2 is unique in that it relies on economic power as much as military power, as can be seen by examination of Figures 3 and 4.

Figure 4

Relative Economic Power

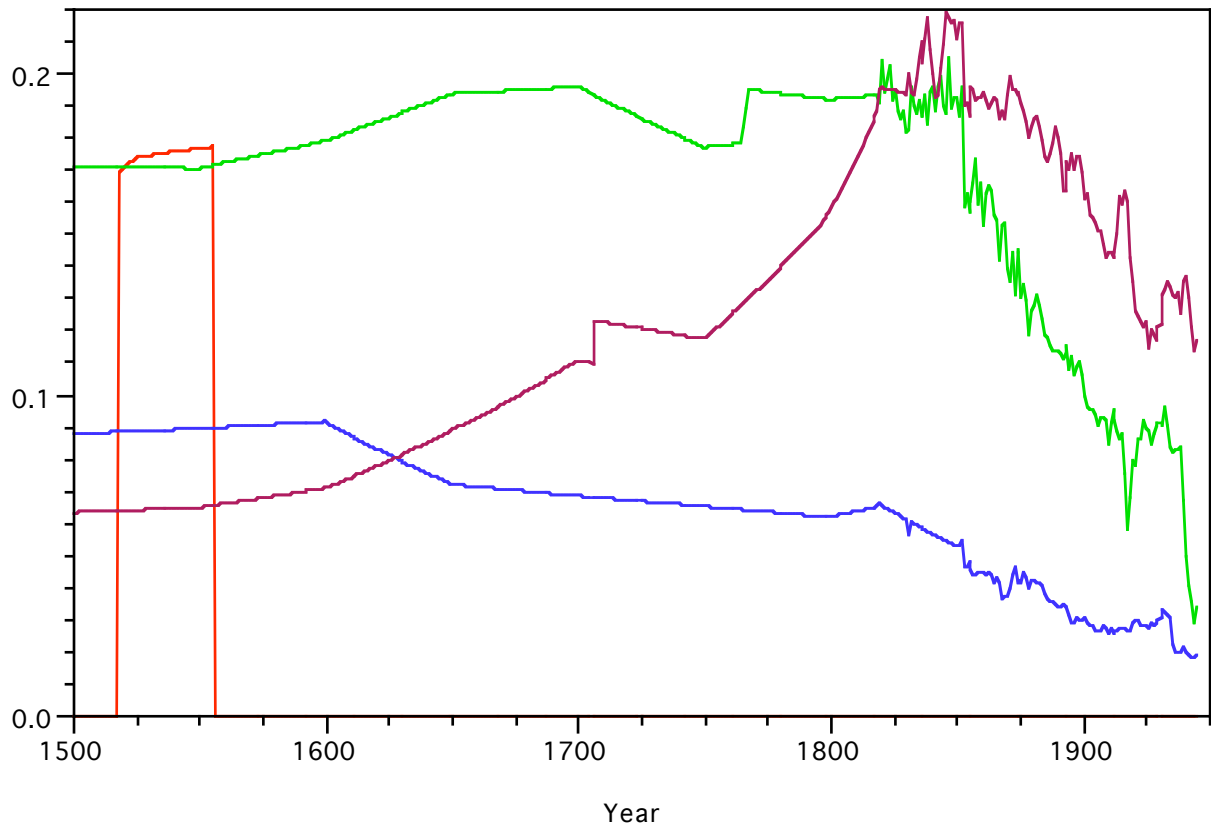


- EmperorE
- FranceE
- SpainE
- UKE

Given that GDP share is often used as a measure of country power, Figure 5 depicts the same set of countries using that variable. Clearly, the four measures portrayed in Figures 2-5 differ significantly from each other. While the ultimate test is which of the variables, when used to define the structure of the international system, provides the best explanatory power, to my eyes, the combined power measure in Figure 2 provides the most plausible description of the power relationships between countries of the four.

