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The Causality Relationship between Military Expenditure and GDP in 12 NATO Member Countries based on Per Capita Values

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12 NATO Üyesi Ülkede Kişi Başı Değerlere Dayalı Askeri Harcamalar ve GSYH Nedensellik İlişkisi

Abstract

This study deals with the relationship between per capita real GDP, per capita real military expenditure, and per capita real capital in 12 NATO member countries from 1995-2020. The country group is chosen from Central and Eastern European countries depending on their common properties. Bai and Ng (2004) PANIC, Westerlund and Edgerton (2008) structural break co-integration, and Konya (2006) bootstrap panel causality tests were applied to consider cross-sectional dependence, respectively. Meanwhile, the convergence of the 12 countries' military expenditure in Russia is discussed. It is seen that there is weak evidence for this convergence. According to bootstrap panel causality findings, there is strong evidence in 5 countries based on the non-existence of causality. Therefore, Neutrality Hypothesis is valid in Croatia, Estonia, Latvia, Lithuania, and Turkey.

Keywords : Military Expenditure, GDP, Capital, Cross-Sectional Dependence, Bootstrap Causality.

JEL Classification Codes : C33, E13, H56.

Öz

Bu çalışma 12 NATO üyesi ülkede kişi başına reel GSYH, kişi başına reel askeri harcama ve kişi başına reel sermaye arasındaki ilişkiyi 1995-2020 dönemi için ele almaktadır. Yatay kesit bağımlılığını dikkate almak için sırasıyla Bai ve Ng (2004) PANIC, Westerlund ve Edgerton (2008) yapısal kırılma eşbütünleşme ve Konya (2006) bootstrap paneli nedensellik testleri uygulanmıştır. Aynı zamanda, 12 ülkenin kişi başına reel askeri harcamasının Rusya'ya yakınsaması tartışılmaktadır. Bu yakınsama için zayıf bulguların mevcut olduğu görülmektedir. Bootstrap panel nedensellik bulgularına göre 5 ülkede nedenselliğin olmadığına dair kuvvetli kanıtlar mevcuttur. Bu nedenle, Hırvatistan, Estonya, Letonya, Litvanya ve Türkiye'de Yansızlık Hipotezi geçerlidir.

Anahtar Sözcükler : Askeri Harcama, GSYH, Sermaye, Yatay Kesit Bağımlılığı, Bootstrap Nedensellik.

1. Introduction

Economists have long discussed the relationship between military spending and economic growth in the literature. There are different investigations on the impact of military expenditure on economic growth and the direction of this relationship. Benoit (1978: 271) is one of the leading economists who deal with this issue based on the weight of the defence budget. He asserted that developing countries with high military budgets had a high level of economic growth, whereas those with low military budgets had low growth.

Benoit (1978: 271) separates the impact of military spending on economic growth for developed and developing countries. Mainstream economics has accepted that military spending decreases available resources for investment and reduces the growth rate in developed countries. On the other hand, Benoit (1978: 276-277) states that only a limited amount of income does not spend on the military goes to productive ways in less developed countries. Meanwhile, the military programs of these countries can create a contribution to their economies from various directions. First, military spending can increase nutritional and dressing facilities in less developed countries. Secondly, technical training, repair, and maintenance can create civilian benefits to society.

Moreover, works and maintenance in public affairs like roads and barrages can provide civilian externalities. Vocational activities in the military can also reduce unemployment with R&D spill-overs to civil society. The internet was one of the military's most important R&D spill-over impacts on civil society. The internet was born by the US Defence Department Advanced Research Projects Agency (DARPA) to avoid collapsing a communication network in the USA in the 1960s (Castells, 2008: 7). So, it can be claimed that there can be a positive causality impact operating from military expenditure to economic growth due to those kinds of utilities.

The direction of interaction is from military to growth, providing that aggregate demand is initially less than aggregate supply. The additional demand created by the army sector increases utilisation of capital accumulation, decreases resource cost, and generates other labour employment if resources exist at capacity utilisation. The increment in demand leads to more efficient resource utilisation, which stimulates investment and rises growth at the end (Değer, 1986: 182). Dunne et al. (2005: 450) express this positive direction of impact as a Keynesian multiplier effect based on demand-side analysis. An increment in military spending increases demands if there is insufficient capacity in the economy. So, resources are utilised more efficiently while employment levels start to increase.

The negative impact of military spending on growth is related to the reallocation of the resources, which is also the idea of mainstream economics leaning on the crowding-out effect. The increment in military spending can divert resources from productive ways as an opportunity cost of investment by enlarging the saving-investment gap. It also creates a balance of payment problem for the economy if the imports of arms products have a heavy burden on the budget. So, it causes shrinkage in the growth capacity (Değer, 1986: 183).

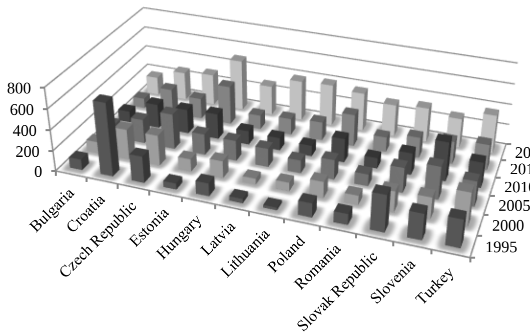
Moreover, Lim (1983: 379) states that a higher economic growth rate can be achieved due to the elevation of capital productivity. Değer (1986) discusses the impact of military expenditure through capital accumulation. If the increment in defence burden reduces the capital formation for the new investments, then economic growth is hindered by capital stock in quality and quantity.

Rosh (1988: 672-673) introduces the concept of the security web, which is the mutual security perception of a regional group of countries against an external threat. Higher militarisation of other countries in the regional groups can lead to more military expenditure for an individual country. According to Kohler (1979: 120), determining the reason behind military spending takes importance for its increment, decrement, or stagnation. The cycle of military expenditures can be due to modernisation of armament, increment in quality of forces, innovations for internal and external trade benefits, etc. This is in line with Dunne and Perlo-Freeman (2003: 25); the overall economic environment can determine the military burden in time.

On the other hand, military expenditures are a component of government spending. So, the increment in the military can be positively caused by Gross Domestic Product if tax revenue is income elastic based on Wagner’s Law (Rosh, 1988: 675); if not, it is expected to affect it negatively. A high level of economic growth can bring a higher defence budget by rapidly rising tax revenue depending on the power of the defence lobby. Moreover, highly income rising or rich countries can expand more on defence easily relative to others (Benoit, 1978: 275).

CEE (Central and Eastern European) countries have exercised radical changes from planned to market economies and experienced a political shift built upon democracy after the 1990s. Besides, 11 CEE countries (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia) become members of the European Union and the NATO (North Atlantic Treaty Organization) on different dates. So, it can be interpreted that these 11 countries have experienced a radical transformation of economics, politics, and social order. As a result, their institutional orders and living arrangements become subject to investigation. The new conditions can also be dealt with from social and ideological synthesis. But one of the stubborn facts is the social consequences of this transilience. It brought a new solution to social and political problems, given democratic institutions and people’s freedom in this region. So, these countries are one of the most rapid Westernization examples related to their developments. Turkey can be seen as the border of the CEE region and has some standard features with these countries. Turkey is added to this country sample due to its geographical position. Turkey is also a member of NATO since 1952 and has been in accession negotiation with the EU (European Union) since the 1963 Ankara Treaty.

