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THE RELATIONSHIP BETWEEN GLOBALIZATION AND MILITARY EXPENDITURES IN G7 COUNTRIES: EVIDENCE FROM A PANEL DATA ANALYSIS

***Abstract:** This study explores the causal linkages between military expenditure and globalization in G7 countries (i.e. Canada, France, Germany, Italy, Japan, the UK, and the USA) by analyzing data for the period 1988-2011. Panel causality was examined to explain dependency and heterogeneity across countries. The results of one-way Granger causality show that globalization influenced military expenditures in Germany, and Japan. Moreover, there was no evidence that military expenditures caused globalization in any G7 country. The evidence from Italy shows interaction causality between globalization and military expenditure. Bootstrap panel Granger causality tests show that the causality between globalization and military expenditure varies across countries with different conditions. The findings of this study could provide important policy implications for the G7 countries under study.*

***Keywords:** Military Expenditure; Globalization; Dependency and Heterogeneity; Bootstrap Panel Granger Causality Test, G7 countries.*

JEL Classification: H56, O41, C23

1. Introduction

Over the past two decades, a plethora of empirical studies have devoted increasing interest to investigating the relationship between military spending and economic growth in both developing and developed countries because that relationship has important military and economic policy implications. The importance of military spending in the economic development process has led

researchers to concentrate on empirically identifying the nature of causal linkages between military spending and economic growth.

The methodologies used in the previous studies are diverse and the econometric models used include cross-sectional analysis for a group of countries versus a time-series analysis for a single country; single equations versus simultaneous equations; using large samples or breaking the sample up according to economic and noneconomic structural features. Most methodologies test for causality from military spending or the other way around. The results from this empirical literature are, however, mixed and inconclusive, and there are at least four viewpoints on the existence and nature of the relationship between military spending and economic growth (Menla Ali and Dimitraki, 2014; Furuoka et al., 2014).

Benoit (1978) and others who argues that there is positive causality running from military spending to economic growth represent the first view. According to Benoit, military expenditure can lead to higher economic growth by raising aggregate demand. Assuming that developing countries have underutilized resources, the increase in aggregate demand raises the level of investment and generates more jobs, which will, in turn, result in higher rates of economic growth. Others have suggested that military expenditure may lead to higher economic growth by a spin-off effect. This effect comprises the side effects of military expenditure on physical and social infrastructure investments such as roads, transportation, ports, and research and training, all of which are beneficial to civilian society and conducive to economic growth (Deger, 1986). The second view is that military expenditure is detrimental to economic growth. Proponents of this view claim that, because military expenditure is financed by taxes or borrowing, it will crowd-out private investment. Furthermore, it is a diversion of resources away from more productive government outlays such as education and health services. Yet a third view about the relationship between military expenditure and economic growth states that the causality between the two is bi-directional; that is, military expenditures cause economic growth, and economic growth causes higher military expenditures (Kusi, 1994). Finally, there is a fourth view that states there is no relationship between military expenditure and economic growth (Biswas and Ram, 1986). Benoit (1978) argues that there is a positive causality running from military spending to economic growth which represents the first viewpoints ('guns and butter'). According to Benoit (1978), military spending can lead to higher economic growth by raising aggregate demand. Assuming that developing countries have underutilized resources, the increase in aggregate demand will raise the level of investment and will generate more jobs, which will in turn result in higher rates of economic growth. Others have suggested that military spending may lead to higher economic growth through its spin-off effect. Spin-off are sides effects of military spending on physical and social infrastructure such as roads, transportation assets, ports, and research and training, all of which are beneficial to civil society and conducive to economic growth (Deger, 1986).

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Lavallee (2003) studies of globalization as a process within the international system displays a patchwork of divergent paradigms and theoretical dispositions. Globalization has become a catchall phrase, which can encompass numerous and often contradictory meanings. Is globalization an exogenous power-shaping actor within the world system or is globalization the result of endogenous changes taking place within the state itself? More importantly, is globalization a new phenomenon, or merely a remnant of the not-so-distant past?

A recent study by Dreher (2006) used a panel data model to discuss how a single globalization dimension affects economic growth. The study collected data from 123 countries for the period from 1970 to 2000. After calculation of the overall index and sub-indexes of globalization variables, the results showed that globalization indeed promotes economic growth. The effects of globalization on economic growth have also been frequently found in other papers that utilize the same index of measurement. Only recently have many studies examined this connection between globalization and economic growth by applying a cross-sectional approach (Chanda, 2001). However, these studies have not adequately controlled the problem of endogeneity. Their results, therefore, possibly reflect unobserved characteristics that do not vary over time, and are not the consequences of globalization; further, they might reflect reverse causality. Aware of the shortcomings of the cross-sectional approach, some studies have used a panel data approach to examine the relationship between various dimensions of globalization and growth (Dollar and Kraay, 2001).