Figure 5

Relative GDP Share

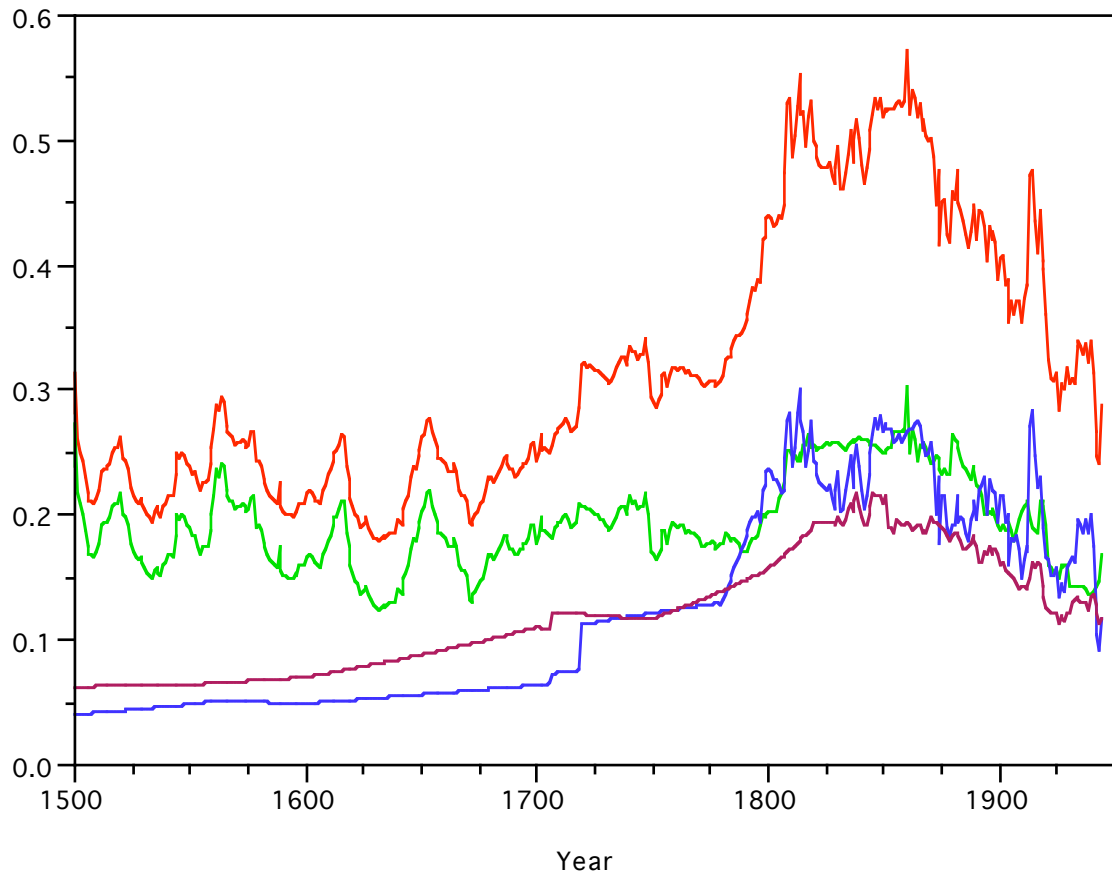


— EmperorGDP
— FranceGDP
— SpainGDP
— UKGDP

Another way to look at how the measures differ is to focus on individual countries. Figure 6 portrays the United Kingdom. The suffixes M, E, and GDP following UK signify military, economic, and GDP based power, respectively.