Figure: 1
Per Capita Real Military Expenditure of 12 Countries (Millions of US$)



Source: Author's calculation.

Per capita, real military expenditure values of 12 countries are indicated in Figure 1. Military expenditure data of countries are attained from Stockholm International Peace Research Institute (SIPRI, 2021), which is expressed at 2019 constant prices. This data is transformed into 2010 prices and then divided by the midyear population data of countries attained from World Development Indicators (WDI, 2021). First of all, the 1995 high value of Croatia is related to the Bosnia War, realised between 1992-1995. However, it is seen that there is an increment in the per capita real values in time. The average weight of 12 countries was 200 in 1995, whereas this value reached approximately 336 in 2020. Beswick (2019) states that one of the fundamental rise reasons of military expenditure is related to the expansion of Russia into the territory. Crane (1987) examined the military spending composition of the region during the era of the Soviet Union. So, the military convergence of these 12 countries to Russia becomes a subject of interrogation to reveal the tension level of these countries.

This study asks the question of whether a general pattern is possible for these 12 countries from the aspect of nexus among per capita real military expenditure, per capita real capital, and per capita real GDP (Gross Domestic Product). First of all, unit root structure has been investigated considering cross-sectional dependence. Then, the co-integration relationship has been put forward depending on cross-sectional dependence and structural break. In the last step, bivariate and trivariate bootstrap panel Granger causality findings have been explored among variables by considering per capita capital structure and time trend methodologically in the light of Konya's (2006) study.

2. Literature Review

Joerding (1986) examines the relationship between military expenditure and economic growth with the Granger causality method in 57 less developed countries. Military spending is diversified with two different measurements as ACDA (Arms Control and

Disarmament Agency) and SIPRI. It is obtained that the significant Granger causality findings are from growth to military in two measures. Biswas and Ram (1986) evaluate the relationship with the augmented growth model based on the Feder approach in low- and middle-income countries. It is seen that the effect of the military on growth is negative from 1960 to 1970 in low-income countries, whereas it transformed into positive from 1970 to 1977. Kusi (1994) takes the same issue with the Granger causality method in 77 developing countries from 1971-1989. Findings demonstrate no causal linkage in 62 countries, but the remaining countries do not reflect a common pattern. Smith (1980) dealt with subjects in terms of investment and reached a negative association in 14 OECD countries. Cappelen et al. (1984) investigate the impact of the military on growth in 72 common sample countries, which consist of large, Mediterranean, and small country groups. Findings reflect that the effect of the military on growth is positive and significant in Mediterranean countries. In addition, Frederiksen and Looney (1983) express that the military’s influence on growth is negative and significant in resource constraint countries, while it is significant and positive in resource-abundant countries. Classification of resource abundancy is determined with cluster analysis of 9 variables based on savings, import level, investment productivity, and foreign exchange availability.

Karagol and Palaz (2004: 290) specify that the direction and measure of causality nexus between military expenditure and economic growth can bring some policy implications. If military spending foregoes growth, government intervention can be anticipated. A positive relationship signals aggregate demand expansion, whereas an adverse effect is related to the crowding-out effect. Kollias et al. (2004) investigate the causality relationship between military spending and growth for 15 EU countries. Kollias et al. (2004: 557) state that causality from military to growth reflects aggregate demand and employment effect originating from R&D activities and military production. But causality from growth to military indicates security impact that countries are trying to protect their welfare and citizens from external threats. So, unidirectional causality from military to growth is based on economic reasons, while the reverse relies on geopolitical and security motives. However, Kollias et al. (2004) signify that causality from growth to military can also be a defence policy response for the state of the economy. The economy’s strength is stated as the best warranty for security (Treddenick, 1996: 645).

On the contrary, Marxist thought declares the positive impact of military expenditure on growth as a security effect. A rise in military spending can increase economic growth via the safety of capital and citizens in favour of disposing of domestic and foreign threats (Hatemi-J et al., 2017: 1194). Moreover, bidirectional causality between military and growth reflects the existence of Keynesian aggregate demand effects due to reciprocal dependence (Kollias et al., 2004: 561), which is expressed as a “feedback effect” (Chowdhury, 1991: 87). Military expenditure is represented as a ratio of GDP, whereas the rate of change in GDP represents growth. Consequently, seven countries have unidirectional causality from growth to military, three countries (Austria, Denmark, and Luxemburg) have reciprocal causality, and the other three (France, Finland, and Portugal) have no causality. Besides, three countries (Belgium, Greece, and Ireland) do not have a co-integration relationship (Kollias et al., 2004).

Chang et al. (2014) examine the bootstrap causal relationship between military spending and growth for G7 countries and China in a common sample for 1988-2010. Chang et al. (2014) express that military spending can guide higher growth by uprising aggregate demand. On the other hand, if the military expenditure is financed by taxes or borrowing, then a detrimental effect (Military-Growth Detriment Hypothesis) of the military on growth can arise due to crowding out the impact on private investment (guns or butter). If the military expenditure is financed with funds from non-military investment programs, then a detrimental effect on growth can arise (Lim, 1983: 383). Competition among sectors is expected for funding if the defence budget is set more for fiscal reasons than threat reasons (Treddenick, 1996: 645).

Meanwhile, Değer (1986: 189) declares that economic growth can negatively affect the military burden due to the need to spend more on defence, possibly through more imported armaments. So, it is important to reveal the relationship between military expenditure and growth to enlighten policymakers on a better military strategy. Chang et al. (2014) apply the bootstrap panel causality method due to cross-sectional dependency and heterogeneity in the panel. The Neutrality Hypothesis is valid for France, Germany, and Italy in causality findings. In contrast, Military-Growth Detriment Hypothesis is valid for Canada, Japan, the UK, and the USA due to significant negative causality from military to growth. Besides, there is significant positive causality from the growth of the military in China, Japan, and the USA.

Pan et al. (2015) search the relationship between per capita real GDP and per capita real military expenditure with a bootstrap panel causality approach in 10 Middle Eastern countries from 1988-2010. There is unidirectional causality from military to growth in Turkey and growth in the military in Egypt, Kuwait, Lebanon, and Syria. Meanwhile, there is bidirectional causality in Israel, and Neutrality Hypothesis is supported in Bahrain, Jordan, Oman, and Saudi Arabia. Destek and Okumus (2016) also refer to the bootstrap panel causality method for BRICS and MIST countries in a typical sample from 1990-2013. While there is a one-way negative causality from military to growth in Turkey, there is one-way positive causality from military to growth in China. Two-way causality is valid in Russia; the remaining countries reflect the Neutrality Hypothesis. Aye et al. (2014) employ a bootstrap causality approach in South Africa from 1951 to 2010. Findings indicate the Neutrality Hypothesis for the whole period.