Over the past several decades, a large number of empirical studies have investigated the relationship between military expenditures and economic growth in both developing and developed countries, as this has important military and economic policy implications. The importance of military expenditure in the economic development process has led researchers to concentrate on empirically identifying the nature of causal linkages between military expenditure and economic growth. The methodologies used in previous studies are diverse, and the econometric models include a cross-sectional analysis for a group of countries versus a time-series analysis for a single country, single equations versus simultaneous equations, and using large samples versus breaking the sample up according to economic and non-economic structural features. Most of them test for causality from defense spending or the other way around. The results from these examinations, however, are mixed and inconclusive, and there are at least four viewpoints on the existence and nature of the relationship between military expenditure and economic growth (AL-Yousif, 2002; Chang et al., 2011).

By examining the military data from most developing countries over the past 20 years, one can easily notice that despite the economic difficulties, these countries have imported expensive military goods. The ratio of military imports to total imports in (Least Developed Countries, [LDCs]) averaged 7% over the past two decades. The proportions of military expenditures to GDP, on the other hand, are in fact higher in LDCs relative to more advanced countries. In G7 countries, for

example, about 16% of a typical country's GDP on average goes to military expenditure. This paper re-investigates the relationship between globalization and military expenditures in G7 countries (Canada, France, Germany, Italy, Japan, the UK, and the USA) over the period 1988-2011 by focusing on country-specific analyses. To detect causal linkages, we apply a panel causality approach, which is able to account for both cross-country interrelations and country-specific heterogeneity. G7 countries provide an interesting opportunity for investigating the causal link between military expenditures and globalization for several reasons. Firstly, according to the Stockholm International Peace Research Institute (SIPRI, 2011) report, the G7 countries are among the top 18 countries with the largest military budgets for 2011. The USA, with a budget of \$698 billion, spends more on defense more than the G7 countries combined. The United States military spending is almost six times that of the next biggest spender. If we look at the ranking of these seven countries, the second is the UK (\$59.6 billion), followed by France (\$59.3 billion), Japan (\$54.5 billion), Germany (\$45.2 billion), Italy (\$37.0 billion), and Canada (\$22.8 billion). Secondly, 7% (France), 11% (Germany), 2% (Italy), 4% (the UK), and 30% (the USA) sell weapons to countries all over the world. These countries were responsible for 57% of all arms deliveries in the world during 2006–2011 (SIPRI, 2012). Third, countries can be ranked by the ratio of military spending to GDP; four of the top ten countries in that ranking are G7 countries with sharp regional tensions. The fear of conventional military attack is very real, which helps justify high military expenditures in this area. Thus, these military expenditures promote economic growth and so motivate researchers to investigate the relationship between military expenditures and economic growth.¹

While most previous studies have discussed how globalization and military expenditures impact economic growth, none of these studies has examined how globalization affects military expenditures.² Existing studies document the possible influence of globalization on military expenditures from a theoretical perspective (Lavalley 2003).³ In this study, we empirically verify the impact of globalization on the military sector. We test for the existence of any bilateral causality between globalization and military expenditures (i.e., military density and real military expenditures per capita) by using a bootstrap panel Granger causality test for a sample of seven G7 countries for the period from 1988 to 2011.

¹ Chang *et al.* (2013) provide a comprehensive review of the relationship between military expenditures and economic growth.

² The difference between our study and that of Chang *et al.* (2013) is that ours uses globalization view and the bootstrap panel granger causality model. Chang *et al.* (2013) is the first empirical paper to examine the influence of the economic growth and military expenditures by applying a panel co-integration technique. They found that military expenditures have a significant impact on the development of economic growth and an impact on reducing the deviation of individual countries' military expenditures.

³ Lavalley (2003) indicates that increased globalization in the military sector might bring a movement towards the world average.

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This paper is the first study to use a new panel Granger causality approach based on the seemingly unrelated regression (SUR) model and Wald tests with country-specific bootstrap critical values followed by the Kónya (2006) empirical method to explore the relationships between globalization and military expenditures in G7 countries.⁴ This new methodology makes it possible to test for Granger-causality on each individual panel country separately, while accounting for possible bias and cross-sectional inconsistencies that may occur in our panel data.⁵ We hope that this study can bridge the gap in the current literature between globalization and military expenditures.

More importantly, the bootstrap approach has not been used in previous articles on military expenditures. It is widely known that the bootstrap approach produces robust critical values (Hacker and Hatemi, 2005).⁶ To detect causality between globalization and military expenditures, we utilize the panel causality approach since the information for the panel data set consists of not only a time series dimension but also a cross-sectional dimension. These advantages of panel data analysis have made non-stationary panel tests (unit root, co-integration, and causality) popular for econometrics. In recent years, the economic or financial instability of one country has been shown to spread to other countries through international trade and economic and financial integration. This emphasizes the importance of the cross-sectional dependency issues considered in our empirical analysis. Even though there is strong evidence of dependence across countries, it is well-known that each country sustains its own dynamics in economic development; this fact calls attention to the need for an empirical modeling strategy that can control for cross-country heterogeneity and dominance. Accordingly, the panel causality method that we utilize is able to control for dependency across countries as well as for country-specific characteristics. In this paper, we follow a systematic modeling strategy to examine causality between globalization and military expenditures. We also test for cross-sectional dependence and cross-country heterogeneity by using recently developed and statistically powerful tests instead of assuming the existence of these dynamics in our panel data set. We contribute to the existing literature by addressing these two concerns.

