Not Just Guns or Butter, but What Came First—Guns or Butter? Introducing GVAR to International Relations

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Abstract

Power remains one of the crucial and most studied concepts in International Relations. In recent decades a prevailing notion became present in the literature explaining that the economic power is the most fundamental type of power—a sort of a prerequisite for all other forms of power (military, political, cultural). Yet, such an assumption has never been properly tested. Therefore, to test this assumption, the paper introduces a new time-series method to Political Science—Global Vector Auto-regression. The method enables the researcher to perform big-n and big-t hypotheses tests. In this paper, we test if economic power is a prerequisite for military power. We use four variables from National Material Capabilities from the Correlates of War dataset, where two are used as proxies for measuring economic power, and two are used to measure military power. We run the analysis for two separate time-spends: first from 1871 through 1913, and from 1955 through 2012. Our inquiry suggests that the role of the economy has changed through history. Namely, in 19th century it was the military power that drove (Granger-caused) the economy; yet, since 1955 the roles are reversed. Finally, we identify future research projects how to test also the relations between the remaining two power factors (political and cultural).

Keywords— time series; IPE; GVAR; IR

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Power: Assumed but Untested

"Power is the ultimate aphrodisiac"

Kissinger (1973)

Since the dawn of social and political science, *power* has been a key concept of multiple research projects (Lasswell and Kaplan 1950). In recent decades a prevailing notion became present in international relations, which sometimes takes the shape of a latent assumption (Kennedy 1989; Luttwak 1990; Fukuyama 1992; Nau 1995; Kirshner 1997; Gilpin 2001; Brooks 2005; Ikenberry 2011). The argument is neatly summed by Organski, who claimed that economic power is a prerequisite for all other power capabilities: without a strong economy a dominant state stagnates and declines (Organski 1958, 299-306). However, this claim has never been properly tested. For instance, Mearsheimer (2001, Ch. 3) dedicates a whole chapter to explain how latent power matters to military power,[1]. Yet his explanation remains untested.

We believe that if the literature offers assumptions about the nature of power while proposing causal mechanisms between power factors—military, economic, political and cultural (Mann 1986)—then it should also provide empirical evidence about those. We focus one of these assumptions, particularly, that economic power is a *prerequisite* of all other power factors.

This paper contributes to the literature by introducing Global Vector Autoregression (GVAR) methods to international relations. While panel-data methods handle well numerous panels (countries) within relatively short time spans, and time-series methods do the same but for longer time spans but for small panels (usually just one), GVAR perform statistically well with both big N and long T. In particularly, we show how Granger-causality tests (C. W. J. Granger 1969) within the framework of GVAR methods should shed some light on the power prerequisite assumption. In this paper we focus solely on the (Granger) causal relation between *economic* and *military* powers. We hypothesize that pre-WWI it was military power that Granger-caused economic power—greater military led to greater economic power. Conversely, we expect that post WWII economic power Granger-caused military power.

The paper proceeds as follows. First, section I discusses the concept of power by particularly focusing on the relationship between economic and military power. In section II we present actual time-series data on economic and military power for the maximum possible number of available panels. The section also shows Granger-causality tests within the GVAR framework. We also show some simulations. Finally in section V we propose future research avenues regarding this scientific inquiry.

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I. Conceptualizing Power

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II. Introducing the GVAR Methodology

GVAR was introduced in 2004 (M. Pesaran, Schuermann, and S. M. Weiner 2004). It "was developed in the aftermath of the 1997 Asian financial crisis to quantify the effects of macroeconomic developments on the losses of major financial institutions." Its main feature is that the GVAR method "take[s] into account the various interlinkages in the global economy in the context of a truly multicountry setting" (H. Pesaran, Schuermann, and S. Weiner 2004, 139) by incorporating a large number of panels ("big N") for long time-spans ("big T"). While GVAR has been widely used in economics (Favero 2013; Mauro, Filippo, and Pesaran 2013; Chudik and Pesaran 2016; Eickmeier and Ng 2015) its characteristics are also appealing for political science. Therefore, it is ideal for testing such an assumption as relations between economic and military power in a truly global setting. Yet, to our knowledge, the GVAR method has not been used or introduced in political science so far. In the rest of the paper we do so by rephrasing the famous dilemma about whether governments should allocate resources to finance "guns" (military power) or "butter" (economic power or economic development in general).

Global vector auto-regressive models (GVAR) are a special category of vector auto-regressive models (VAR). Following Box-Steffensmeier et al. (2014, 164), define a VAR model as follows,

$$\mathbf{x}_{it} = \boldsymbol{\alpha}_i + \boldsymbol{\Phi}_i \mathbf{x}_{i,t-p} + \mathbf{u}_{it} \tag{1}$$

where $\mathbf{x}_{it}$ is a $k_i \times 1$ vector of endogenous variables which are lagged p times on the right-hand side, and where $E(\mathbf{u}_{it}) = 0$. Now, following Mauro and Pesaran (2013, 14), define a GVAR model with p lags for country i as follows,

$$\mathbf{x}_{it} = \boldsymbol{\alpha}_i + \boldsymbol{\Phi}_i \mathbf{x}_{i,t-p} + \boldsymbol{\Lambda}_{1i} \mathbf{W}_{x,t} + \boldsymbol{\Lambda}_{2i} \mathbf{W}_{x,t-p} + \mathbf{u}_{it} \tag{2}$$