Topçu and Aras (2017) seek the relationship between military expenditures and growth in CEE countries based on co-integration and causality methods for 1993-2013. According to Westerlund's (2007) co-integration findings, series are not co-integrated, and the significant causality is from growth to military. Yıldırım et al. (2005) investigate the relationship leaning on the Feder model in the Middle East countries from 1989 to 1999. In terms of panel GMM findings, the increment at the rate of change in military expenditure has a significant positive impact on the growth. Besides, Öcal and Yıldırım (2009) investigated the arms race between Greece and Turkey based on the nonlinear co-integration specification for the period 1956-2003. According to TAR and m-TAR models, Turkey has an asymmetric adjustment at the long-run equilibrium. Tütüncü and Şahingöz (2020) deal with an arms race between Greece and Turkey with bootstrap causality and asymmetric causality. While there is one-way causality from Greece to Turkey depending on bootstrap causality, there is bidirectional causality leaning on asymmetric causality. Topçu et al. (2013) assess the nexus between the old and new members of the EU separately from 1988 to 2012. Concerning Pedroni's co-integration findings, all series are co-integrated. In the Granger Causality finding, causality is from growth to military in both old and new member countries. Karadam et al. (2017) search the non-linear relationship in Middle East countries and Turkey from 1988 to 2012. According to PSTR model findings, the impact of the military on growth is positive at the low regime, whereas it transforms into negative at the high regime. However, Koçbulut and Altıntaş (2021) interrogate the same relationship with the panel threshold model in 17 OECD countries from 1995-2018. The impact of the military on growth is positive above a certain threshold level.

Özşahin and Üçler (2021) examine the relationship between military spending and employment based on Konya's (2006) bootstrap panel causality test in 18 NATO member countries for the post-cold war period of 1991-2018. In terms of findings, both variables suffer from cross-sectional dependence, and the SUR model is one of the solutions for contemporaneous correlation. There is a unidirectional causality running from military to employment in Denmark, France, and Germany, whereas causality is from employment to military in Italy. While there is bidirectional causality in Luxemburg and Poland, the remaining countries reflect the Neutrality Hypothesis. So, it is not possible to claim a common conclusion for these 18 NATO member countries. Hatemi-J et al. (2017) investigate bivariate asymmetric causality in 6 defence spender countries at the top level for 1980-2013. There is unidirectional positive causality running from military to growth in China and Japan, called Military Spending-Led Hypothesis. Kollias et al. (2004: 557) denominate this as a "spin-off effect" due to the high impact of the military on aggregate demand, employment, and military R&D. There is unidirectional positive causality running from growth to military in France, Russia, Saudi Arabia, and the USA, which is claimed as Growth-Led Hypothesis by Hatemi-J et al. (2017). Destek (2015) applies asymmetric causality in G-6 countries from 1960 to 2013. There exist one-way negative causality operating from military to growth in France, Germany, and the UK; Neutrality Hypothesis is valid in Canada and Italy. Gül and Torusdağ (2020) examine the relationship between inflation and military expenditure with a bootstrap panel approach in 25 NATO member countries from 1990-2018. There is a unidirectional causality running from inflation to military in England, Croatia, the Czech Republic, Estonia, Latvia, and the United States.

Saba and Ngepah (2019) evaluate the relationship in 35 African countries based on Dumitrescu and Hurlin's (2012) panel causality method for 1990-2015. From the findings, there is no common pattern for all African countries. Despite these 12 countries reflecting bidirectional causality, both policies related to military spending or growth affect each other mutually. Çolak and Özkaya (2020) deal with the issue of external debt in Transition Economies for the period 1997-2016. Two significant thresholds exist in the model based on panel threshold regression findings, and military expenditure does not create a significant burden on external debt up to the first threshold point. After this point burden of debt starts to increase, indicating the arms race and security motives in the region. Esener and Ipek (2015) state that the impact of military spending on external debt is positive and significant in 36 developing countries, depending on GMM findings.

Moreover, Altınok and Arslan (2020) investigated the relationship between public expenditure and real growth based on the bootstrap panel causality method for 2002-2017 in South-eastern European countries. There is one-way causality from growth to public spending in all countries, except Bulgaria and Turkey. There is one-way causality from public spending to growth in all countries except North Macedonia.

Zhong et al. (2015) deal with unemployment in a common sample of G7 countries leaning on bootstrap panel causality from 1988 to 2012. First of all, cross-sectional dependency and heterogeneity of the panel are evaluated, and it is seen that both dependence and heterogeneity are present in the model. There is bidirectional causality in Italy and the United Kingdom, notwithstanding that Italy's estimated coefficient is negative for the causality running from military to unemployment. While there is one-way positive causality operating from military to unemployment in Canada and Japan, there is negative causality from unemployment to the military in France and Germany. Yildirim and Sezgin (2003) discuss the relationship from employment depending on the ARDL model in Turkey from 1950 to 1997. Findings reflect that the effect of the military on employment is negative and significant both in the short and the long run.

Zhong et al. (2016) focus on the nexus between military expenditure and growth for BRICS and USA in a common sample for 1988-2012. According to bootstrap panel causality findings, there is negative causality running from military to per capita real GDP in Russia and USA. In contrast, positive causality runs in the reverse direction in Brazil, India, and Russia. Ceyhan and Köstekçi (2021) searched the relationship between military growth and unemployment in Turkey from 1988 to 2019. According to FMOLS (Fully Modified OLS) findings, military spending has a cumulative effect on growth and unemployment in the long run.

On the other hand, Topal (2018) investigates the relationship between military and growth with the time-varying causality method in Turkey from 1960 to 2016. Due to economic and political reasons, the causal link weakened after the mid of 1970s. Finally, Alptekin and Levine (2012) resort to the Meta approach leaning on estimates of 32 empirical studies. Findings reflect that Military Spending-Led Hypothesis is valid in developed countries, and there is evidence for the non-linear relationship.

3. Theoretical Model

Heo (1999: 700) states that military expenditure is a component of government expenditure, and additional spending can be financed by income taxes, budget deficit, or issuing new money. So, the increment in military expenditure brings either a tax burden, more budget deficit, or both. Değer and Smith (1983: 337) declare that military spending deflects resources at the expense of foregone investment and consumption. Besides, a balance of payment cost arises if a high amount of military equipment is imported abroad. That is to say, the government increases the debt burden to compensate for defence spending, and interest rates start to increase, decreasing investment and/or raising the balance of payment gap. So, military expenditure is taken into aggregate production function to reflect the crowding-out effect frankly (Heo, 1999: 700; Chang et al., 2014: 180).

$$GDP_{it} = A.f(K_{it}, L_{it}, ME_{it}) \tag{1}$$

Following Chang et al.'s (2014) theoretical discussion, the aggregate production function is presumed as Cobb-Douglas type and has constant return to scale at Equation 1.

$$GDP_{it} = A.f\left(K_{it}^{\alpha}, L_{it}^{1-\alpha-\beta}, ME_{it}^{\beta}\right) \tag{2}$$

A represents technological progress, α measures capital elasticity of output, β measures military elasticity of output, and $1 - \alpha - \beta$ measures labour elasticity of output. Even this, values are divided to the population at Equation 2, then logarithm is taken to express elasticities of values at the analysis.

$$lgdp_{it} = \alpha_{it} + \beta 1.lk_{it} + \beta 2.lme_{it} + \theta.T_{it} + \varepsilon_{it} \tag{3}$$

Equation 3 represents the final version of the theoretical model, where ε_{it} represents the random error term, and T is added to the proxy time trend. Since per capita values ensure variables in the same units for large and small countries and are less sensitive to regional fluctuations, it is preferred to labour to avoid the scale effect by following Chang et al. (2014). $lgdp$ is the per capita real GDP, lk is the per capita real capital and lme is the per capita real military expenditure.