The plan of this paper is organized as follows. Section 2 provides the data used in the study and Section 3 briefly describes the bootstrap panel Granger causality test proposed by Kónya (2006). Section 4 presents the empirical results

⁴ We select G7 countries as samples, because G7 countries have exercised considerable economic power and have played important roles in the world economy over the past few decades.

⁵ Bai and Kao (2006) demonstrated that the assumption of cross-sectional independence is difficult to satisfy in panel data, and neglecting this information causes bias and inconsistent results.

⁶ Hacker and Hatemi (2005) argued that a bootstrap distribution reduces size distortion compared with an asymptotic distribution with Monte Carlo simulations.

and then draws economic and policy implications from the findings. Finally, Section 5 concludes the paper.

2. Data

The annual data used in this study covers the period from 1988 to 2011 for the G7 countries (Canada, France, Germany, Italy, Japan, the UK, and the USA).⁷ The variables used in this study include the overall Globalization index (*Glob*), the per capita real military expenditure (*PRME*), and the per capita real GDP (*PRGDP*).⁸ In this study, *PRGDP* serves as a control variable. We follow Dreher (2006) and use Globalization index⁹ as a proxy variable for globalization. *PRGDP* is from the World Development Indicators (WDI, 2011), and *PRME* is from the *Stockholm International Peace Research Institute* (SIPRI). Dreher (2006) divides globalization into three dimensions: economic integration, social integration, and political integration, the details of which are shown in Dreher et al. (2008). In our study, we only focus on the overall Globalization index, which consists of economic globalization (36%), social globalization (38%), and political globalization (26%). This index is taken from the KOFI Index of Globalization website (<http://globalization.kof.ethz.ch/>).¹⁰ We transform all indexes into natural logarithms. The per capita setting can also be found in the work of Brumm (1997). Figure 1 plots the globalization index versus *PRME* across G7 countries.

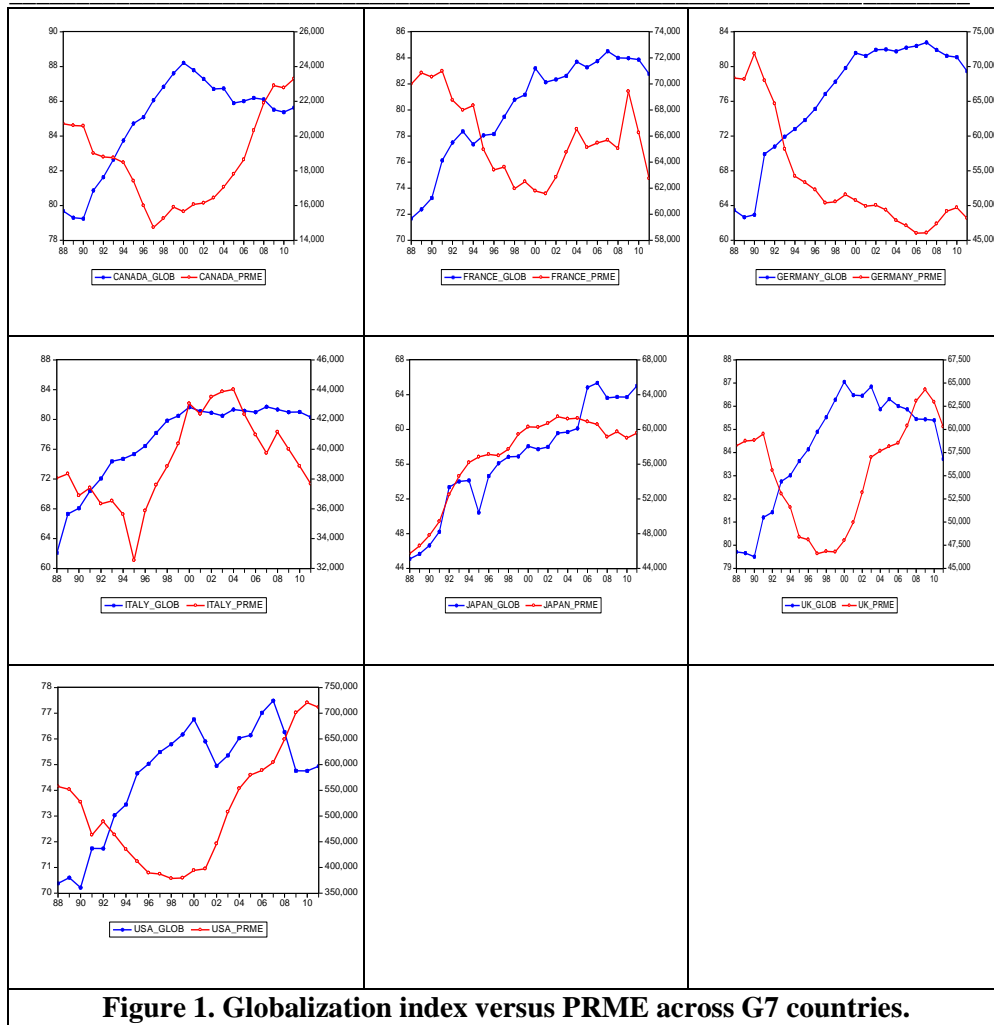
⁷ Due to a limited database and a lack of data sources, only G7 countries could be investigated in this study.

