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MILITARY EXPENDITURE AND ECONOMIC GROWTH IN BRICS AND MIST COUNTRIES: EVIDENCE FROM BOOTSTRAP PANEL GRANGER CAUSALITY ANALYSIS

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Abstract
This paper investigates the causal relationship between military expenditure, economic growth, and real capital stock in BRICS (Brazil, Russia, India, China, and South Africa) and MIST (Mexico, Indonesia, South Korea, and Turkey) countries. For this purpose, the period from 1990 to 2013 is examined using with the bootstrap panel Granger causality method. Results show that there is cross-sectional dependency and country-specific heterogeneity across BRICS and MIST countries. It is also concluded that a positive unidirectional causality from military expenditure to economic growth exists in China. By contrast, there is negative unidirectional causality from military expenditures to economic growth in Turkey. In addition, the feedback hypothesis is confirmed for Russia and the neutrality hypothesis is supported by the data from Brazil, India, Indonesia, South Korea, Mexico and South Africa.

JEL Classification: H56, O11, C33
Keywords: Military expenditure, Economic Growth, Cross-Sectional Dependency, BRICS and MIST Countries

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1. Introduction

Over the past few decades, many studies have investigated the relationship between military expenditure and economic growth. This relationship is determined on the basis of the assumption of an optimum military spending level for countries at different stages of development. Political suggestions are given, accordingly. The analysis of the relationship between military expenditure and economic growth is based on two fundamental views: Focusing on the supply-side approach, the neoclassical view states that economic activities are affected by military spending through factors such as infrastructure originating externalities, technological spin-off, human capital, and so on. By contrast, the Keynesian view focuses on the demand-side approach and argues that military spending affects economic growth through the crowding-out effect and fields such as export, education, and health (Karagol and Palaz, 2004; Yildirim *et al*., 2004; Aye *et al*., 2014).

The BRICS (Brazil, Russia, India, China and South Africa) and MIST (Mexico, Indonesia, South Korea and Turkey) countries are regarded as high-income developing countries. It is known that the military expenditure of most of these countries comprises a large share of total government expenditure. According to SIPRI (Stockholm International Peace and Research) reports, the average military expenditure share of government spending was 4.1% for Brazil, 10.8% for Russia, 10.1% for India, 9.7% for China, 4.7% for South Africa, 2.3% for Mexico, 4.3% for Indonesia, 12.7% for South Korea, and 7.0% for Turkey for the 2000-2014 period. In addition, the total military expenditure of these countries accounts for 26.11% of total world military expenditure. Therefore, military policy can be said to play a vital role for BRICS and MIST countries.

In this study, the relationship between military expenditure and economic growth is analysed for BRICS and MIST countries. These countries were chosen because they are high-income developing countries. The countries included in the analysis are expected to play a leading role in world economy in the forthcoming years and will be beneficial in recommending military policy to developing economies. Due to an insufficient number of studies in which the relationships between military spending and economic growth are analysed via panel data to allow cross-section dependency and heterogeneity, this approach benefits from methods accepted as second generation panel causality test.

The rest of this paper is divided into the following sections; in the second section, the model and data sources to be used are introduced. Information about the methods used in the analysis is given in the third section and the results of the analysis are presented in the fourth section. Finally, conclusions and policy recommendations are given in the fifth section.

2. Literature review

In studies where the relationship between military expenditure and economic growth are analysed, this is done in terms of causality and findings are evaluated accordingly. However, using different econometric methods and data sets in these studies has also led to contradictory results. Obviously, the validities of four different hypotheses are analysed depending on the causality relationship between military spending and economic growth.

The first hypothesis is called "growth hypothesis" and it is based on the "guns and butter" hypothesis put forward by Benoit (1973, 1978) and accepted as an initial approach to the relationship between military spending and economic growth. According to the "growth hypothesis", there is a positive unidirectional causality relationship from military spending to economic growth. Benoit (1973, 1978) argues that military spending will increase total aggregate demand, put idle resources into production, especially in developing countries, increase investments and create new opportunities. Furthermore, Deger (1986) asserted that the positive effects of military spending on economic growth would actualise through the technological spin-off effect and argued that these effects would come true via physical and social infrastructure investments such as roads, transport and R&D. When the "growth hypothesis" is valid, increasing the level of military spending will be a rational policy for countries. The growth hypothesis was confirmed by some studies such as those by Yildirim *et al*. (2005) for Middle East countries, Lee and Chen (2007) for 27 OECD and 62 non-OECD countries, Kollias *et al*. (2007) for EU15 countries and Kollias and Paleologou (2013) for the US. Similarly, Dunne *et al*. (2001), Atesoglu (2002), Karagol (2006), Feridun *et al.* (2011), and Chang *et al*. (2011) also obtained results supporting the growth hypothesis. In addition, the recent study by Chang *et al*. (2015) performed on the EU 15 countries supported the "growth hypothesis" in the long term.