4. Dataset and Methodology

Annual data covers the period of 1995-2020 for 12 countries for the relationship between per capita real GDP, per capita real military expenditure, and per capita real capital. Military expenditure data is attained from SIPRI (2021), which publishes it at 2019 constant prices. It is first transformed into 2010 prices and then divided by the mid-year population of countries, respectively. The data of gross capital formation (2010 constant) and per capita GDP (2010 constant) are obtained from WDI (2021). Gross capital formation is expressed as gross domestic investment consisting of expenditures and the fixed assets of the economy and net changes in the level of inventories, which is also divided by the mid-year population of each country. All variables are transformed to logarithmic values at the final step.

Further, correlation analysis was realised among variables. The correlation coefficient between lgdp and lme is 0.34, and the coefficient between lme and lk is 0.42, indicating moderate positive correlations. Nevertheless, the correlation coefficient between lgdp and lk is 0.94, which points strong positive correlation relationship (Ratner, 2009: 140). This knowledge is taken into consideration in the co-integration analysis. It is observed that all variables have an increment trend in time. So that time trend is added to models.

4.1. Empirical Methodology

The scientific view interrogates the reality of nature as a fundamental objective, so it examines beliefs, values, and conceptual and experimental tool communities as a whole. The main task of scientists is to reveal the truth by eliminating all illusions of prejudice and dogmatic inferences in the light of experiments and laboratories. Like this, objective reality is reached owing to clear vision and impartiality (Kuhn, 1963: 347). Social scientists tempt to put forward possible nexus among variables based on their gaugeable values. Whether a case that occurred in one part of the world can cause an event in a different part of the world in a forward time becomes an inquiry (Granger, 1980: 331). This inquiry can be answered with observable values and an appropriate analysis of the dataset's properties.

If past values of Y_t serves to estimate containing information of X_t, and if this information does not exist in any other predictor series, then Y_t is asserted to cause X_t (Granger, 1969: 430). The flow of time has a central role in this definition depending on entropy. The past value of one variable gives information to forecast the present and future values, but not reversible. Meanwhile, this definition brings a stationarity pre-requirement for the series (Granger, 1980: 338-349). If the economic series are non-stationary, it makes an economic shock continuous for a random walk process. For instance, ρ takes the value of 1 in $y_t = \rho y_{t-1} + \varepsilon_t$ AR(1) autoregressive process, if there is the unit root at the series (Wooldridge, 2013: 639). So, the unit root makes the estimator biased and inconsistent at OLS (Ordinary Least Square) estimations. Another issue is related to dependency on cross-section units in the panel. Cross-sectional dependence entails biased and size distorted estimation if neglected (Pesaran, 2006: 992).

Zellner (1962: 349-351) claims that simultaneous equation by equation estimation of SUR (Seemingly Unrelated Regression) yields more consistent findings than OLS single equation estimations. Konya (2006: 982) enlarges this issue by applying the SUR estimator to the panel causality model with the bootstrap procedure. This method produces solutions to difficulties related to panel causality estimations. SUR estimator considers the cross-sectional dependency situation of units at estimation. By the way, cross-correlations of errors can be modelled with the SUR estimator (Pesaran, 2021: 13). It allows simultaneous correlation among panel units, which rescues the necessity of joint homogeneity for all panel members. Besides, it unencumbers the pretesting requirements of unit root and co-integration by adding maximum integration into estimation with bootstrap error terms. Wald test determines the direction of causality with country-specific bootstrap critical values

(Konya, 2006: 979). So, the bootstrap methodology does not affect panel unit root and co-integration structures.

This study establishes a causality relationship among lgdp, lme, and lk. For this purpose, the cross-sectional dependency situation of variables is investigated in the empirical part. Unit root situation of variables is assessed with ADF and PP tests by ignoring cross-section dependency. Then PANIC test procedure is applied by considering cross-sectional dependence. In the second part of the unit root interrogation, the lme value of each country relative to Russia is analysed with a PANIC test to reveal the military convergence situation of these countries towards Russia. In the third step, the co-integration situation of variables is assayed with Westerlund and Edgerton’s (2008) structural break test. The final step is to examine bivariate and trivariate causality among variables using Konya’s (2006) methodology with time trend impact.

4.1.1. Cross-Sectional Dependence

Cross-sectional dependence is the correlation in panel units. Breusch and Pagan (1980: 247) set forth Lagrange Multiplier (LM) to identify cross-sectional dependence in the panel.

$$LM = T\sum_{i=1}^{N}\sum_{j=1}^{N-1}\rho_{ij}^2 \tag{4}$$

LM test is displayed at Equation 4, where ρ_{ij}^2 reflects estimated coefficient of correlation from OLS single equation model and has (χ^2) distribution with $\left(\frac{Nx(N-1)}{2}\right)$ degrees of freedom. Cross sectional dependence is identified with the null hypothesis of $H_0: Cov(\varepsilon_{it}, \varepsilon_{jt}) = 0$ for $i = j$, against the alternative hypothesis of $H_A: Cov(\varepsilon_{it}, \varepsilon_{jt}) \neq 0$ for at least one pairwise of $i \neq j$ (Menyah et al., 2014: 390).

Pesaran (2021: 13) claims that the LM test is more appropriate when the time (T) dimension is larger than the cross-section (N) dimension. So, Pesaran (2021: 22) introduces the CD test for large N and small T dimensions.

$$CD = \sqrt{\frac{2T}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\rho_{ij} \tag{5}$$

Pesaran (2021: 18) emphasises the size distortion problem in the LM test and propounds the CD_{LM} test for large N and T dimensions, which have a standard normal distribution (Kar et al., 2011: 691).

$$CD_{LM} = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T\rho_{ij}^2 - 1) \tag{6}$$

Pesaran et al. (2008: 106) introduce the bias-adjusted LM test as an alternative to the LM test, which heads the exact average and variance of the test statistic with strictly exogenous regressors and normal residuals.

$$LM_{adj} = \sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \frac{(T-k)\rho_{ij}^2 \mu_{Tij}}{v_{Tij}} \tag{7}$$

This test is also consistent with near-zero values of the cross-sectional average of factor loadings. The bias-adjusted LM test is more appropriate for large N and T dimensions.

$$\tilde{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S}-k}{\sqrt{2k}}\right) \text{ and } \tilde{\Delta}_{adj} = \sqrt{N}\left(\frac{N^{-1}\tilde{S}-E(\tilde{Z}_{it})}{\sqrt{var(\tilde{Z}_{it})}}\right) \tag{8}$$

Pesaran and Yamagata (2008: 57) introduce delta and adjusted-delta tests to check homogeneity in the panel. The null hypothesis of homogeneity $(H_0: \beta_i = \beta_j)$ is tested against the $(H_A: \beta_i \neq \beta_j)$ alternative hypothesis. The Delta test is more convenient than the adjusted-delta for large samples.