where $\mathbf{x}_{it}$ is a $k_i \times 1$ vector of domestic (i.e. endogenous) variables, $\mathbf{W}_t$ is a $k_i \times 1$ vector of weakly-exogenous foreign variables, and $\mathbf{u}_{it}$ is a serially uncorrelated and cross-sectionally weakly dependent process. As it becomes apparent, the inclusion of foreign variables $\mathbf{W}_t$ in Equation 2 is one of the main characteristics of the GVAR approach, and the main difference with the VAR equation described in Equation 1. In simple, the Global vector autoregressive GVAR model in Equation 2 explains $\mathbf{x}_{i,t}$ as a function of past values $\mathbf{x}_{i,t-p}$ lagged p times, at the same time that it weights these dynamics by weakly-exogenous foreign variables $\mathbf{W}_{t-p}$ (weights which are captured by parameters $\mathbf{\Lambda}_{ni}$). Note that the exogeneity of x is obtained by multiplying this term by the weights matrix $\mathbf{W}_t$, both with its current values and p lagged values.

Since we are substantively interested in weather "guns" *cause* "butter" or the other way around, in this paper we estimate country-specific bivariate Granger-causality tests within the GVAR framework.[2] The Granger-causality method was introduced by C. Granger (1969) and seeks to investigate if some variable X (Granger) "causes" another variable Y, or the other way around. A variable X is said to "Granger-cause" Y if predictions of Y based on lagged values of Y and lagged values of X perform better than explaining Y just with its own past values.

Since Granger-causality tests are usually estimated via VAR equations (Equation 1) we now derive the Granger-causality test within the GVAR framework. The substantive advantage of GVAR Granger-causality tests over regular Granger-causality tests is that estimates are weighted by the global economy ($\mathbf{W}_t$ in Equation 2), situating the domestic dynamics within the global context. As explained in (International Monetary Fund 2016, 17), "[t]hrough the use of foreign variables, the GVAR is able to account for bilateral inter-relationships amongst countries, and therefore control for spillovers on the basis of cross-country exposure." More formally, we estimate a GVAR Granger-causality system for every country i with p lags as shown in Equation 3. Likewise, note that the exogeneity of x and y is obtained by multiplying each by the weights matrix $\mathbf{W}_t$, both with its current values and p lags.

$$
\begin{aligned}
\mathbf{x}_{it} &= \boldsymbol{\alpha}_i + \mathbf{\Phi}_{1i}\mathbf{y}_{i,t-p} + \mathbf{\Phi}_{2i}\mathbf{x}_{i,t-p} + \mathbf{\Lambda}_{1i}\mathbf{W}_{x,t} + \mathbf{\Lambda}_{2i}\mathbf{W}_{x,t-p} + \mathbf{\Lambda}_{3i}\mathbf{W}_{y,t} + \mathbf{\Lambda}_{4i}\mathbf{W}_{y,t-p} + \mathbf{u}_{it} \\
\mathbf{y}_{it} &= \boldsymbol{\alpha}_i + \mathbf{\Phi}_{1i}\mathbf{x}_{i,t-p} + \mathbf{\Phi}_{2i}\mathbf{y}_{i,t-p} + \mathbf{\Lambda}_{1i}\mathbf{W}_{y,t} + \mathbf{\Lambda}_{2i}\mathbf{W}_{y,t-p} + \mathbf{\Lambda}_{3i}\mathbf{W}_{x,t} + \mathbf{\Lambda}_{4i}\mathbf{W}_{x,t-p} + \mathbf{u}_{it}
\end{aligned}
\tag{3}
$$