⁸ We use per capita numbers for two following reasons. First, per capita numbers are less sensitive to territorial changes. Second, per capita numbers provide variables in the same units for large and small countries and they control for the scale of the economy.

⁹ Globalization index ranges between 0 (not globalized) and 100 (globalized).

¹⁰ Kacowicz (1999) claimed that globalization means many different things for different people with an intensification of economic, political, social, and cultural relations across borders. Park et al., (2002) wrote that on the basis of multi-layered perspectives of globalization, a large body of research has identified that globalization arises out of complex interactions among social, political, and economic processes and involves materiality. This multi-scalar viewpoint shows that globalization is not only an economic process, but is also constituted by social and political activities. Therefore, we use the overall Globalization index in our study to test the causality between globalization and economic growth. See Dreher (2006) for details on how to construct the index.

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3. Empirical Methodology

Our empirical methodology is carried out in two steps. First, we investigate cross-sectional dependence and slope homogeneity. In the second step, based on the results from the first step, this work apply an appropriate panel causality method which is able to represent both cross-sectional and slope homogeneity features in this panel data set. In the following, we briefly outline the econometric methods.

3.1. Cross-Sectional Dependence Tests

One of the important assumptions in the bootstrap panel causality is the existence of cross-sectional dependency among the countries in the panel. In the

case of cross-sectionally correlated errors, the estimator from the regression system described with the SUR is more efficient than the estimator with the pooled ordinary least squares (pooled OLS) model because the country-by-country OLS approach does not consider cross-sectional dependency. Therefore, testing for cross-sectional dependency is the most crucial issue for the selection of an efficient estimator and hence for the panel causality results.

To test for cross-sectional dependency, the Lagrange multiplier (LM) test from Breusch and Pagan (1980) has been extensively used in empirical studies. The procedure of the LM test requires the estimation of the following panel data model:

$$y_{it} = \alpha_i + \beta_i' x_{it} + u_{it} \text{ for } i = 1, 2, \dots, N; t = 1, 2, \dots, T \quad (1)$$

In equation (1), y_{it} is *PRME* (D), i is the cross-sectional dimension, t is the time dimension, x_{it} is $k \times 1$ vector of explanatory variables (such as *PRGDP* and *Glob*), and α_i and β_i are the individual intercepts and slope coefficients that are allowed to vary across countries. In the LM test, the null hypothesis of no-cross sectional dependence, $H_0 : Cov(u_{it}, u_{jt}) = 0$, for all t and $i \neq j$ - is tested against the alternative hypothesis of cross-sectional dependence, $H_1 : Cov(u_{it}, u_{jt}) \neq 0$, for at least one pair of $i \neq j$. In order to test the null hypothesis, Breusch and Pagan (1980) developed the LM (CD_{BP}) test as:

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij}^2. \quad (2)$$

In equation (2), $\hat{\rho}_{ij}$ is the sample estimate of the pair-wise correlation of the residuals from the pooled OLS estimation of equation (1) for each i . Under the null hypothesis, the LM statistic has an asymptotic chi-square with $N(N-1)/2$ degrees of freedom. It is important to note that the LM test is valid for relatively small N and sufficiently large T . In the case of large panels, for example, where $T \rightarrow \infty$ first and then $N \rightarrow \infty$, Pesaran (2004) proposed the scaled version of the LM test as follows:

$$CD_{lm} = \left(\frac{1}{N(N-1)} \right)^{1/2} \sum_{i=1}^{N-1} \sum_{j=i+1}^N (T \hat{\rho}_{ij}^2 - 1). \quad (3)$$

Under the null hypothesis, the CD_{lm} test converges to the standard normal distribution. However, the CD_{lm} test may be subject to substantial size distortions when N is large and T is small. Pesaran (2004) developed a more general cross-sectional dependency test that is valid for large panels; this CD test is as follows:

$$CD = \sqrt{\left(\frac{2T}{N(N-1)} \right)} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij} \right). \quad (4)$$

Under the null hypothesis, the CD test has asymptotic standard normal distribution. Pesaran (2004) indicated that the CD test has a mean that is exactly zero for fixed T and N , and is robust for heterogeneous dynamic models that include multiple breaks in slope coefficients and error variances, as long as the unconditional means of y_{it} and x_{it} are time-invariant and their innovations have symmetric distributions. However, the CD test will lack power in certain situations in which the population average pair-wise correlations are zero, but the underlying individual population pair-wise correlations are non-zero (Pesaran et al., 2008). Pesaran et al. (2008) proposed a bias-adjusted test which is a modified version of the LM test; that test uses the exact mean and variance of the LM statistic. The bias-adjusted LM test is as follows:

$$LM_{adj} = \sqrt{\left(\frac{2T}{N(N-1)}\right)} \sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij} \frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{\sqrt{v_{Tij}^2}}. \quad (5)$$

In equation (5), μ_{Tij} and v_{Tij}^2 are respectively the exact mean and variance of $(T-k)\hat{\rho}_{ij}^2$ that are provided in Pesaran et al. (2008). Under the null hypothesis with first $T \rightarrow \infty$ and then $N \rightarrow \infty$, the LM_{adj} test is asymptotically distributed as a standard normal distribution.