4.1.2. Unit Root and Co-integration along with Cross-Sectional Dependence

Bai and Ng (2004: 1127-1128) propose a Panel Analysis of Non-stationarity in Idiosyncratic and Common (PANIC) test in the detection of unit root depending on common factor component in case of cross-sectional dependency at second-generation panels.

$$X_{it} = D_{it} + \lambda_i' F_t + e_{it} \tag{9}$$

The model of the PANIC test is demonstrated at Equation 9, where D_{it} is the polynomial trend function, F_t is the $rx1$ common factor vector, λ_i is the factor loadings vector, X_{it} is the deterministic component, and e_{it} is the idiosyncratic error term. Idiosyncratic error term consists of two components; one is more of an idiosyncratic and the other a small number of common factors. The number of common factors is discretionarily determined but must lean on a theoretical background for the soundness of the analysis. If the F_t is found stationary at the model, then e_{it} becomes the source of the unit root. In addition, the principal component is applied to the first difference equation model, and loadings and common factors of each model are estimated with ADF regressions. Stationarity is examined leaning on the homogeneity situation of the panel under the null hypothesis of the presence of unit root.

Westerlund and Edgerton (2008: 668-670) put forward a co-integration test that takes both structural break and cross-sectional dependence into consideration.

$$y_{it} = \alpha_i + \eta_i t + \delta_i D_{it} + x_{it}' \beta_i + (D_{it} x_{it})' \gamma_i + z_{it} \tag{10}$$

$$x_{it} = x_{it-1} + w_{it} \tag{11}$$

Scalar models are expressed at Equations 10 and 11, where D_{it} is the scalar dummy, α_i is the intercept, and β_i is the slope. δ_i and γ_i are parameters at the time of the structural break. This test is extended with unobserved common factor component by inspiring from Bai and Ng (2004), and z_{it} consists of both idiosyncratic and common factors $(F_t + v_{it})$ as a solution to cross-sectional dependence.

$$LM_\tau(i) = \frac{\hat{\phi}_i}{SE(\hat{\phi}_i)} \; and \; LM_\phi(i) = T\hat{\phi}_i\left(\frac{\hat{w}_i}{\hat{\sigma}_i}\right) \tag{12}$$

Breaks are enlarged towards three-shift situations without shift, level shift, and regime shift. By this way, three different shift situations can be investigated on the brink of no break, break at the intercept, and break at the slope. Co-integration is examined with the LM test by diversifying with Tau (τ) and Phi (ϕ) statistics under the null hypothesis of no co-integration. $\hat{\phi}$ is the estimated standard error of ϕ, and also it is the parameter of restricted maximum likelihood estimate of α at the first difference error model. While $SE(\hat{\phi}_i)$ is the standard error of $\hat{\phi}_i$, $\hat{w}_i$ is the estimated standard deviation of Δv_{it} (Westerlund & Edgerton, 2008: 671-673).

4.1.3. Bootstrap Panel Causality

Konya (2006: 979) introduces the SUR equation by equation method into Granger Causality with critical bootstrap values. The bootstrap method induces to remove the pre-requirement of unit root and co-integration investigation, whereas the SUR method resolves the cross-sectional dependence problem by modelling cross-correlations of errors. Meanwhile, the SUR method does not require homogeneity in panel estimation due to contemporaneous correlation among panel units.

$$\begin{aligned}
lgdp_{1,t} &= \alpha_{1,1} + \textstyle\sum_{l=1}^{llgdp1} \beta_{1,1,l}\, lgdp_{1,t-1} + \sum_{l=1}^{llme1} \theta_{1,1,l}\, lme_{1,t-1} + \varepsilon_{1,1,t} \\
lgdp_{2,t} &= \alpha_{1,2} + \textstyle\sum_{l=1}^{llgdp1} \beta_{1,2,l}\, lgdp_{2,t-1} + \sum_{l=1}^{llme1} \theta_{1,2,l}\, lme_{2,t-1} + \varepsilon_{1,2,t} \\
&\vdots \\
lgdp_{N,t} &= \alpha_{1,N} + \textstyle\sum_{l=1}^{llgdp1} \beta_{1,N,l}\, lgdp_{N,t-1} + \sum_{l=1}^{llme1} \theta_{1,N,l}\, lme_{N,t-1} + \varepsilon_{1,N,t}
\end{aligned} \tag{13}$$

$$and$$

$$\begin{aligned}
lme_{1,t} &= \alpha_{2,1} + \textstyle\sum_{l=1}^{llgdp2} \beta_{2,1,l}\, lgdp_{1,t-1} + \sum_{l=1}^{llme2} \theta_{2,1,l}\, lme_{1,t-1} + \varepsilon_{2,1,t} \\
lme_{2,t} &= \alpha_{2,2} + \textstyle\sum_{l=1}^{llgdp2} \beta_{2,2,l}\, lgdp_{2,t-1} + \sum_{l=1}^{llme2} \theta_{2,2,l}\, lme_{2,t-1} + \varepsilon_{2,2,t} \\
&\vdots \\
lme_{N,t} &= \alpha_{2,N} + \textstyle\sum_{l=1}^{llgdp2} \beta_{2,N,l}\, lgdp_{N,t-1} + \sum_{l=1}^{llme2} \theta_{2,N,l}\, lme_{N,t-1} + \varepsilon_{2,N,t}
\end{aligned} \tag{14}$$

Bivariate SUR model simultaneous systems are demonstrated at Equations 13 and 14. l is the lag length of the system, $\varepsilon_{1,1,t}$ and $\varepsilon_{2,1,t}$ are white noises and correlated for each cross-section, but not among units. Unidirectional Granger Causality operates from lme to lgdp if in Equation 13 not all $\theta_{1,i}$'s are zero, but all $\beta_{2,i}$'s are zero in Equation 14. Besides, unidirectional causality operates from lgdp to lme if all $\theta_{1,i}$'s are zero in Equation 13, but not all $\beta_{2,i}$'s are zero in Equation 14. Finally, there is bidirectional causality between lme and lgdp if neither all $\beta_{2,i}$'s nor all $\theta_{1,i}$'s are zero, there is no Granger causality between lme and lgdp, if all $\beta_{2,i}$'s and $\theta_{1,i}$'s are zero.

$$\begin{aligned}
lgdp_{1,t} &= \alpha_{1,1} + \sum_{l=1}^{llgdp1} \beta_{1,1,l}\, lgdp_{1,t-1} + \sum_{l=1}^{llme1} \theta_{1,1,l}\, lme_{1,t-1} \sum_{l=1}^{llk1} \gamma_{1,1,l}\, lk_{1,t-1} + \varepsilon_{1,1,t} \\
lgdp_{2,t} &= \alpha_{1,2} + \sum_{l=1}^{llgdp1} \beta_{1,2,l}\, lgdp_{2,t-1} + \sum_{l=1}^{llme1} \theta_{1,2,l}\, lme_{2,t-1} + \sum_{l=1}^{llk1} \gamma_{1,2,l}\, lk_{2,t-1} + \varepsilon_{1,2,t} \qquad (15) \\
&\vdots \\
lgdp_{N,t} &= \alpha_{1,N} + \sum_{l=1}^{llgdp1} \beta_{1,N,l}\, lgdp_{N,t-1} + \sum_{l=1}^{llme1} \theta_{1,N,l}\, lme_{N,t-1} + \sum_{l=1}^{llk1} \gamma_{1,N,l}\, lk_{N,t-1} + \varepsilon_{1,N,t}
\end{aligned}$$

$$and$$

$$\begin{aligned}
lme_{1,t} &= \alpha_{2,1} + \sum_{l=1}^{llgdp2} \beta_{2,1,l}\, lgdp_{1,t-1} + \sum_{l=1}^{llme2} \theta_{2,1,l}\, lme_{1,t-1} + \sum_{l=1}^{llk2} \gamma_{2,1,l}\, lk_{1,t-1} + \varepsilon_{2,1,t} \\
lme_{2,t} &= \alpha_{2,2} + \sum_{l=1}^{llgdp2} \beta_{2,2,l}\, lgdp_{2,t-1} + \sum_{l=1}^{llme2} \theta_{2,2,l}\, lme_{2,t-1} + \sum_{l=1}^{llk2} \gamma_{2,2,l}\, lk_{2,t-1} + \varepsilon_{2,2,t} \qquad (16) \\
&\vdots \\
lme_{N,t} &= \alpha_{2,N} + \sum_{l=1}^{llgdp2} \beta_{2,N,l}\, lgdp_{N,t-1} + \sum_{l=1}^{llme2} \theta_{2,N,l}\, lme_{N,t-1} + \sum_{l=1}^{llk2} \gamma_{2,N,l}\, lk_{N,t-1} + \varepsilon_{2,N,t}
\end{aligned}$$