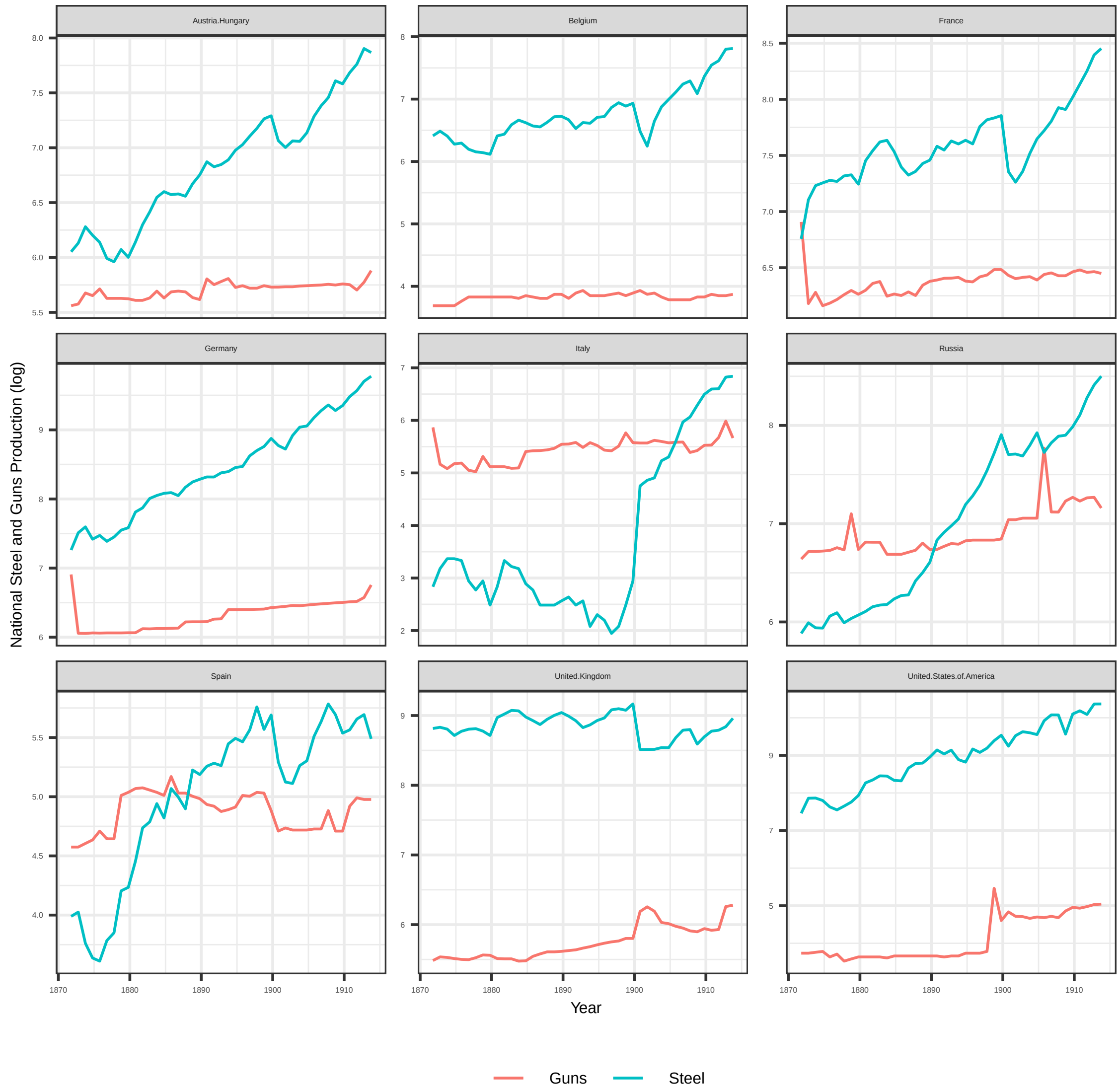

Figure 1: National Steel and Guns Production (log), 1871-1913.
Note: *Variables are "milper" and "irst." Both were obtained from Singer, Bremer, and Stuckey (1972).*

III. Data

We operationalize military and economic power using variables from the Correlates of War Project, particularly, the National Material Capabilities dataset (Singer, Bremer, and Stuckey 1972).[3] Namely, to proxy for military power we use the "military personnel" variable, and to proxy for economic power we use the "iron and steel production" variable. Let the former be $\mathbf{x}_{it}$ and the latter be $\mathbf{y}_{it}$ in Equation 3.

To construct the weight matrix $\mathbf{W}$ we also use *Bilateral Trade* data from the same database that is used for the foreign (or structural) variables.(Barbieri and O. M. Keshk 2016)

Our initial results are ambiguous, where the first hypothesis is confirmed, while the second one is not. This means that military power is the prerequisite for economic power not only in 19th century, but also today. Still, more research is necessary on the subject. Yet, what matters at this point is that the results attest that we should not take any assumption for granted.

Particularly, the vector $\mathbf{x}_{it}$ contains country-year levels of "military personnel," while vector $\mathbf{y}_{it}$ contains country-year levels of "iron and steel production."

.[4] The dataset covers all countries in the world between 1816-2012.

We have truncated this time period into two parts, each related to a specific hypothesis. Namely, the first period is between 1871 and 1913. The time spread is rather obvious—unification of Germany and the beginning of World War I. The Zeitgeist of that period is neatly summed up in the infamous Bismarck's "Blood and Iron" speech *Excerpt from Bismarck's "Blood and Iron" Speech"* (1862, 1862):

> Germany is not looking to Prussia's liberalism, but to its power; Bavaria, Württemberg, Baden may indulge liberalism, and yet no one will assign them Prussia's role; Prussia has to coalesce and concentrate its power for the opportune moment, which has already been missed several times; Prussia's borders according to the Vienna Treaties are not favorable for a healthy, vital state; it is not by speeches and majority resolutions that the great questions of the time are decided—that was the big mistake of 1848 and 1849—but by iron and blood.