Figure 6

Different Measures of Power: United Kingdom

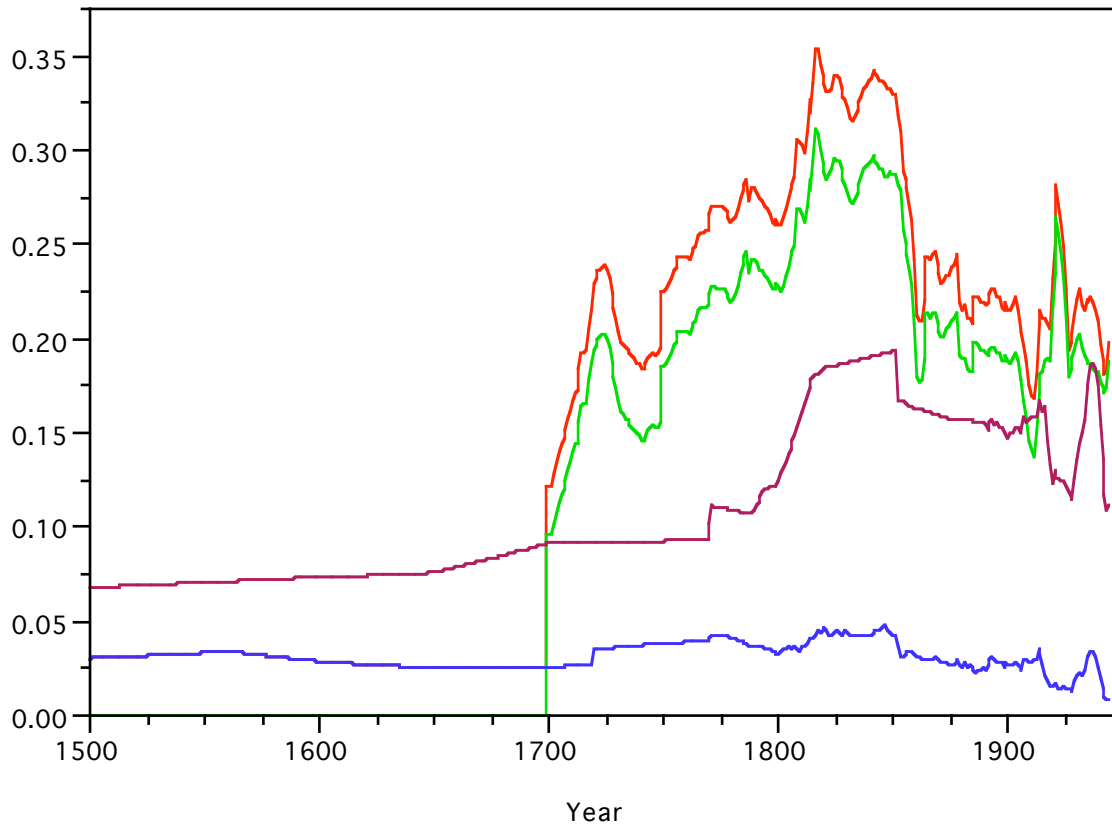


— UK
— UKM
— UKE
— UKGDP

Figure 7 presents the same measures for Russia. Of note is how Russia's total power is almost completely a function of its military power.

