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Abstract

This is the abstract.

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I. Modelling "Steel and Guns" in a Global Setting: Presenting the GVAR Methodology

I. GVAR: Country-specific Equations and Granger-causality Tests

Following Mauro and Pesaran (2013, 14), we define a country i GVAR model with p lags as follows,

$$\mathbf{x}_{it} = \boldsymbol{\alpha}_i + \boldsymbol{\Phi}_i \mathbf{x}_{i,t-p} + \boldsymbol{\Lambda}_{i0} \mathbf{x}^{\star}_{it} + \boldsymbol{\Lambda}_{i1} \mathbf{x}^{\star}_{i,t-p} + \mathbf{u}_{it} \tag{1}$$

where $\mathbf{x}_{it}$ is a $k_i \times 1$ vector of domestic variables, $\mathbf{x}^{\star}_{it}$ is a $k^{\star}_i \times 1$ vector of weakly-exogenous foreign variables, and $\mathbf{u}_{it}$ is a serially uncorrelated and cross-sectionally weakly dependent process. The inclusion of the foreign variables $\mathbf{x}^{\star}_{it}$ is one of the main characteristics of the GVAR approach. In simple, the Global vector autoregressive generalized model defined in Equation 1 explains x_{it} as a function of past values of x_{it}[1], at the same time that it weights estimates Φ_i by a weakly-exogenous foreign variables $x^{\star}_{i,t-p}$ (a effect which is captured by parameters Λ_i).

Since we are substantively interested in if "guns" *cause* "steel" 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 in Granger (1969) and it 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 estimating by fitting vector auto-regressive models (VAR), we now derive the Granger-causality test within the GVAR framework. The advantage of GVAR Granger-causality tests over regular Granger-causality tests is that the estimates are weighted by the global economy, situating the domestic effects within the global context. More formally, we estimate the following equations for every country i,

$$\mathbf{x}_{it} = \boldsymbol{\alpha}_i + \boldsymbol{\Phi}_i \mathbf{x}_{i,t-p} + \boldsymbol{\Lambda}_{i0} \mathbf{x}^{\star}_{it} + \boldsymbol{\Lambda}_{i1} \mathbf{x}^{\star}_{i,t-p} + \mathbf{u}_{it} \tag{2}$$

$$\mathbf{x}_{it} = \boldsymbol{\alpha}_i + \boldsymbol{\Phi}_{1i}\mathbf{y}_{i,t-p} + \boldsymbol{\Phi}_{2i}\mathbf{x}_{i,t-p} + \boldsymbol{\Lambda}_{i1}\mathbf{y}^\star_{it} + \boldsymbol{\Lambda}_{i2}\mathbf{y}^\star_{i,t-p} + \boldsymbol{\Lambda}_{i3}\mathbf{x}^\star_{it} + \boldsymbol{\Lambda}_{i4}\mathbf{x}^\star_{i,t-p} + \mathbf{u}_{it} \tag{3}$$

$$\mathbf{y}_{it} = \boldsymbol{\alpha}_i + \boldsymbol{\Phi}_{1i}\mathbf{x}_{i,t-p} + \boldsymbol{\Phi}_{2i}\mathbf{y}_{i,t-p} + \boldsymbol{\Lambda}_{i1}\mathbf{x}^\star_{it} + \boldsymbol{\Lambda}_{i2}\mathbf{x}^\star_{i,t-p} + \boldsymbol{\Lambda}_{i3}\mathbf{y}^\star_{it} + \boldsymbol{\Lambda}_{i4}\mathbf{y}^\star_{i,t-p} + \mathbf{u}_{it} \tag{4}$$

In our case, the vector $\mathbf{x}_{it}$ contains country-year levels of "military personnel" and "iron and steel production", as systematized by the Correlates of War Project, particularly, the National Material Capabilities (version 5.0) dataset (Singer, Bremer, and Stuckey 1972). The dataset covers all countries in the world between 1816-2012.

In our case, the vector of foreign variables is the single variable "dyadic trade" which measures bilateral trade flows between two countries. This variable was developed by the same project in the Trade dataset (version 4.0).(Barbieri, Keshk, and Pollins 2009; Barbieri and Keshk 2016). Using this variable, a square weighting matrix was constructed as follows: if there are 30 countries, the weight matrix has 30 rows and 30 columns—its diagonal element contains only zeros. Every country is weighted by the other 29 remaining countries.

add Deterministic variables to table (trend, constant)

II. Results

Table 1: *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	steel → guns	2.834	0.017	8,31	0.273	1
	guns → steel	1.393	0.238	8,31	0.075	
Belgium	steel → guns	4.216	0.001	10,28	0.458	2
	guns → steel	2.759	0.017	10,28	0.316	
France	steel → guns	1.35	0.257	8,31	0.067	1
	guns → steel	1.907	0.095	8,31	0.157	
Germany	steel → guns	3.827	0.003	8,31	0.367	1
	guns → steel	2.694	0.022	8,31	0.258	
Italy	steel → guns	3.61	0.004	10,28	0.407	2
	guns → steel	5.039	0	10,28	0.515	
Russia	steel → guns	10.499	0	16,19	0.813	5
	guns → steel	2.423	0.034	16,19	0.394	
Spain	steel → guns	1.749	0.126	8,31	0.133	1
	guns → steel	1.454	0.214	8,31	0.085	
United Kingdom	steel → guns	2.674	0.023	8,31	0.256	1
	guns → steel	1.29	0.284	8,31	0.056	
United States	steel → guns	2.254	0.044	10,28	0.248	2
	guns → steel	5.528	0	10,28	0.544	