3.2. Slope Homogeneity Tests

Another important point in the bootstrap panel causality approach is testing for cross-country heterogeneity. In order to test the null hypothesis of slope coefficient homogeneity against the alternative hypothesis, the familiar approach is to apply the Wald principle. The Wald principle is valid for cases where the cross-sectional dimension (N) is relatively small and the time dimension (T) of the panel is large; the explanatory variables are strictly exogenous, and the error variances are homoscedastic. Swamy(1970) developed the slope homogeneity test to detect cross-sectional heteroscedasticity (Pesaran and Yamagata, 2008). However, Wald and Swamy's tests are applicable for panel data models where N is small relative to T . Pesaran and Yamagata (2008) proposed a standardized version of Swamy's test (also called the $\tilde{\Delta}$ test) for testing slope homogeneity in large panels. The $\tilde{\Delta}$ test is valid as $(N, T) \rightarrow \infty$ without any restrictions on the relative expansion rates of N and T when the error terms are normally distributed. In the $\tilde{\Delta}$ test approach, the first step is to compute the following modified version of Swamy's test:

$$\tilde{S} = \sum_{i=1}^N \left(\hat{\beta}_i - \tilde{\beta}_{WFE} \right)' \frac{x_i' M_{\tau} x_i}{\tilde{\sigma}_i^2} \left(\hat{\beta}_i - \tilde{\beta}_{WFE} \right). \quad (6)$$

In equation (6), $\hat{\beta}_i$ is the estimator from the pooled OLS, and $\tilde{\beta}_{WFE}$ is the estimator from the weighted fixed effect pooled estimation of the regression model of

equation (1); M_r is an identity matrix, and $\tilde{\sigma}_i^2$ is the estimator of σ_i^2 .¹¹ The standardized dispersion statistic is then defined as:

$$\tilde{\Delta} = \sqrt{N} \left(\frac{N^{-1}\tilde{S} - k}{\sqrt{2k}} \right). \quad (7)$$

Under the null hypothesis with the condition of $(N, T) \rightarrow \infty$, so long as $\sqrt{N}/T \rightarrow \infty$ and the error terms are normally distributed, the $\tilde{\Delta}$ test has an asymptotic standard normal distribution. The small sample properties of the $\tilde{\Delta}$ test can be improved under normally distributed errors by using the following bias - adjusted version:

$$\tilde{\Delta}_{adj} = \sqrt{N} \left(\frac{N^{-1}\tilde{S} - E(\tilde{z}_{it})}{\sqrt{\text{var}(\tilde{z}_{it})}} \right). \quad (8)$$

where the mean is $E(\tilde{z}_{it}) = k$ and the variance is $\text{var}(\tilde{z}_{it}) = 2k(T - k - 1)/T + 1$.

3.3. Bootstrap Panel Granger Causality Test

We apply the bootstrap panel causality method proposed by Kónya (2006) in order to measure the determinants of causality between globalization and military expenditures. As emphasized by Kónya (2006),¹² the results of the bootstrap panel causality method unit root test, and cointegration test are all robust. This implies that not all variables need to be tested for stationary series properties. This robust feature of bootstrap panel causality arises from the generation of country-specific critical values from the bootstrapping method. The variables in the model do not need to be a stationary series (Kónya, 2006).¹³ It is important to note here that the variable levels used in empirical analysis play crucial roles in determining causal linkages because differencing variables to make them stationary (i.e., using the difference form of variables) may lead to a loss of trend dynamics in the series.

The bootstrap panel causality approach of Kónya first requires estimating the described system by seemingly unrelated regression (SUR) to impose zero restrictions for causality by the Wald principle, and then requires generating bootstrap critical values. Since country-specific Wald tests with country-specific bootstrap critical values are used in the panel causality method, the Wald test does not require doing the joint hypothesis for all countries in the panel.

The equation system for panel causality analysis includes two sets of equations that can be written for our case as follows:

¹¹ In order to save space, we refer to Pesaran and Yamagata (2008) for the details of Swamy's test and the estimators described in equation (6).

¹² The alternative panel Granger causality test was developed by Hurlin (2008). The method controls for unobservable heterogeneity in panel data, but not for heterogeneity problems in cross-sectional data.

¹³ We refer to Kónya (2006) for more details of the bootstrapping method and of country-specific critical values.