Figure 7

Different Measures of Power: Russia

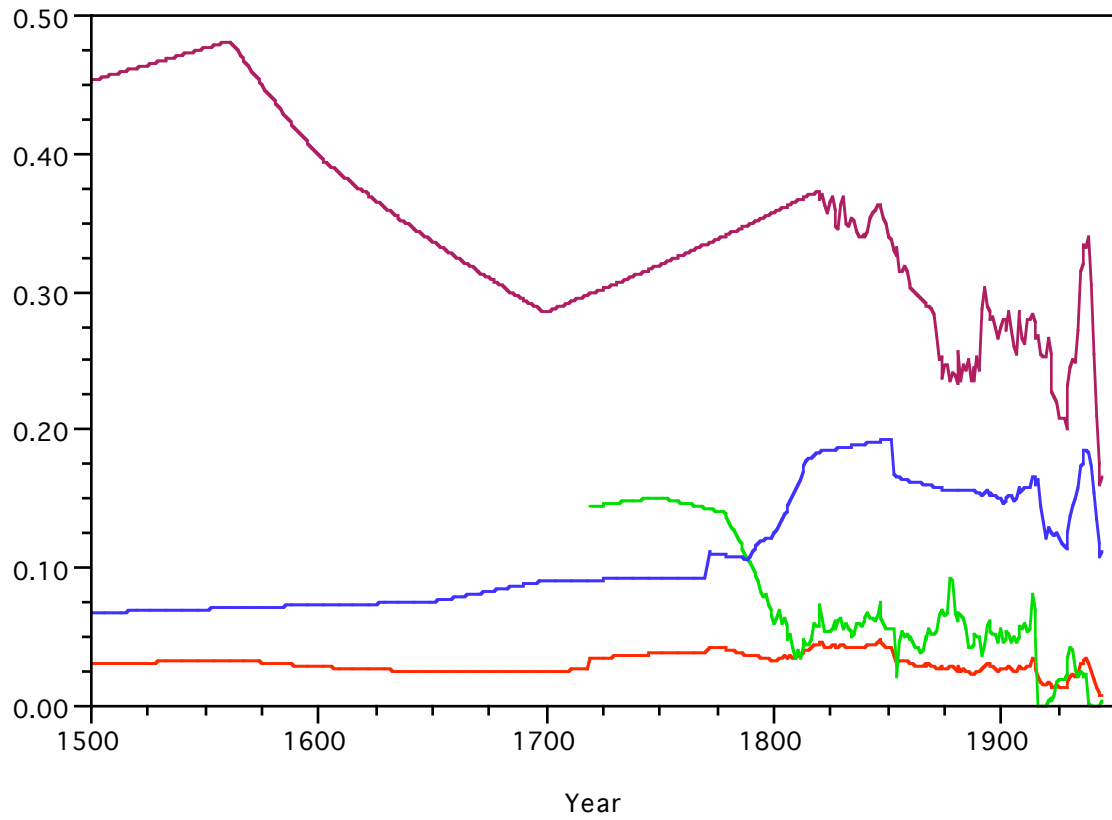


— Russia
— RussiaM
— RussiaE
— RussiaGDP

The reader may notice in Figure 6 that UKE and UKGDP are reasonably close to each other whereas RussiaGDP is much higher than RussiaE in Figure 7. Comparison of Figures 8 and 9 explains this difference. In Figure 8, Russia's GDP is fairly high (about 7 to 20 percent of the total), but its economic power number is pulled down by a significantly lower trade value (RussiaT) after about 1790 and, most importantly, because it is so poor (RussiaW). RussiaW is approximately half the value of UKW.