Table 2: *Bivariate Gobal Granger Causality Tests of the World Political Economy, 1955-2014*

	Granger Relationship	F-Test	P-Value	DF	Adjusted R-sq	Lags
Argentina	steel → guns	1.072	0.402	9,45	0.012	1
	guns → steel	6.222	0	9,45	0.465	
Australia	steel → guns	0.996	0.466	11,42	-0.001	2
	guns → steel	3.564	0.001	11,42	0.347	
Austria	steel → guns	0.694	0.736	11,42	-0.068	2
	guns → steel	2.526	0.015	11,42	0.24	
Belgium	steel → guns	4.525	0	13,39	0.468	3
	guns → steel	1.012	0.459	13,39	0.003	
Brazil	steel → guns	0.19	0.997	11,42	-0.202	2
	guns → steel	5.779	0	11,42	0.498	
Bulgaria	steel → guns	0.606	0.813	11,42	-0.089	2
	guns → steel	3.202	0.003	11,42	0.314	
Canada	steel → guns	1.531	0.157	11,42	0.099	2
	guns → steel	3.517	0.002	11,42	0.343	
Chile	steel → guns	0.294	0.973	9,45	-0.133	1
	guns → steel	5.678	0	9,45	0.438	
China	steel → guns	0.13	0.999	9,45	-0.17	1
	guns → steel	25.707	0	9,45	0.805	
Colombia	steel → guns	3.422	0.001	17,33	0.452	5
	guns → steel	1.719	0.089	17,33	0.196	
Egypt	steel → guns	0.19	0.994	9,45	-0.156	1
	guns → steel	2.639	0.015	9,45	0.215	
Finland	steel → guns	1.504	0.154	17,33	0.146	5
	guns → steel	2.994	0.003	17,33	0.404	
France	steel → guns	1.456	0.194	9,45	0.071	1
	guns → steel	2.438	0.024	9,45	0.193	
Greece	steel → guns	1.35	0.232	11,42	0.068	2
	guns → steel	1.917	0.064	11,42	0.16	
Hungary	steel → guns	3.568	0.001	11,42	0.348	2
	guns → steel	4.868	0	11,42	0.445	
India	steel → guns	0.45	0.9	9,45	-0.101	1
	guns → steel	7.349	0	9,45	0.514	
Israel	steel → guns	1.405	0.201	13,39	0.092	3
	guns → steel	1.291	0.259	13,39	0.068	
Italy	steel → guns	0.386	0.936	9,45	-0.114	1
	guns → steel	1.142	0.355	9,45	0.023	
Japan	steel → guns	2.783	0.006	17,33	0.377	5
	guns → steel	2.074	0.036	17,33	0.267	
Luxembourg	steel → guns	5.861	0	17,33	0.623	5
	guns → steel	1.483	0.162	17,33	0.141	
Mexico	steel → guns	2.421	0.014	17,33	0.326	5
	guns → steel	4.269	0	17,33	0.526	
Netherlands	steel → guns	4.03	0	13,39	0.431	3
	guns → steel	1.771	0.084	13,39	0.162	
North Korea	steel → guns	3.9	0.001	11,42	0.376	2
	guns → steel	5.135	0	11,42	0.462	
Norway	steel → guns	0.786	0.684	15,36	-0.067	4
	guns → steel	1.26	0.276	15,36	0.071	
Poland	steel → guns	0.597	0.792	9,45	-0.072	1
	guns → steel	1.487	0.182	9,45	0.075	
Portugal	steel → guns	0.678	0.724	9,45	-0.057	1
	guns → steel	1.59	0.147	9,45	0.089	
Romania	steel → guns	0.753	0.659	9,45	-0.043	1
	guns → steel	2.089	0.051	9,45	0.154	
Russia	steel → guns	2.955	0.008	9,45	0.246	1
	guns → steel	1.032	0.43	9,45	0.005	
South.Africa	steel → guns	0.323	0.963	9,45	-0.127	1
	guns → steel	1.282	0.273	9,45	0.045	
South Korea	steel → guns	0.306	0.969	9,45	-0.131	1
	guns → steel	7.079	0	9,45	0.503	
Spain	steel → guns	3.799	0.001	13,39	0.412	3
	guns → steel	1.347	0.229	13,39	0.08	
Taiwan	steel → guns	2.099	0.05	9,45	0.155	1
	guns → steel	2.644	0.015	9,45	0.215	
Turkey	steel → guns	1.617	0.139	9,45	0.093	1
	guns → steel	10.103	0	9,45	0.603	
United Kingdom	steel → guns	10.371	0	9,45	0.61	1
	guns → steel	0.994	0.459	9,45	-0.001	
United States	steel → guns	1.527	0.168	9,45	0.081	1
	guns → steel	2.986	0.007	9,45	0.249	

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II. Appendix

I. Info that goes into the Appendix