While the second hypothesis is based on the argument known in the literature as "guns or butter", it is a hypothesis called "growth detriment hypothesis", which argues that military spending has negative effects on economic growth. According to this hypothesis, there is a unidirectional causal relationship from military spending to economic growth, but the causality relationship in this hypothesis is negative. Military spending is considered to be generally financed using taxes and current resources transferred from more productive areas, such as education and health, to military spending, which will have a crowding-out effect on private sector investments and negatively affect economic activities (Deger and Smith, 1983; Dunne and Vougas, 1999). If this hypothesis is valid, the rational policy for countries would be to reduce their level of military spending. As a result of their studies, Smith (1980), Cappelen *et al.* (1984), and Batchelor *et al*. (2000) obtained findings supporting that military spending had negative effects on economic growth.

The third hypothesis is known as the "feedback hypothesis" and states that the bidirectional causal relationship between military spending and economic growth is valid. According to this hypothesis, increase (decrease) in military spending will increase (decrease) economic growth, and, in a similar way, economically more (less) developed economies will allocate more (fewer) resources to military spending (Kollias *et al.* 2004). In their studies, Chowdhury (1991), LaCivita and Frederiksen (1991), and Chen *et al*. (2014) supported the "feedback hypothesis". Similarly, Pradhan (2010), who carried out a study on 5 Asian countries, supported the feedback hypothesis for the Philippines and defended that a unidirectional causal relationship from economic growth to military spending is valid for Indonesia, Malaysia, Singapore and Thailand. The fourth and final hypothesis is the "neutrality hypothesis", which states that there is no causal relationship between military spending and economic growth. According to this hypothesis, changes in military spending level do not affect economic activities nor does economic growth affect the determination of the level of military spending (Biswas and Ram, 1986). In the study they performed on China and the G7 countries, Chang *et al*. (2014) stated that the neutrality hypothesis is valid for France and Germany, the feedback hypothesis is valid for Japan and the USA and a unidirectional causal relationship from economic growth to military spending is valid for China.

3. Model and data

Because military spending is accepted as a type of public expenditure, the function obtained by using the Cobb-Douglas production function - assuming constant returns to scale following Barro (1990) and Cuaresma and Reitschuler (2003) and in line with the studies by Karagol and Palaz (2004), Lai *et al*. (2005), Lee and Chen (2007), Chang *et al*. (2014) and Chang *et al.* (2015) - is illustrated by the following equation;

$$Y_{it} = f(MILEX_{it}, K_{it}, L_{it}) \tag{1}$$

where $i = 1\ldots, N$ and $t = 1\ldots, T$, respectively, show the cross-section and the time period, while *Y*, *MILEX*, *K* and *L* represent real output, real military spending, real capital stock and labour force, respectively. Inclusion of military spending into the aggregate production function arises from the crowding-out effects stated by Heo (1999), the Keynesian aggregate demand multiplier stated by Kollias *et al*. (2004) and the spin-off effect stated by Deger (1986), as well as possible effects on real output. The empirical model is set up in terms of labour force through dividing the aggregate production function by labour and taking logarithms as follows:

$$lnGDP_{it} = \beta_0 + \beta_1 lnMIL_{it} + \beta_2 lnCAP_{it} + \varepsilon_{it} \tag{2}$$

where *InGDP* is the logarithmic form of real per capita income, *InMIL* is the logarithmic form of per capita military spending and *InPK* is the per capita real capital stock.

Data cover the years 1990-2013 for BRICS countries (Brazil, Russia, India, China and South Africa) and MIST countries (Mexico, Indonesia, South Korea, Turkey). GDP and CAP data are obtained from the World Development Indicators database and used in 2005 constant US Dollar prices. Finally, the MIL data is obtained from the SIPRI military expenditure database.