As history has shown, by iron he did not mean economy, but military power (Hobsbawm 1987; Kissinger 1994; Schroeder 1976). Therefore, our hypotheses are:

Hypothesis 1. *Between 1871 and 1913 military power Granger causes economic power.*

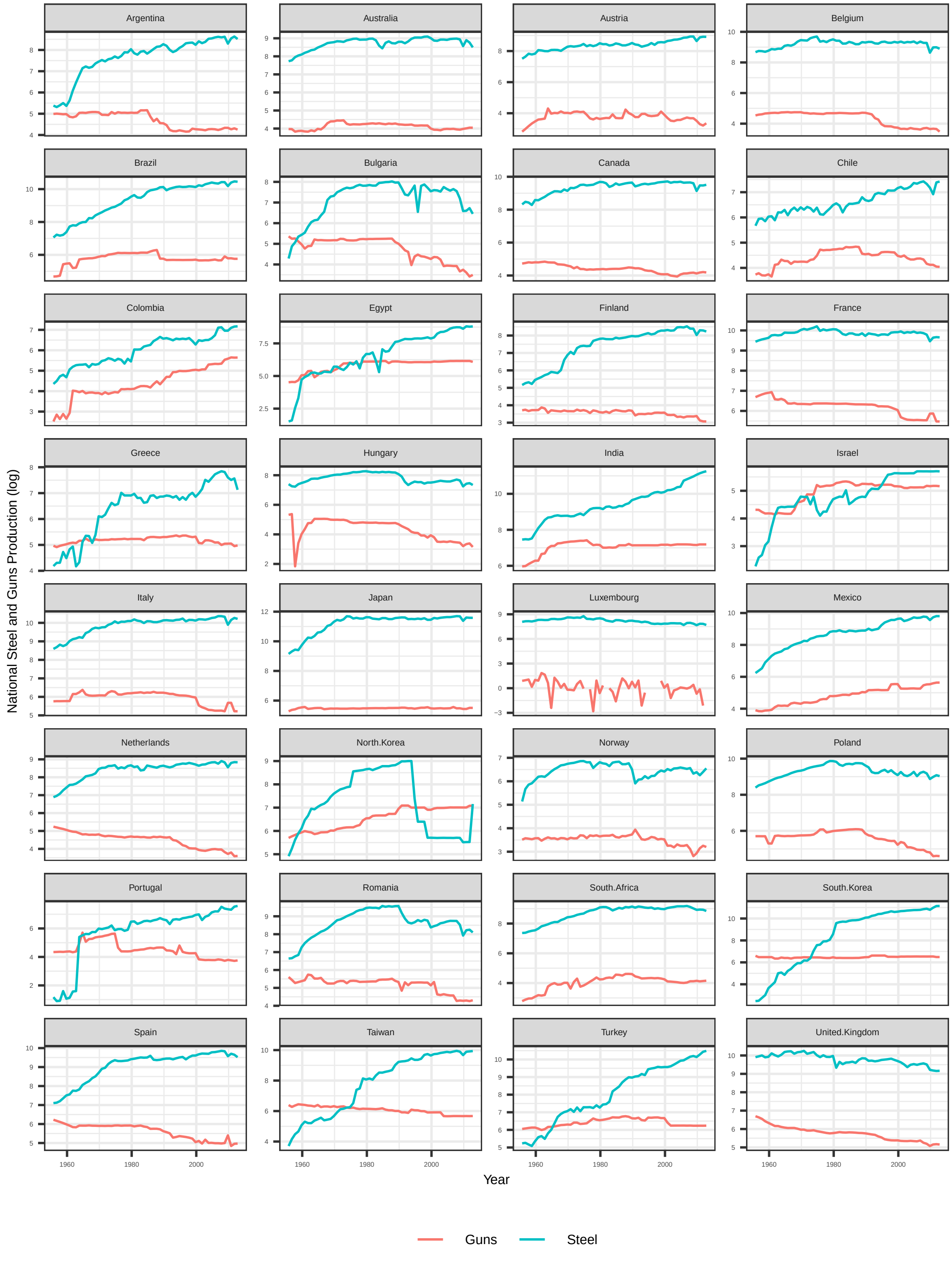

Figure 2: National Steel and Guns Production (log), 1955-2012.
Note: *Variables are "milper" and "irst." Both were obtained from Singer, Bremer, and Stuckey (1972).*

In the future versions of the paper we may include only the very few numbers of states, whose data goes all the way back to 1816. Furthermore, we also may take advantage of imputing some data points for some states in order to enhance the number of states also in this period—for both versions 1816-1913 and 1871-1913.

Figure 1 portrays the values of the two variables used in our model by country between 1871 and 1913. The second period of our analysis takes place between 1955 and 2012. The beginning of this framework was generated based on the balance between the competing objective of time length and amount of states included in our model. As stated earlier, here we have opted more in favor of greater time span, whereas in the future iterations and as a sort of robustness checks, we will also use a different starting points, such as: 1971 (Nixon Shock) or 1973 (the end of Bretton Woods System), 1946 (the end of World War II), 1991 (the end of Cold War), and 1980 (oil crisis). Moreover, we will also consider imputation in all these formats.

Nevertheless, we suspect that the nature of relations between economic and military power would be reversed in this period. This is not due to the technological advancement of the military, but rather due to the changed nature of the economy. The latter became finance driven, which is detached from the real economy. Namely, exponential growth of trade, Foreign Direct Investments, and monetary transactions altogether all attribute to the growth of monetary velocity (Cagan and Schwartz 1987), the creation of international banking consortia—by 1971 90% of 50 world's biggest banks had become a part of broader and larger conglomerates (Ganoe 1972), and "by the end of 1970s financial flow size dwarfed trade flows by 25:1 and they were much more volatile" (Gilpin 2011) therefore, today 99% of all financial transactions are short term-speculative transactions. All this contributes to the fact that the economy is not only adjacent to the strategic interactions of states, but in fact has become its own domain of power relations among states.[5] Subsequently, we hypothesize:

Hypothesis 2. *Between 1955 and 2012 economic power Granger causes military power.*

Figure 2 displays the values of the two variables used in our model by country from 1955 and 2012.