Konya (2006: 981-982) diversifies the causality model with the trivariate SUR system. So, lk is added to the system as a promotive variable. But lk does not directly affect Granger Causality as a joint cause; it is treated as an auxiliary variable at Equations 15 and 16.

4.2. Empirical Findings

First of all, the cross-sectional dependence situation of variables is evaluated to determine further estimations. Then, the unit root properties of variables are quested by considering the impact of cross-sectional dependence.

Table: 1
Findings of Cross-Sectional Dependence

Constant			
Tests	lgdp	lme	lk
LM1	210,145***	123,623***	106,924***
LM2	12,546***	5,015***	3,562***
CD	-1,810**	-2,709***	-2,351***
LM_{adj}	104,471***	1,856**	97,312***
Constant and Trend			
LM1	212,904***	114,631***	127,930***
LM2	12,786***	4,233***	5,390***
CD	-1,875**	-2,056**	-2,596***
LM_{adj}	98,836***	44,123***	91,854***

*Note: ***, ** indicate significance at the 1, and 5 per cent, respectively.*

Cross-sectional dependence creates size distorted and biased estimations. The cross-sectional dependence situation of variables takes importance in determining co-integration and causality models in particular to avoid inconsistent findings. Cross-sectional dependence features of variables are expressed in Table 1. It is seen that all variables suffer from cross-sectional dependence both in constant and constant and trend models. Besides, it is diagnosed that all variables have a trend in time. Therefore, constant and trend models are prioritised in interpreting findings in the further part of the analysis.

Table: 2
Findings of Unit Root

Variables	Constant		Constant and Trend	
	ADF	PP	ADF	PP
lgdp	19,324	23,073	14,102	9,429
D(lgdp)	88,638***	76,920***	73,012***	56,306***
lme	37,759**	22,447	17,497	8,013
D(lme)	97,714***	118,668***	76,414***	139,370***
lk	52,215***	32,933	39,169**	24,612
D(lk)	151,890***	140,197***	295,103***	159,706***

*Note: ***, ** indicate significance at the 1, and 5 per cent, respectively.*

Unit root findings of variables are reported in Table 2 by ignoring cross-sectional dependence. Schwartz information criterion is used for lag levels of ADF (Augmented Dickey-Fuller). ADF and PP (Phillips Perron) tests are reported depending on Fisher statistics. According to PP test findings, all variables have unit root at the level and become stationary at the first difference in both models. The PANIC test is used to consider cross-sectional dependence at unit root interrogation.

Table: 3
Findings of Unit Root under Cross-Sectional Dependency

Variables	Constant		Constant and Trend	
	Choi	Mw	Choi	Mw
lgdp	-2,526	6,502	0,701	28,853
D(lgdp)	3,912***	51,106***	1,636*	33,334*
lme	0,189	25,308	-0,873	17,953
D(lme)	2,619***	42,144**	2,783***	43,281***
lk	-1,172	15,879	0,534	27,699
D(lk)	4,994***	58,600***	2,495***	41,288**
military expenditure relative to Russia's	0,992	30,871	1,301*	33,012

*Note: ***, **, * denote significance at 1, 5, and 10 per cent, respectively.*

The findings of the PANIC test are demonstrated in Table 3. In terms of findings, all variables have unit root at the level and lead into stationary at the first difference in constant and constant and trend models leaning on Choi and Mw tests. All calculations are done with Gauss 21, and the maximum lag is pre-determined as 4. While the Schwartz information criterion is used for lag levels, many factors are appointed as 2. Thus, the existence of unit root refers continuous impact of economic shocks over these series.

Nonetheless, per capita real military expenditure (2010 constant) of 12 countries is relatively calculated to Russia's per capita real military expenditure (2010 constant) and added to the unit root investigation in Table 3. Liu et al. (2019) state that stationarity at the relative value of a country reflects the convergence situation of this country to another one. According to findings, per capita real military expenditure of 12 countries has weak evidence towards convergence to Russia based on Choi test finding. Weak evidence of convergence can correspond to low levels, but tension and armament competition exist in the region.

Table: 4
Co-integration, Cross-Sectional Dependence and Homogeneity

Tests	No Shift	Level Shift
Tau (τ) Statistics	-2,342 (0,001)***	-2,684 (0,003)***
Phi (Φ) Statistics	-1,114 (0,133)	-1,485 (0,068)*
Cross-Sectional Dependence in Model		
LM	265,703***	
CD_{LM}	17,382***	
CD	12,374***	
LM_{adj}	14,912***	
Homogeneity		
Delta	16,172***	
Adjusted Delta	17,522***	

*Note: ***, * denote significance at 1 and 10 per cent, respectively.*

Westerlund and Edgerton’s (2008) LM test co-integration findings are displayed in Table 4 depending on the theoretical model at Equation 3. Cross-sectional dependence in the model reflects the correlation among epsilons. Values in parenthesis reflect the probabilities of test statistics. In terms of findings, there is cross-sectional dependency among epsilons in the model. Meanwhile, co-integration depends on the Tau test in level shift and no shift models, which reject the null hypothesis at the 1% level. So, it means that series move together in the long run. Both delta and adjusted-delta tests reject homogeneity in the panel. It implies that countries can implement their policies separately from each other.

Table: 5
Findings of Regime Shift Co-integration and Break Dates

Countries	Break Date
Bulgaria	1998
Croatia	1998
Czech R.	2008
Estonia	2008
Hungary	2008
Latvia	2008
Lithuania	2008
Poland	2006
Romania	2008
Slovakia	2006
Slovenia	2008
Turkey	2000
Tau (τ) Statistics	-2,002 (0,023)**
Phi (Φ) Statistics	-1,401 (0,081)*

*Note: **, * denote significance at 5 and 10 per cent, respectively.*

The co-integration finding of the regime shift model takes place in Table 5. The trimming rate is 10%, and 4 is identified as the maximum lag length. The maximum factor is 2, and all calculations are done with Gauss 21. The null hypothesis of no co-integration is rejected in both Tau and Phi statistics. The break date is determined endogenously, and 2008 is assigned as a break for 7 countries: the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Romania, and Slovenia.

They are remaining analysis based on bootstrap panel causality to clarify the magnitude and direction of causality nexus between per capita real military expenditure and per capita real GDP and policy implications of countries. Causality models are scrutinised with trend structure. So, 8 different bootstrap causality situations arise from adding a third variable and time trend into models.