4. Methodology

The panel data analysis based on the assumption that there are no dependencies between cross-sections is called "first generation tests"; while analysis based on the assumption that there are dependencies between cross-sections is called "second generation tests". Considering that countries determine their levels of military spending generally based on enemy military spending, allied and neighbouring countries that rely on first generation tests in the analyses examining the effects of military spending on economic growth may come to erroneous conclusions. Therefore in this study, the existence of cross-sectional dependence, particularly between the countries involved in the analyses, is proved with tests before homogeneity tests are performed.

4.1 Cross-section dependency and homogeneity tests

The Lagrange multiplier (LM) test, frequently used in the literature and developed by Breusch and Pagan (1980), is used for the purpose of examining cross-sectional dependence. The LM test is examined through the use of the following equation:

$$y_{it} = \alpha_i + \beta_i x_{it} + \varepsilon_{it} \quad \text{for } i = 1\ldots,N \text{ and } t = 1\ldots,T, \tag{3}$$

where i and t, respectively, state the cross-section dimension and the time period. While the null hypothesis of $H_0: Cov(\varepsilon_{it}, \varepsilon_{jt}) = 0$ states that there is no dependency between cross-sections, the alternative hypothesis of $H_1: Cov(\varepsilon_{it}, \varepsilon_{jt}) \neq 0$ indicates dependency between at least one pair of cross-sections. The calculation of the LM test is as follows:

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^2 \sim \chi^2_{N(N-1)/2} \tag{4}$$

where $\hat{\rho}_{ij}$ is the sample of pair-wise correlation of the residuals from the ordinary least squares estimation of Equation (3) for each cross section. While the LM test is suitable for panels providing the condition of small N and sufficiently large T, for situations where T → ∞ and N → ∞, the scaled LM version developed by Pesaran (2004) is as follows:

$$CD_{LM} = \left(\frac{1}{N(N-1)}\right)^{1/2} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \left(T\hat{\rho}_{ij}^2 - 1\right) \sim N(0,1) \tag{5}$$

Because the CD_{LM} test tends to lead to dimension failures in case of large N and small T, Pesaran (2004) developed a more comprehendible test. The calculation of the CD test is as follows:

$$CD = \sqrt{\left(\frac{2T}{N(N-1)}\right)} \sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\left(\hat{\rho}_{ij} - 1\right) \sim N(0,1) \tag{6}$$

However, the CD test will lack power in certain situations when population average pair-wise correlations are zero (Pesaran *et al*. 2008). Therefore, Pesaran *et al*. (2008), suggest a bias-adjusted test which is a modified version of the LM test. The bias-adjusted LM test is:

$$LM_{adj} = \sqrt{\left(\frac{2}{N(N-1)}\right)} \sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\frac{(T-k)\hat{\rho}_{ij}^2-\mu_{Tij}}{\sqrt{v_{Tij}^2}} \sim N(0,1) \tag{7}$$

where k, μ_{Tij} and v_{Tij}^2 are the number of regressors, exact mean and variance of $(T-k)\hat{\rho}_{ij}^2$ respectively (Pesaran *et al.* 2008).

Another important point that needs to be determined is the homogeneity of the slope. Pesaran and Yamagata (2008) developed the revised version of the Swamy test (which is called $\tilde{\Delta}$ test) in order to determine slope homogeneity in large panels. In this particular case, the revised version of the Swamy (1970) test is calculated as follows:

$$\tilde{S} = \sum_{i=1}^{N}(\hat{\beta}_i - \tilde{\beta}_{WFE})'\frac{x_i' M_T x_i}{\tilde{\sigma}_i^2}(\hat{\beta}_i - \tilde{\beta}_{WFE}) \tag{8}$$

where β_i and $\tilde{\beta}_{WFE}$ are the pooled OLS and the weighted fixed effect pooled estimation of Equation (3), respectively. $\tilde{\sigma}_i^2$ is the estimator of σ_i^2 and M_T as an identity matrix of order T. The modified statistic is:

$$\tilde{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S}-k}{\sqrt{2k}}\right) \tag{9}$$

where k is the number of explanatory variables, under the null hypothesis, with the condition $(N,T) \to \infty$, so long as $\sqrt{N}/T \to \infty$. The small sample properties of the $\tilde{\Delta}$ test can be improved under normally distributed errors by using the following bias-adjusted version:

$$\tilde{\Delta}_{adj} = \sqrt{N}\left(\frac{N^{-1}\tilde{S}-E(\tilde{z}_{it})}{\sqrt{var(\tilde{z}_{it})}}\right) \tag{10}$$