When it comes to the foreign or global variable that determines the structure of international relations in our model, we have opted for dyadic trade data, which is available also for the period in 19th century. This variable was constructed by the same project but in the Trade dataset (Barbieri, Keshk, and Pollins 2009; Barbieri and O. Keshk 2016)[6] and was used to construct the weight matrix $\mathbf{W}$. The matrix is a square matrix which has all K countries in both its columns and rows with zeros as diagonal elements. The matrix represents bilateral trade among two countries measured by the *flow1* and the *flow2* variables. The former measures imports from a country (*importer1*) to another country (*importer2*), and the latter measures the reverse dyad, i.e. imports from *importer2* to *importer1*. More formally, $\mathbf{W}$ contains t sub-matrices (one sub-matrix per year) with dimensions $k \times k$ for a total of $\mathbf{K}$ countries such that,

$$\mathbf{W}_t = \begin{array}{cc} & \begin{array}{cccccc} \mathbf{i}_1 & \mathbf{i}_2 & \mathbf{i}_3 & \dots & \mathbf{i}_K \end{array} \\ \begin{array}{c} \mathbf{i}_1 \\ \mathbf{i}_2 \\ \mathbf{i}_3 \\ \vdots \\ \mathbf{i}_K \end{array} & \begin{bmatrix} 0 & f_{21} & f_{31} & \dots & i_{K1} \\ f_{12} & 0 & f_{32} & \dots & i_{K2} \\ f_{13} & f_{23} & 0 & \dots & i_{K3} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ f_{1K} & f_{2K} & f_{3K} & \dots & i_{KK} \end{bmatrix} \end{array}$$

Every W_t matrix weights all K country-specific Granger regressions described in Equation 3. Every K system is weighted by the other $K-1$ countries. And as Equation 3 shows, the GVAR methodology also considers p lags of the $\mathbf{W}$ matrix. Following the literature on Granger-causality tests we focus our attention model-specific f-tests (one per country) which tests if all variables in the model are jointly significant. Then null is that there is no Granger causality.

IV. Results

Figure 3 shows country-specific p-values of the Granger-causality f-tests obtained when fitting Equation 3 (detailed results shown in the Appendix section, particularly Table A1, Table A2 and Table A3).

The plot shows that during the $1871-1913$ period, in 44% of the countries economic power Granger-caused military power. Yet, interestingly, this percentage drops to 38% and 33% for the great power during the $1955-2012$ period. On the other hand, in the same second period in 46% of the countries military power Granger-caused economic power.

Hence, we have failed to reject 1, which was expected. However, our results have rejected 2, which was not. Therefore, the results speak in favor of persistent dominance of the military power among the power factors.

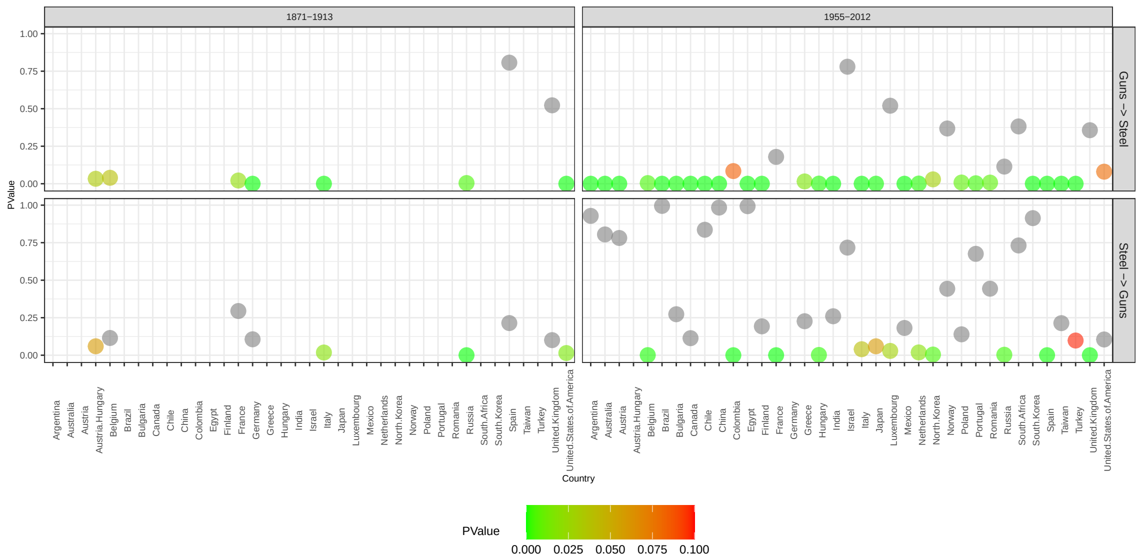

Figure 3: P-Values of the Country-specific Granger-causality F-Tests, 1871-2012.
Note: *Plot shows country-specific p-values of the Granger-causality f-tests obtained when fitting Equation 3 (detailed results shown in Table A1, Table A2 and Table A3). The plot shows that during the 1871-1913 period, in 44% of the countries, steel Granger-caused guns. This porcentage changes to 38% and to 33% for the hegemonic countries during the 1955-2012 period.*