Table: 6
Bivariate Bootstrap Panel Causality I

Countries	**Ho:** lme does not cause lgdp				
	Coefficient	**Wald**	**Critical Values**		
			% 10	% 5	% 1
Bulgaria	0,011	0,504	12,744	21,502	81,613
Croatia	-0,084	14,958	19,041	27,412	57,168
Czech R.	-0,007	0,201	14,486	20,893	39,033
Estonia	0,047	4,200	19,308	29,139	54,982
Hungary	-0,015	0,710	9,822	14,697	28,683
Latvia	-0,0005	0,002	15,420	22,292	41,194
Lithuania	-0,013	1,453	15,037	21,338	39,645
Poland	0,0002	0,001	10,568	16,024	33,206
Romania	-0,023	1,292	9,763	14,514	29,174
Slovakia	-0,013	0,556	14,009	20,663	40,274
Slovenia	-0,011	1,250	16,732	24,692	46,102
Turkey	-0,084	4,556	10,031	15,305	31,898

Bivariate bootstrap causality is displayed in Table 6 from lme to lgdp. Bootstrap critical values are attained with the simulation of 10 thousand replications, and 1-4 is treated as lag length for all causality models. All causality calculations are done with TSP 5.0. There exist no significant findings for bootstrap causality running from lme to lgdp in any country. This finding signals a common pattern in which countries can determine their growth policy without caring about the impact of military policy. So, there is evidence to claim that these 12 countries can be categorised with the Neutrality Hypothesis. On the other hand, the trend's impact on causality is asked to clarify the issue due to its tendency in time.

Table: 7
Bivariate Bootstrap Panel Causality with Trend II

Countries	**Ho:** lme does not cause lgdp				
	Coefficient	**Wald**	**Critical Values**		
			% 10	% 5	% 1
Bulgaria	0,005	0,167	15,974	25,654	69,663
Croatia	-0,087	16,882	28,378	39,936	75,523
Czech R.	-0,018	0,356	13,518	19,826	35,935
Estonia	0,002	0,057	22,496	31,722	59,850
Hungary	0,091	19,214**	10,380	14,856	27,945
Latvia	-0,002	0,601	15,851	23,629	43,174
Lithuania	-0,022	11,048	18,579	26,730	45,676
Poland	0,007	0,000	14,735	22,859	49,706
Romania	-0,019	2,489	15,095	22,365	43,850
Slovakia	-0,033	5,015	14,866	21,446	39,726
Slovenia	0,002	0,192	20,490	29,544	59,920
Turkey	-0,086	13,225	18,923	27,798	59,187

*Note: ** denotes significance at 5%.*

Bivariate bootstrap panel causality with the trend is expressed in Table 7 from lme to lgdp. Time trend is a proxy variable and is assumed to be substituted for the missing variable from the model (Konya, 2006: 986). According to findings, there is bootstrap positive causality running from lme to lgdp just in Hungary; the remaining countries support Neutrality Hypothesis. The spin-off effect is pertinent for Hungary based on findings that promote Military Spending-Led Hypothesis. This result supports the existence of the Neutrality Hypothesis for the remaining 11 countries, but the impact of lk is added to the causality model to bring new evidence both with the trend and without trend applications.

Table: 8
Bivariate Bootstrap Panel Causality III

Countries	**Ho:** lgdp does not cause lme				
	Coefficient	Wald	Critical Values		
			% 10	% 5	% 1
Bulgaria	0,205	1,495	6,177	8,940	16,685
Croatia	0,102	0,626	7,341	10,652	20,517
Czech R.	-0,074	0,517	15,306	23,058	42,340
Estonia	0,539	9,512	15,316	21,981	40,497
Hungary	0,073	0,316	19,298	28,288	51,574
Latvia	0,028	0,025	12,134	18,145	33,295
Lithuania	0,276	4,579	21,685	30,138	53,188
Poland	0,558	10,739*	8,156	12,008	22,126
Romania	0,108	1,521	6,319	9,204	16,269
Slovakia	0,143	2,489	10,164	15,119	28,732
Slovenia	0,013	0,007	9,204	13,478	26,144
Turkey	0,180	9,332	12,093	17,230	33,980

*Note: * denotes significance at 10%.*

Bivariate bootstrap causality takes part in Table 8 from lgdp to lme. There is significant positive causality operating from lgdp to lme just in Poland, which denotes the Growth-Led Hypothesis. The remaining countries support Neutrality Hypothesis. The trend's impact is taken into interrogation to make the issue clearer.

Table: 9
Bivariate Bootstrap Panel Causality with Trend IV

Countries	**Ho:** lgdp does not cause lme				
	Coefficient	Wald	Critical Values		
			% 10	% 5	% 1
Bulgaria	-0,331	0,300	12,517	17,998	32,873
Croatia	0,015	0,003	12,068	17,772	35,241
Czech R.	-1,088	14,225*	13,444	19,851	37,852
Estonia	0,413	3,217	12,199	18,154	35,614
Hungary	-1,860	22,735*	16,608	24,669	49.415
Latvia	-0,502	1,723	15,320	22,543	41,534
Lithuania	-0,389	1,393	13,985	20,334	38,522
Poland	-0,725	3,989	9,330	13,747	27,562
Romania	-0,577	7,884*	6,747	10,290	20,641
Slovakia	-0,623	4,050	17,643	25,778	47,763
Slovenia	2,139	23,791**	14,889	21,771	41,071
Turkey	0,598	10,095	13,614	20,782	46,038

*Note: **, * denote significance at 5 and 10 per cent, respectively.*

Bivariate bootstrap causality with time trend is demonstrated in Table 9 from lgdp to lme. There is bootstrap negative causality operating from lgdp to lme in the Czech Republic, Hungary, and Romania, which is the Growth-Military Detriment Hypothesis. Besides, there is positive bootstrap causality operating from lgdp to lme just in Slovenia. Even if the findings do not support Table 8, Slovenia promotes the Growth-Led Hypothesis.

Table: 10
Trivariate Bootstrap Panel Causality V

Countries	**Ho:** lme does not cause lgdp				
	Coefficient	Wald	Critical Values		
			% 10	% 5	% 1
Bulgaria	-0,012	15,100*	9,923	16,437	77,850
Croatia	-0,090	9,696	14,562	20,878	39,364
Czech R.	0,037	13,943*	13,197	19,510	37,044
Estonia	0,038	9,352	17,186	25,308	48,772
Hungary	0,041	11,136*	11,131	16,628	32,387
Latvia	0,009	5,780	13,034	19,131	36,911
Lithuania	-0,008	12,686	13,076	19,815	38,815
Poland	0,003	0,033	9,405	14,786	31,598
Romania	-0,015	2,501	9,157	13,643	26,428
Slovakia	0,003	4,331	12,127	17,845	36,616
Slovenia	-0,010	0,371	13,372	19,289	36,612
Turkey	-0,198	0,231	8,945	13,933	28,442

*Note: * denotes significance at 10%.*

The trivariate system is evaluated to consider the theoretical model more closely by adding per capita real capital as an auxiliary variable. But lk is treated as an auxiliary variable in the model, not spark off a joint causality impact. Trivariate bootstrap causality is in Table 10 from lme to lgdp. There is positive bootstrap causality running from lme to lgdp in Czech Republic and Hungary, which endorse Military Spending-Led Hypothesis. There is negative bootstrap causality from lme to lgdp in Bulgaria, corresponding to the Military-Growth Detriment Hypothesis.