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

4.2 Panel Causality Test

If there is cross-section dependency and heterogeneity between BRICS and MIST countries, the bootstrap panel causality method developed by Konya (2006) is a suitable causality method. This test allows both cross-section dependency and country specific heterogeneity and the test is based on seemingly unrelated regression (SUR) estimation of a set of equations, which, therefore, provide the Wald statistics for each country in the panel. (Menyah *et al*. 2014). The critical values of the test are obtained with bootstrap simulation. This approach is also robust to the unit root and cointegration properties of variables; therefore, the testing procedure does not require any pre-testing for panel unit root and cointegration (Kar *et al*. 2011). The system can be written as follows:

$$GDP_{1t} = a_{11} + \sum_{i=1}^{p_1} \beta_{11i} GDP_{1t-i} + \sum_{i=1}^{p_1} \delta_{11i} MIL_{1t-i} + \sum_{i=1}^{p_1} \gamma_{11i} CAP_{1t-i} + \varepsilon_{11t}$$

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$$GDP_{Nt} = a_{1N} + \sum_{i=1}^{p_1} \beta_{1Ni} GDP_{Nt-i} + \sum_{i=1}^{p_1} \delta_{1Ni} MIL_{Nt-i} + \sum_{i=1}^{p_1} \gamma_{1Ni} CAP_{Nt-i} + \varepsilon_{1Nt} \quad (11)$$

$$MIL_{1t} = a_{21} + \sum_{i=1}^{p_2} \beta_{21i} GDP_{1t-i} + \sum_{i=1}^{p_2} \delta_{21i} MIL_{1t-i} + \sum_{i=1}^{p_2} \gamma_{21i} CAP_{1t-i} + \varepsilon_{21t}$$

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$$MIL_{Nt} = a_{2N} + \sum_{i=1}^{p_2} \beta_{2Ni} GDP_{Nt-i} + \sum_{i=1}^{p_2} \delta_{2Ni} MIL_{Nt-i} + \sum_{i=1}^{p_2} \gamma_{2Ni} CAP_{Nt-i} + \varepsilon_{2Nt} \quad (12)$$

$$CAP_{1t} = a_{31} + \sum_{i=1}^{p_3} \beta_{31i} GDP_{1t-i} + \sum_{i=1}^{p_3} \delta_{31i} MIL_{1t-i} + \sum_{i=1}^{p_3} \gamma_{31i} CAP_{1t-i} + \varepsilon_{31t}$$

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$$CAP_{Nt} = a_{3N} + \sum_{i=1}^{p_3} \beta_{3Ni} GDP_{Nt-i} + \sum_{i=1}^{p_3} \delta_{3Ni} MIL_{Nt-i} + \sum_{i=1}^{p_3} \gamma_{3Ni} CAP_{Nt-i} + \varepsilon_{3Nt} \quad (13)$$

where *GDP* is the real gross domestic product per capita, *MIL* the real military expenditures per capita and *CAP* the real gross fixed capital per capita. In addition, *N* indicates the number of countries, *t* the time period and *i* refers to the optimal lag length. Moreover, each equation has different predetermined variables but error terms might be cross-sectionally dependent (Konya, 2006).

In the bootstrap panel causality testing procedure, alternative causal relations can be found. For instance, there is a one-way Granger causality from *MIL* to *GDP* if not all δ_{1i} are zero, but all β_{2i} are zero. Similarly, there is a one-way Granger causality from *GDP* to *MIL* if all δ_{1i} are zero, but not all β_{2i} are zero; there is a two-way Granger causality between *GDP* and *MIL* if neither δ_{1i} nor β_{2i} is zero; there is no causal relation between *GDP* and *MIL* if both δ_{1i} and β_{2i} are zero.