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$$\begin{aligned}
 y_{1,t} &= \alpha_{1,1} + \sum_{i=1}^{ly_1} \beta_{1,1,i} y_{1,t-i} + \sum_{i=1}^{lx_1} \delta_{1,1,i} x_{1,t-i} + \sum_{i=1}^{lz_1} \gamma_{1,1,i} z_{1,t-i} + \varepsilon_{1,1,t} \\
 y_{2,t} &= \alpha_{1,2} + \sum_{i=1}^{ly_1} \beta_{1,2,i} y_{2,t-i} + \sum_{i=1}^{lx_1} \delta_{1,2,i} x_{2,t-i} + \sum_{i=1}^{lz_1} \gamma_{1,2,i} z_{2,t-i} + \varepsilon_{1,2,t} \\
 &\vdots \\
 y_{N,t} &= \alpha_{1,N} + \sum_{i=1}^{ly_1} \beta_{1,N,i} y_{N,t-i} + \sum_{i=1}^{lx_1} \delta_{1,N,i} x_{1,N,t-i} + \sum_{i=1}^{lz_1} \gamma_{1,N,i} z_{N,t-i} + \varepsilon_{1,N,t}
 \end{aligned} \tag{9}$$

and

$$\begin{aligned}
 x_{1,t} &= \alpha_{2,1} + \sum_{i=1}^{ly_2} \beta_{2,1,i} y_{1,t-i} + \sum_{i=1}^{lx_2} \delta_{2,1,i} x_{1,t-i} + \sum_{i=1}^{lz_2} \gamma_{2,1,i} z_{1,t-i} + \varepsilon_{2,1,t} \\
 x_{2,t} &= \alpha_{2,2} + \sum_{i=1}^{ly_2} \beta_{2,2,i} y_{2,t-i} + \sum_{i=1}^{lx_2} \delta_{2,2,i} x_{2,t-i} + \sum_{i=1}^{lz_2} \gamma_{2,2,i} z_{2,t-i} + \varepsilon_{2,2,t} \\
 &\vdots \\
 x_{N,t} &= \alpha_{2,N} + \sum_{i=1}^{ly_2} \beta_{2,N,i} y_{N,t-i} + \sum_{i=1}^{lx_2} \delta_{2,N,i} x_{N,t-i} + \sum_{i=1}^{lz_2} \gamma_{2,N,i} z_{N,t-i} + \varepsilon_{2,N,t}
 \end{aligned} \tag{10}$$

In the equation systems (9) and (10), y refers to the indicator of per capita real military expenditure (*PRME*), x denotes the indicator of globalization (*Glob*), z refers to per capita real GDP (*PRGDP* as a control variable), N is the number of panel members, t is the time period ($t=1, \dots, T$), and l is the lag length. In this regression system, each equation has different predetermined variables while the error terms might be cross-sectionally correlated, hence, we can view these sets of equations as an SUR system. To test for Granger causality in this system, alternative causal relations for each country are likely to be found: (i) there is one-way Granger causality from X to Y if not all $\delta_{1,i}$ are zero, but all $\beta_{2,i}$ are zero; (ii) there is one-way Granger causality from Y to X if all $\delta_{1,i}$ are zero, but not all $\beta_{2,i}$ are zero; (iii) there is two-way Granger causality between X and Y if neither $\delta_{1,i}$ nor $\beta_{2,i}$ are zero; (iv) there is no Granger causality between X and Y if all $\delta_{1,i}$ and $\beta_{2,i}$ are zero.

Before proceeding to estimation, optimal lag lengths must be determined.¹⁴ Since the results from the causality test may be sensitive to the lag structure,

¹⁴ As indicated by Kónya (2006), this is an important step because the causality test results may depend critically on the lag structure. In general, lag decisions may cause different estimation results. Too few lags means that some important variables are omitted from the model and this specification error will usually cause incorrect estimation in the retained regression coefficients, leading to biased results. On the other hand, too many lags will

determining the optimal lag length(s) is crucial for the robustness of empirical findings. In a large panel system, lag lengths and numbers of independent variables can cause a substantial computational burden. Following Kónya(2006), maximal lags are allowed to differ across variables but need to be the same across equations. In our paper, the regression system is estimated by each possible pair of $ly_1, lx_1, ly_2, lx_2, lz_1$, and lz_2 ; we assume from 1 to 4 lags exist, and then we choose the combinations that minimize the Schwarz Bayesian Criterion.

4. Results

As outlined earlier, testing for cross-sectional dependency and slope homogeneity in a panel causality study is crucial for selecting the appropriate estimator. Taking into account both cross-sectional dependency and country-specific heterogeneity in empirical analysis is necessary because countries are highly integrated and have a high degree of integration in economic relations. Thereby, our empirical analysis starts by examining the existence of cross-sectional dependency and heterogeneity across the studied countries. The results from the cross-sectional dependence and slope homogeneity tests are reported in Table 1. The cross-sectional dependence tests strongly indicate that the null hypothesis of no cross-sectional dependence is rejected at the 10 percent level of significance. The cross-sectional dependence tests thereby support evidence of high integration among these G7 countries, which implies that any shock that occurs in one country is quickly transmitted to other countries.

Table 1 also reports the results from the slope homogeneity tests of Swamy (1970) and Pesaran and Yamagata(2008). Both tests reject the null hypothesis of the slope homogeneity hypothesis, supporting country-specific heterogeneity. The rejection of slope homogeneity implies that by imposing a homogeneity restriction on the variable of interest, the panel causality analysis results in misleading inferences. The directions of causal linkages between military expenditures and globalization in these G7 countries seem to be heterogeneous, thus the directions of causal linkages among the variables of interest may differ across countries.