As such, military power has passed the most likely and the most difficult case test. Namely, the first period presents itself as the most likely case for the military power be the prerequisite for the economic power. Furthermore, the second period can be labeled as the most difficult case for the military power. And conversely for the economic power. Its dominance was rejected by both the least likely and the most likely case. Where the second period presents the most likely case and the first one the most difficult case.[7]

V. Discussion

The present research project makes two contributions to the broader International Relations literature. First, we test the general assumption that the economic power is the prerequisite for all other power factors. Second, we introduce to Political Science a new time series method—GVAR.

Our preliminary results indicate that the assumption of economic power dominance, which is so often and with ease made by scholars, is at least dubious, and flawed at best. In fact, the military power Granger-causes economic power in both periods—19th and 20th century.

However, future iterations of this project are necessary to be fully confident in such a result and conclusion. First, we need to enhance our model to also include military expenditures and energy consumption. Second, robustness checks using different time frames and imputation needs to be performed as well. Third, a comparison of results using GVAR with PVAR method would be beneficial. Namely, the amount of countries whose data is available for 19th century would still be classified as a small N. Thus, PVAR would also be appropriate method to be used for this period with small N. Consequently, we would expect that for 19th century conclusions from PVAR and GVAR would be the same, whereas for 20th century the conclusions would differ due to the big N in that period.

References

Barbieri, Katherine, and Omar Keshk. 2016. "Correlates of War Project Trade Data Set Codebook, Version 4.0." http://correlatesofwar.org.

Barbieri, Katherine, Omar Keshk, and Brian Pollins. 2009. "TRADING DATA: Evaluating our Assumptions and Coding Rules." *Conflict Management and Peace Science* 26 (5): 471–491.

Barbieri, Katherine, and Omar M.G.Omar Keshk. 2016. *Correlates of War Project Trade Data Set Codebook, Version 4.0. Online.*

Blackwill, Robert D., and Jennifer M. Harris. 2016. *War by Other Means: Geoeconomics and Statecraft.* Cambridge: Harvard University Press.

Box-Steffensmeier, Janet, John Freeman, Matthew Hitt, and Jon Pevehouse. 2014. *Time Series Analysis for the Social Sciences.* Cambridge University Press.

Brooks, Stephen G. 2005. *Producing security: Multinational corporations, globalization, and the changing calculus of conflict.* Princeton: Princeton University Press.

Cagan, Phillip, and Anna J. Schwartz. 1987. "Has the growth of money substitutes hindered monetary policy?" In *Money in Historical Perspective,* edited by Anna J. Schwartz, 209–33. Chicago: University of Chicago Press.

Chudik, Alexander, and M.Hashem Pesaran. 2016. "Theory and practice of GVAR modelling." *Journal of Economic Surveys* 30 (1): 165–97.

Csurgai, Gyula. 2009. "Sovereign Wealth Funds: Strategies of Geo-economic Power Projections." In *Globalization and the Reform of the International Banking and Monetary System,* edited by Otto Hieronymi. London: Palgrave.

Eickmeier, Sandra, and Tim Ng. 2015. "How do US Credit Supply Shocks Propagate Internationally? A GVAR Approach." *European Economic Review* 74:128–145.

Elster, Jon. 1976. "Some Conceptual Problems in Political Theory." In *Power and Political Theory,* edited by Brian Barry, 245–70. New York: Willey.

Excerpt from Bismarck's "Blood and Iron" Speech". 1862.

Favero, Carlo. 2013. "Modelling and Forecasting Government Bond Spreads in the Euro Area: A GVAR Model." *Journal of Econometrics* 177 (2): 343–356.

Fukuyama, Francis. 1992. *The End of History and the Last Man.* New York: Free Press.

Ganoe, Charles. 1972. "Banking Consortia: are they here to stay?" *Columbia Journal of World Business* 7 (4): 517.

Gilpin, Robert. 2001. *Global Political Economy Understanding the International Economic Order.* Princeton: Princeton University Press.

———. 2011. *Global political economy: Understanding the International Economic Order.* Princeton: Princeton University Press.

Granger, Clive. 1969. "Investigating Causal Relations by Econometric Models and Cross-spectral Methods." *Econometrica* 37 (3): 424.

Granger, Clive W. J. 1969. "Investigating causal relations by econometric models and cross-spectral methods." *Econometrica* 37 (3): 424–38.

Hobsbawm, Eric. 1987. *The Age of Empire: 1875-1914.* New York: Pantheon Books.

Ikenberry, G. John. 2011. *Liberal Leviathan: The origins, crisis, and transformation of the American world order.* Princeton: Princeton University Press.

International Monetary Fund. 2016. "Cross-Country Report on Spillovers: Selected Issues."

Kennedy, Paul. 1989. *The Rise and Fall of the Great Powers: Economic Change and Military Conflict from 1500 to 2000.* New York: Vintage Books.

Kirshner, Jonathan. 1997. *Currency and coercion: the political economy of international monetary power.* Princeton: Princeton University Press.