Figure 8

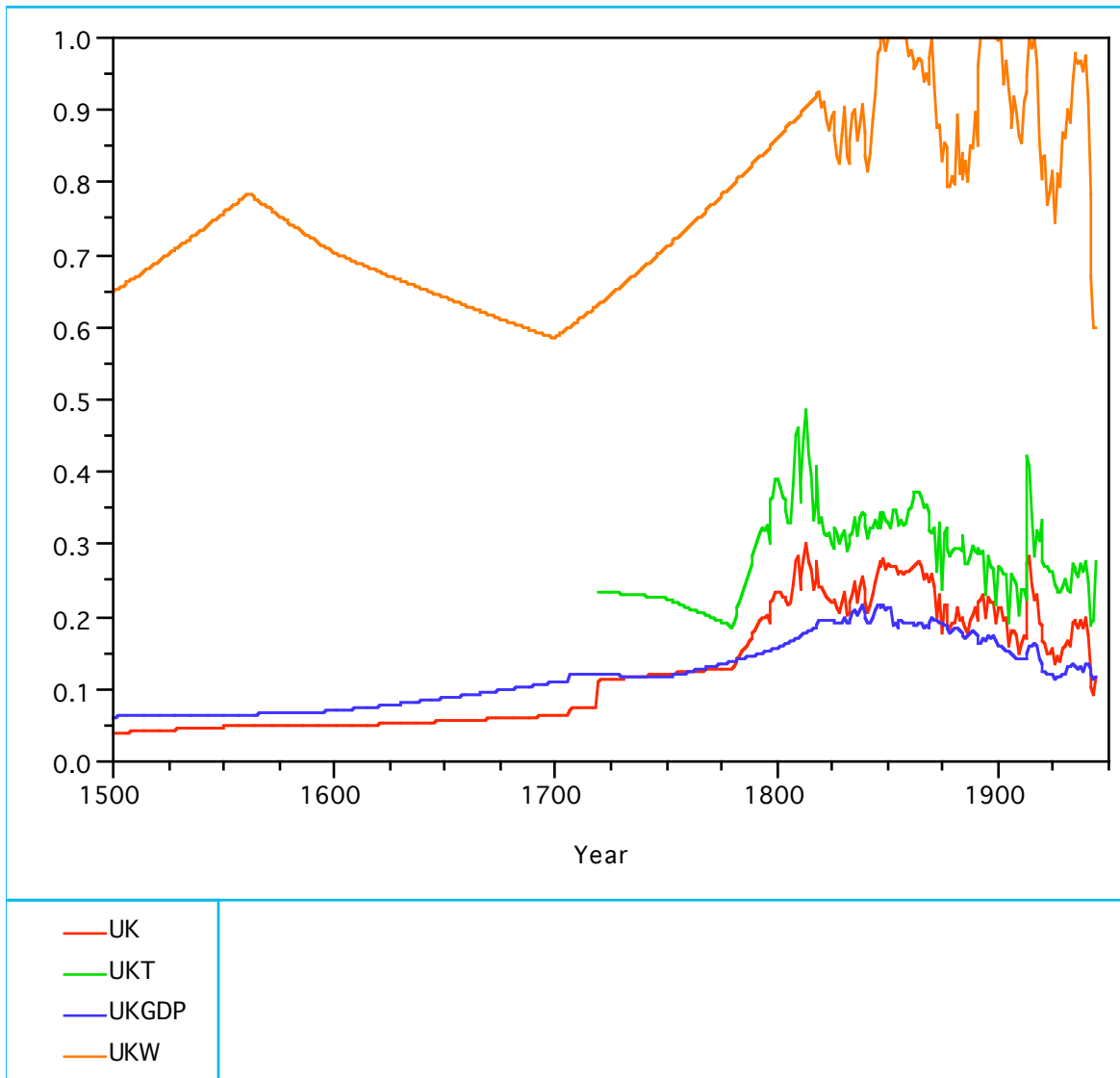
Components of Economic Power: Russia



- Russia
- RussiaT
- RussiaGDP
- RussiaW

Figure 9

Components of Economic Power: United Kingdom



Conclusion

Many more graphs of the data generated for this project can be created. These last eight figures simply give the reader some sense of how the components of power relate to each other. I have made a serious attempt to give the field of international relations a new dataset and measure of power. Naturally, the question is whether this effort was worth it. The answer will be yes if the data can help resolve various hypotheses about the relationship of international system structure and warfare, or, because the data allow us to distinguish between economic and military power, whether concepts such as “over-stretch” are supported by the empirical record. Preliminary analyses indicate that the extended time span and more focused design

of the measures presented here do result in rather clear-cut findings. Future work will determine whether that is indeed the case.

Appendix A: Choices for Country Population Data

France

McEvedy and Jones up to 1820, then Maddison. Maddison has more detail, thus it is preferable for the post-1820 period. McEvedy and Jones have more datapoints for the earlier period. They also distinguish between the French empire and France in terms of the current boundaries. We prefer the latter. Moreover, in this instance, the two data sources are virtually identical for those points (years) where both have an estimate for the period up to 1820. This makes splicing the two time series acceptable. Maddison uses McEvedy and Jones as his source when he does not have appropriate country-specific data.

Netherlands

McEvedy and Jones because it has more datapoints for earlier period where the two sources differ. In the later years the two sets of estimates are almost identical. Thus the complication of splicing is avoided even though a splice would be feasible as the two sets of estimates are very close to each other 2.33 million versus 2.35 million (20 thousand people) at the ostensible splicing point, 1820.

Austria

McEvedy and Jones because it incorporates the Hapsburg Empire, which is the political unit of interest for the power index.

Germany

McEvedy and Jones from 1700 because it incorporates the significant changes in political boundaries of what scholars identify as Prussia/Germany. Martinsson from 1640 to 1700 for Prussia.

Russia

McEvedy and Jones because it incorporates the expansion of the Russian empire.

United States

Maddison.

United Kingdom

McEvedy and Jones up to 1819, then Maddison. They have more detail for the earlier period.

Japan

Maddison. The period we care about is after 1820. The Maddison and McEvedy and Jones times series are also very similar following 1850.

Italy

Maddison. The period we care about is after 1820. The Maddison and McEvedy and Jones times series are also very similar following 1850.

Portugal

de Vries from 1500 to 1819, as he has more datapoints for that timeframe, and then Maddison.

Sweden

Maddison.

Spain

de Vries for the period prior to 1820 as he has more datapoints than Maddison and is reasonably close to McEvedy and Jones. Maddison for 1820 and later. Maddison seems too high for 1650 to 1820.

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