The existence of cross-sectional dependency and heterogeneity across countries is evidence supporting for the suitability of the bootstrap panel causality approach. The results from the bootstrap panel Granger causality analysis are reported in Table 2.¹⁵ Several interesting observations can be made. Firstly, we did not find one-way Granger causality running from military expenditures to globalization in the G7 countries (i.e., Canada, France, Germany, Italy, Japan, the UK, and the USA).

waste observations and this specification error will usually increase the standard errors of the estimated coefficients, leading to inefficient results.

¹⁵ This work refers to Kónya (2006) for the bootstrap procedure on how the country specific critical values are generated.

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Table 1. Cross-sectional Dependence and Homogeneous Tests

Method	Test.Stat.	p-value
<i>Cross-sectional dependence test</i>		
CD_{BP}	40.131***	0.0072
CD_{LM}	2.9521***	0.0032
CD	3.6341***	0.0003
LM_{adj}	7.7440***	0.0000
<i>Homogeneous test</i>		
$\tilde{\Delta}$	29.1683***	0.0000
$\tilde{\Delta}_{adj}$	1.5294*	0.0631
Swamy(1970)	53.9179***	0.0000

Note:

1. * and *** indicate significance at the 0.1 and 0.01 levels, respectively.
2. CD_{BP} , CD_{LM} , CD and LM_{adj} are the cross-sectional dependence tests of Breusch and Pagan (1980), Pesaran (2004), and Pesaran et al. (2008), respectively.
3. $\tilde{\Delta}$ and $\tilde{\Delta}_{adj}$ are slope homogeneity tests of Pesaran and Yamagata (2008).
4. Swamy (1970) developed the slope homogeneity test to detect cross-sectional heteroscedasticity (Pesaran and Yamagata, 2008)

Table 2. Granger causality between Globalization and PRME for G7 countries.

Countries	H_0 : PRME does not Granger Cause Glob				H_0 : Glob does not granger cause PRME			
	Wald Statistics	Bootstrap Critical Value			Wald Statistics	Bootstrap Critical Value		
		1%	5%	10%		1%	5%	10%
Canada	1.146705	9.59134	7.29786	6.00575	4.090637	15.6629	9.05907	7.34111
France	1.787623	12.54223	8.38863	5.93713	3.841887	10.68308	6.93171	6.36299
Germany	0.412654	15.63212	9.3098	7.28559	10.75113**	11.8071	8.03473	6.07386
Italy	10.02474**	17.23913	9.19516	6.24705	10.19164**	16.35906	7.11637	5.52877
Japan	1.114751	26.07683	14.94395	12.80046	6.094718*	9.83005	6.52189	3.87522
United Kingdom	2.083704	17.19779	8.6537	6.10866	0.079291	12.51267	6.3349	5.00464
United States	2.948205	14.75297	9.06146	5.89296	2.938421	19.98848	8.84223	5.12868

Note:

1. ** and * indicate significance at the 0.05, and 0.1 levels, respectively.
2. Bootstrap critical values are obtained from 10,000 replications.

These results indicate that military spending does not play an important role for globalization in G7 countries. In contrast, in terms of globalization causality military expenditures, this study finds one-way Granger causality in Germany and Japan. These results indicate that when there is a globalization boom, military expenditures will decrease in these two countries (since this work find the coefficients for these two countries are all negative). Finally, the results show significant bilateral causality between globalization and military expenditures in Italy only. However, if we look at the coefficients, this study find that globalization negatively affects military spending (since the coefficient is negative), which is consistent with the view that globalization negatively impacts military spending. To summarize, this study find that globalization negatively affects military spending in Germany, Italy, and Japan. The fact that this feedback relationship is found in Italy implies that neither globalization nor military spending can be considered exogenous. Overall, our results indicate that military expenditure is not a strongly exogenous variable, relative to globalization, for most of the G7 countries under study.

As mentioned previously, the time series approaches overlook cross-sectional dependence across countries in the causality tests, and hence they may result in misleading inferences regarding the nature of causality between military spending and globalization. This study find strong evidence for the existence of cross-sectional dependence among these G7 countries, and therefore, it might be concluded that more appropriate policy implications can be derived from causality approaches that account for cross-sectional dependence. Furthermore, we also detect cross-country heterogeneity in the panel of G7 countries, implying that each country may develop its own military policies.

Table 3. Summary of Causality Test between Glob versus PRME of G7 countries

Countries	PRME → Glob	Glob → PRME	Effect
Canada	X	X	None
France	X	X	None
Germany	X	Δ	Globalization leading
Italy	↔	↔	Interaction causality
Japan	X	Δ	Globalization leading
United Kingdom	X	X	None
United States	X	X	None

Note:

“Δ” denotes granger cause from the left-hand side variable to the right-hand side variable.

“X” denotes no granger cause from the right-hand side and left-hand side variable.

“↔” denotes interaction Granger causation from the right-hand and the left-hand side variable.