Table: 11
Trivariate Bootstrap Panel Causality with Trend VI

Countries	**Ho:** lme does not cause lgdp				
	Coefficient	Wald	Critical Values		
			% 10	% 5	% 1
Bulgaria	-0,039	96,032***	20,797	30,239	60,850
Croatia	-0,116	9,798	24,843	34,370	60,460
Czech R.	0,010	2,762	14,454	21,332	40,297
Estonia	0,050	2,712	16,826	25,257	47,874
Hungary	0,089	0,791	12,005	17,500	34,008
Latvia	-0,024	2,351	16,142	23,923	45,178
Lithuania	-0,029	0,068	20,659	29,687	59,763
Poland	-0,034	0,961	12,089	18,502	35,739
Romania	0,113	23,593*	22,625	32,190	62,884
Slovakia	-0,025	1,076	14,088	20,843	40,647
Slovenia	0,035	4,880	14,854	21,740	40,079
Turkey	-0,153	0,001	16,245	24,128	46,013

*Note: ***, * denotes significance at 1 and 10 per cent.*

Trivariate bootstrap causality with the trend is demonstrated in Table 11 from lme to lgdp. There is bootstrap positive causality operating from lme to lgdp just in Romania, which points to Military Spending-Led Hypothesis. There is bootstrap negative causality operating lme to lgdp just in Bulgaria, which implies Military-Growth Detriment Hypothesis.

Table: 12
Trivariate Bootstrap Panel Causality VII

Countries	**Ho:** lgdp does not cause lme				
	Coefficient	Wald	Critical Values		
			% 10	% 5	% 1
Bulgaria	0,245	0,869	9,785	14,260	26,705
Croatia	-0,011	0,032	11,205	16,855	31,878
Czech R.	-0,252	0,846	15,370	22,530	43,448
Estonia	0,786	5,648	17,134	25,365	46,875
Hungary	-0,074	2,369	32,648	43,765	73,485
Latvia	-0,130	0,255	18,111	26,692	50,445
Lithuania	0,267	0,733	25,097	34,268	62,962
Poland	0,637	12,099**	8,115	11,959	22,923
Romania	0,458	3,657	10,480	15,874	31,494
Slovakia	-0,087	2,632	12,564	18,866	35,615
Slovenia	-0,014	7,263	13,065	18,615	35,491
Turkey	0,205	0,905	12,935	18,856	35,015

*Note: ** denotes significance at 5%.*

Findings of trivariate bootstrap causality take place in Table 12 from lgdp to lme. There is positive bootstrap causality running from lgp to lme just in Poland, which signs to Military Spending-Led Hypothesis.

Table: 13
Trivariate Bootstrap Panel Causality with Trend VIII

Countries	**Ho:** lgdp does not cause lme				
	Coefficient	Wald	Critical Values		
			% 10	% 5	% 1
Bulgaria	0,274	0,181	14,110	24,351	62,072
Croatia	0,331	0,216	13,064	19,516	37,906
Czech R.	-3,382	37,162**	15,152	22,007	44,695
Estonia	0,078	0,319	14,571	21,329	40,813
Hungary	-3,258	106,444***	22,473	31,457	55,124
Latvia	-2,103	11,705	15,869	22,987	48,080
Lithuania	-1,247	5,363	14,188	21,310	43,594
Poland	-1,093	2,606	8,560	12,548	24,325
Romania	-0,947	2,254	10,595	16,032	32,218
Slovakia	-1,424	20,500*	19,450	27,818	50,638
Slovenia	0,038	0,056	14,869	21,659	41,135
Turkey	1,334	9,117	16,426	23,357	43,845

*Note: ***, **, * denote significance at 1, 5 and 10 per cent, respectively.*

The trivariate bootstrap causality with the trend is in Table 13 from lgdp to lme. There is negative bootstrap causality operating from lgdp to lme in the Czech Republic, Hungary, and Slovakia, implying the Growth-Military Detriment Hypothesis.

5. Conclusion

This study investigates the relationship between per capita real GDP, per capita real military expenditure, and per capita real capital in 12 NATO member countries spanning from 1995 to 2020. Cross-sectional dependence of variables is examined since ignoring it leads to biased estimations. It is detected that all variables are suffering from cross-sectional dependence, and all panel units are heterogeneous. It implies that all group members can apply their policies. Unit root, co-integration, and causality tests were determined, building upon cross-sectional dependence. It is seen that all variables have unit root at the level and transform to stationary at the first difference.

Moreover, the per capita real military expenditure of 12 countries relative to Russia's per capita real military expenditure is analysed with the PANIC test to clarify convergence. It is identified that there is weak evidence of convergence towards Russia's per capita real military expenditure. So, it can be claimed that armament competition is not so high in the region but exists. Co-integration is inquired with Westerlund and Edgerton's (2008) structural break test. Series are moving together, in the long run, owing to co-integration. Besides, break dates are detected endogenously, and 2008, reminds of the destructive impact of the global economic crisis, is assigned as a structural break in the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Romania, and Slovenia.

Bivariate and trivariate bootstrap causalities are examined, leaning on Konya's (2006) methodology with the trend and without trend versions. This approach has brought forth 8 different causality situations in both directions and induced various policy recommendations for countries. The main idea behind the trivariate causality is to include per capita real capital as an auxiliary to the model in this study. In terms of whole bootstrap causality findings, there is strong evidence for 5 countries due to a lack of significant causality. Croatia, Estonia, Latvia, Lithuania, and Turkey have no significant bootstrap causality, implying Neutrality Hypothesis. These countries can determine their military and growth policies separately from each other.

On the other hand, these countries can consider designing military R&D for market structure needs to create random positive stimuli in the future. Even if the values of simultaneous equation coefficients are not so high in both trend and without trend trivariate models, there is some evidence in Bulgaria corresponding to Military-Growth Detriment Hypothesis. This can be interpreted as the funding competition between military and non-military sectors, reducing the capital formation of new investments. So, Bulgaria needs to care about the investment effect of military spending on the economy due to the crowding-out effect.

There is evidence in the Czech Republic, Hungary, and Romania for bidirectional causality, reflecting the Keynesian aggregate demand effect due to reciprocal dependence. But the causality from military to growth is positive, whereas growth in the military is negative. The positive magnitude of causal linkage from military to growth matches the Military Spending-Led Hypothesis due to the spin-off effect. These countries can increase their growth by leaning on positive aggregate demand, employment, and R&D externalities of military spending. However, the values of simultaneous equation coefficients are high and negative for the causal linkage from growth to military, which supports the Growth-Military Detriment Hypothesis. Negative findings can result from the need to enhance defence spending via more imported equipment that points to the effort to increase armament.

If a country compensates for its military expenditure heavily with taxes or borrowing, a negative impact of growth on the military can be expected. There is also evidence for Slovakia corresponding to Growth-Military Detriment Hypothesis. These countries should care more about the income elasticity of tax revenue and its impact on the military before changing their growth policy. At the same time, there is some evidence in Poland and Slovenia matching the Growth-Led Hypothesis. Poland and Slovenia can afford additional spending on the military with further increment in per capita income level. The nexus among variables brings different policy implications for other countries and cases, excluding 5 of them.

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