Kissinger, Henry. 1973. "The Sayings of Secretary Henry." http://query.nytimes.com/gst/abstract.html?res=9F07E4DF1439E73ABC4051DFB6678388669EDE.

———. 1994. *Diplomacy.* New York: Simon / Schuster.

Lasswell, Harold D., and Abraham Kaplan. 1950. *Power and Society A Framework for Political Inquiry.* New Haven: Yale University Press.

Levy, Jack. 2008. “Case Studies: Types, Designs, and Logics of Inference.” *Conflict Management and Peace Science* 25 (1): 1–18.

Luttwak, Edward N. 1990. “From Geopolitics to Geo-Economics: Logic of Conflict, Grammar of Commerce.” *The National Interest* 20:17–23.

Mann, Michael. 1986. *The sources of social power.* Vol. 1. Cambridge: Cambridge University Press.

Mauro, Di, Filippo, and M.Hashem Pesaran, eds. 2013. *The GVAR handbook: Structure and applications of a macro model of the global economy for policy analysis.* Oxford: Oxford University Press Oxford.

Mauro, Filippo di, and Hashem Pesaran. 2013. *The GVAR Handbook: Structure and Applications of a Macro Model of the Global Economy for Policy Analysis.* 1st, edited by Filippo di Mauro and Hashem Pesaran. Oxford University Press.

Mearsheimer, John J. 2001. *The tragedy of great power politics.* New York: WW Norton & Company.

Nau, Henry R. 1995. *Trade and security: U.S. policies at cross-purposes.* Washington: American Enterprise Institute.

Organski, Abramo F. K. 1958. *World politics.* New York: Knopf.

Pesaran, Hashem, Til Schuermann, and Scott Weiner. 2004. “Modeling Regional Interdependencies Using a Global Error-Correcting Macroeconometric Model.” *Journal of Business & Economic Statistics* 22 (2): 129–162.

Pesaran, M.Hashem, Til Schuermann, and Scott M. Weiner. 2004. “Modeling regional interdependencies using a global error-correcting macroeconometric model.” *Journal of Business & Economic Statistics* 22 (2): 129–62.

Schroeder, Paul W. 1976. “Alliances, 1815-1945: Weapons of Power and Tools of Management.” In *Historical Dimensions of National Security Problems,* edited by Klaus Knorr, 227–256. Lawrence: University of Kansas Press.

Singer, David, Stuart Bremer, and John Stuckey. 1972. *Capability Distribution, Uncertainty, and Major Power War, 1820-1965,* edited by Bruce Russett, 19–48. Sage.

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VI. Appendix

I. Appendix

Table A1: *Bivariate Gobal Granger Causality Tests of the World Political Economy,* 1871-1913

	Granger Relationship	F-Test	P-Value	DF	Adjusted R-sq	Lags
Austria-Hungary	butter → guns	2.16	0.06	8,31	0.192	1
	guns → butter	2.48	0.03	8,31	0.233	
Belgium	butter → guns	1.781	0.11	16,19	0.263	5
	guns → butter	2.339	0.04	16,19	0.38	
France	butter → guns	1.27	0.29	8,31	0.052	1
	guns → butter	2.72	0.02	8,31	0.261	
Germany	butter → guns	1.844	0.11	8,31	0.148	1
	guns → butter	7.891	0	8,31	0.586	
Italy	butter → guns	2.777	0.02	16,19	0.448	5
	guns → butter	6.801	0	16,19	0.726	
Russia	butter → guns	8.725	0	16,19	0.779	5
	guns → butter	3.595	0	16,19	0.543	
Spain	butter → guns	1.454	0.21	8,31	0.085	1
	guns → butter	0.554	0.81	8,31	-0.101	
United Kingdom	butter → guns	1.85	0.1	16,19	0.28	5
	guns → butter	0.966	0.52	16,19	-0.016	
United States	butter → guns	2.942	0.01	8,31	0.285	1
	guns → butter	8.608	0	8,31	0.609	

Table shows country-specific Granger-causality F-tests. Last column shows number of domestic lags used per every country-specific Granger model. Number of lags for endogenous variables = 2. Number of lags for foreign variables = 2. Max number of lags for estimating the country-specific VAR model = 5. Information criteria for optimal lag length = AIC. Deterministic variables: Trend and constant.

Table A2: *Bivariate Gobal Granger Causality Tests of the World Political Economy,* 1955-2012 *(A)*