To have a clearer picture, the different results for military expenditures are compared, which included the globalization. Table 3 shows a summary of granger causality between military expenditures and globalization for G7 countries. The results indicate that Germany, and Japan show significant one-way granger causality from globalization influenced military expenditures. The evidence from

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Italy shows interaction causality between globalization and military expenditure. However, there was no evidence that military expenditures caused globalization in any G7 country. The other countries, i.e., Canada, France, the United Kingdom and the United States show that there is no significant relationship between globalization and military expenditures.

Our empirical results lead us to conclude that the relationship between military spending and globalization cannot be generalized across countries. This result agrees with the findings of others (Al-Yousif, 2002), who have concluded that military expenditure depends on a number of factors including: the nature of the expenditure; the prevailing circumstances; and the concurrent government policies.

This study evidence suggests that globalization contributes materially to military spending for most G7 countries by improving the government budget and by promoting a more efficient mix of activities than would be undertaken in the absence of nation risk-management instruments. This contribution is magnified by the complementary economic development of each country. In sum, our results show that the globalization and military spending nexus varies across countries with different conditions. Our results shed light on the bilateral causality between globalization and military expenditure, which no research paper has previously discussed.

4.1. Economic and Policy Implications

To explore the effect of globalization on the development of military spending is quite crucial. From the viewpoint of policy-makers, globalization is a form of liberalization related to economic, political, and socio-cultural aspects of the economy. If globalization does impact military spending, any globalization policy may influence drops in military spending. These studies have the following implications.

First, globalization causally influences military spending in Germany, and Japan, suggesting that in these countries, globalization stimulates reductions in military spending. Among these sample countries, Japan has the level of lowest globalization but the highest per capita real GDP. Military literature has documented that GDP is a very important determinant in regard to the demand for military spending and that it is positively correlated with military purchasing. Based on this observation, we can reasonably expect that Japan may have a relatively high level of military development given that it has the highest mean income level among our sample countries. After controlling for real per capita GDP, we find significant evidence of a causal relationship between globalization and military spending in Japan, which implies that globalization could be a factor that stimulates military cutbacks for governments with high income levels. Although our sampling only focuses on the G7 countries, it is reasonable to apply our findings to other countries (e.g., Asian, and OECD countries). Historically, all of the nations have had huge impacts on each other throughout world history. They are all the original members of the OECD and the G8; they show the European and

Asian economic trends. For 2010, some of the most extensive military spending happened in Asia and the OECD; they have many similarities in economic and military aspects.

We find that Germany, and Japan have very similar GDP growth trends; growth rose from 1988 to 2008 gradually, fell in 2009, then rose up again in 2012. Regarding the globalization and military spending nexus in Germany and Japan, we find significant relationships between these countries. These results indicate that globalization does play an important role for military spending in Germany and Japan.

Second, the level of military spending does not increase globalization. We find evidence in the case of all G7 countries; they all have high military expenditures, but no one-way Granger causality. A possible reason for this result is that the increasing effect of globalization is large enough when the country already has a high level of military expenditures. This suggests that policies that promote globalization do not increase military spending when a country has a substantially developed military spending. All G7 countries a high level of globalization, but have no significant increase of military spending caused by globalization.

Thirdly, in the case of Italy, our empirical results from Table 2 suggest bidirectional Granger causality (feedback) between globalization and military spending. For example, a country with a high globalization rate may strengthen its external as well as internal security by decreasing military spending. With respect to Italy, the coefficients in both Table 2 show negative and significant impacts, and these results indicate that globalization and military spending negatively reinforce each other. This feedback relationship found in Italy implies that neither globalization nor military spending can be considered exogenous.

Fourthly, there is no causal linkage between military expenditures and globalization in Canada, France, the United Kingdom and the United States. One interesting finding in this study is these four countries all had high overall Globalization indexes of about 75 during the period of 1996 to 2011; however, this study do not find any causal link between globalization and military spending in these countries.

Finally, and most importantly, our findings reveal that cross-sectional dependence and slope heterogeneity exist across our sample countries. This suggests that there is a dynamic effect between globalization and military spending across the G7 countries. Put another way, homogeneity should exist to some extent in these countries. In this situation, we still find a heterogeneous relationship between globalization and military spending across these countries. What does this imply? It implies that cross-sectional dependence and slope heterogeneity should be seriously considered in a cross-country investigation, particularly in a broad sample covering many countries with substantial differences. Ignoring this potential problem may generate biased results and produce misleading inferences, which can lead to incorrect policy suggestions.

5. Conclusions

In this study, the causal linkages between globalization and military expenditure are analyzed by applying the bootstrap panel Granger causality approach using data from G7 countries over the period 1988 to 2011. We find that (i) there is one-way Granger causality from globalization to military expenditure in Germany, and Japan, (ii) there is no one-way Granger causality running from military expenditure to globalization in these countries (iii) there is a feedback between military expenditure and globalization in Italy, and (iv) there is no causal linkage between military expenditures and globalization in Canada, France, the UK, and the USA. Thus, our results show that causality exists between globalization and military expenditures, and causality varies across countries with different conditions. The results obtained from this study provide important policy implications for these G7 countries that will assist them to develop sound military strategies within the context of globalization.

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