	Granger Relationship	F-Test	P-Value	DF	Adjusted R-sq	Lags
Argentina	butter → guns	0.422	0.93	10,44	-0.12	1
	guns → butter	7.765	0	10,44	0.556	
Australia	butter → guns	0.629	0.8	12,41	-0.092	2
	guns → butter	5.618	0	12,41	0.511	
Austria	butter → guns	0.656	0.78	12,41	-0.084	2
	guns → butter	7.305	0	12,41	0.588	
Belgium	butter → guns	3.842	0	12,41	0.392	2
	guns → butter	3.001	0	12,41	0.312	
Brazil	butter → guns	0.237	0.99	12,41	-0.209	2
	guns → butter	9.498	0	12,41	0.658	
Bulgaria	butter → guns	1.269	0.27	12,41	0.057	2
	guns → butter	4.286	0	12,41	0.427	
Canada	butter → guns	1.69	0.11	10,44	0.113	1
	guns → butter	5.055	0	10,44	0.429	
Chile	butter → guns	0.561	0.84	10,44	-0.088	1
	guns → butter	7.313	0	10,44	0.539	
Colombia	butter → guns	4.855	0	18,32	0.581	5
	guns → butter	1.737	0.08	18,32	0.21	
Egypt	butter → guns	0.219	0.99	10,44	-0.169	1
	guns → butter	5.471	0	10,44	0.453	
Finland	butter → guns	1.428	0.19	12,41	0.088	2
	guns → butter	5.041	0	12,41	0.478	
France	butter → guns	8.235	0	16,35	0.694	4
	guns → butter	1.442	0.18	16,35	0.122	
Greece	butter → guns	1.344	0.23	18,32	0.11	5
	guns → butter	2.39	0.02	18,32	0.334	
Hungary	butter → guns	3.363	0	12,41	0.349	2
	guns → butter	3.711	0	12,41	0.38	
India	butter → guns	1.287	0.26	14,38	0.072	3
	guns → butter	6.048	0	14,38	0.576	
Israel	butter → guns	0.702	0.72	10,44	-0.058	1
	guns → butter	0.63	0.78	10,44	-0.073	
Italy	butter → guns	2.151	0.04	10,44	0.176	1
	guns → butter	11.365	0	10,44	0.657	
Japan	butter → guns	1.876	0.06	16,35	0.216	4
	guns → butter	4.079	0	16,35	0.491	
Luxembourg	butter → guns	2.296	0.03	10,44	0.194	1
	guns → butter	0.925	0.52	10,44	-0.014	
Mexico	butter → guns	1.436	0.18	16,35	0.12	4
	guns → butter	8.525	0	16,35	0.702	
Netherlands	butter → guns	2.483	0.02	10,44	0.216	1
	guns → butter	3.73	0	10,44	0.336	
North Korea	butter → guns	2.875	0	18,32	0.403	5
	guns → butter	2.143	0.03	18,32	0.292	
Norway	butter → guns	1.02	0.44	10,44	0.004	1
	guns → butter	1.122	0.37	10,44	0.022	
Poland	butter → guns	1.57	0.14	12,41	0.114	2
	guns → butter	2.745	0.01	12,41	0.283	
Portugal	butter → guns	0.749	0.68	10,44	-0.049	1
	guns → butter	3.265	0	10,44	0.296	
Romania	butter → guns	1.019	0.44	10,44	0.004	1
	guns → butter	2.878	0.01	10,44	0.258	
South Africa	butter → guns	0.686	0.73	10,44	-0.062	1
	guns → butter	1.102	0.38	10,44	0.019	
South Korea	butter → guns	0.448	0.91	10,44	-0.114	1
	guns → butter	9.019	0	10,44	0.598	
Spain	butter → guns	4.66	0	10,44	0.404	1
	guns → butter	4.92	0	10,44	0.421	
Taiwan	butter → guns	1.382	0.21	12,41	0.08	2
	guns → butter	5.667	0	12,41	0.514	
Turkey	butter → guns	1.696	0.1	14,38	0.158	3
	guns → butter	25.426	0	14,38	0.868	
United Kingdom	butter → guns	9.085	0	10,44	0.6	1
	guns → butter	1.139	0.36	10,44	0.025	

Table shows country-specific Granger-causality F-tests. Last column shows number of domestic lags used per every country-specific Granger model. Number of lags for endogenous variables = 3. Number of lags for foreign variables = 3. Max number of lags for estimating the country-specific VAR model = 5. Information criteria for optimal lag length = AIC. Deterministic variables: Trend.

Table A3: *Bivariate Gobal Granger Causality Tests of the World Political Economy*, 1955-2012 *(B)*

	Granger Relationship	F-Test	P-Value	DF	Adjusted R-sq	Lags
China	butter → guns	0.252	0.98	9,45	-0.142	2
	guns → butter	83.191	0	9,45	0.932	
Russia	butter → guns	3.663	0	7,48	0.253	1
	guns → butter	1.775	0.11	7,48	0.09	
United States	butter → guns	1.821	0.1	7,48	0.095	1
	guns → butter	1.961	0.08	7,48	0.109	

Table shows country-specific Granger-causality F-tests. Last column shows number of domestic lags used per every country-specific Granger model. Number of lags for endogenous variables = 2. Number of lags for foreign variables = 2. Max number of lags for estimating the country-specific VAR model = 5. Information criteria for optimal lag length = AIC. Deterministic variables: NA.

Notes

1. They described it as perhaps the most fundamental power, whereas Elster (1976, 245-70, 249) is even more assertive arguing that power is the most important single idea in political theory.

2. We acknowledge that without proper experimentation and randomization there cannot be proper causation. Consequently, and following the Granger methodology, we employ a rather lose definition of "causation" and explore if lagged values of a variable *forecast* another variable.

3. Version 5.0.

4. Version 5.0.

5. On the issue, see Luttwak (1990), Csurgai (2009), and Blackwill and Harris (2016).

6. Version 4.0.

7. On most and least likely case research design see Levy (2008).