5. Empirical results

The dependency of military spending of ally or rival countries is a situation to be expected. Studies in which the relationship between military spending and economic growth - implementing tests which allow for cross-section dependence and which are accepted as second generation panel data tests - give more reliable results. Cross-section dependence and slope homogeneity test results are seen in Table 1.

Table 1. Cross-Sectional Dependency and Homogeneity Tests

Cross-section dependency tests	Statistic	p-Value
LM	547.088***	0.000
CD_{LM}	60.232***	0.000
CD	23.034***	0.000
LM_{adj}	42.833***	0.000
Homogeneity test		
$\tilde{\Delta}$	64.070***	0.000
$\tilde{\Delta}_{adj}$	71.632***	0.000

Note: *, ** and *** indicate statistical significance at 10, 5 and 1 percent levels, respectively.

According to the results, the null hypothesis, which states that there is no dependency between cross-sections, is rejected at a level of 1%. This shows that a shock in one of the BRICS or MIST countries affects the other countries. The globalisation process and financial integration make countries sensitive to economic shocks from other countries; therefore, cross-section dependency is a situation to be expected. According to the results of Pesaran and Yamagata's (2008) research, we must reject the null hypothesis that represents the slope homogeneity assumption and accept the country-specific heterogeneity assumption as valid.

In testing for panel causality, what is determined first is optimal lags for Eq.11-Eq.13. Estimates are based on using 1 to 4 lags and selecting the combination which minimises the Schwarz Bayesian Criterion. The results of a causal relationship between military expenditure and economic growth are reported in Table 2. In the case of Russia, there is bidirectional causality between military expenditure and economic growth. This means increasing the overall economic growth leads to an increase in the military expenditure of Russia and vice versa. By contrast, there is a positive unidirectional causality from military expenditure to economic growth in China. Therefore, the growth hypothesis can be said to be supported for China. In fact, increasing military expenditure leads to an increase in aggregate demand and positively affects economic activities in China. In the case of Turkey, negative unidirectional causality from military expenditures to economic growth is noted, so the growth detriment hypothesis is confirmed for Turkey. This means that increasing military expenditure may be harmful to economic activities in Turkey. In addition, the neutrality hypothesis is supported for Brazil, India, Indonesia, South Korea, Mexico and South Africa and it implies that a policy to reduce military expenditure will not be detrimental for these countries.

In addition, the results of panel bootstrap causality on the relationship between military expenditure and real capital stock are presented in Table 3. In the cases of Brazil, Indonesia and Russia, there is positive unidirectional causality from real capital to military expenditure. This finding implies that the military expenditure of these countries is positively affected by an increase in real capital stock. In addition, a positive unidirectional causality from military expenditure to real capital stock is noted in China, South Korea, South Africa and Turkey. Therefore, increased military expenditure can be said to lead to an increase in the real capital stock of these countries. On the other hand, there is no causal linkage between real capital stock in India and Mexico.

Table 2. Panel causality between *MIL* and *GDP*.

	H_0:MIL does not cause GDP					H_0:GDP does not cause MIL				
Countries	Coef.	Wald.stat.	Critical values			Coef.	Wald.stat.	Critical values		
			%10	%5	%1			%10	%5	%1
Brazil	-0.084	4.526	9.473	13.894	24.419	0.646	7.973	8.603	12.589	26.517
China	0.106	18.541**	9.683	13.621	34.862	0.540	17.412	18.846	25.934	40.889
India	0.086	1.609	11.036	16.929	34.801	0.450	7.796	12.688	17.802	30.467
Indonesia	-0.029	0.587	10.543	15.003	26.507	0.833	10.197	10.721	15.745	36.878
S. Korea	0.020	0.562	7.815	10.881	19.112	0.093	2.262	8.263	12.015	23.820
Mexico	0.354	0.456	7.235	11.193	25.441	0.612	4.331	10.214	15.805	31.155
Russia	0.201	32.406***	7.665	11.708	23.873	1.384	86.609***	11.737	16.198	33.632
S. Africa	0.018	1.374	8.968	12.770	22.170	0.037	0.592	8.437	12.975	21.145
Turkey	-0.223	7.519*	6.801	10.543	24.641	-0.215	3.519	7.968	12.170	20.796

Note: *, ** and *** indicate statistical significance at 10, 5 and 1 percent levels, respectively. Critical values are based on 10000 bootstrap replications.

Table 3. Panel causality between *MIL* and *CAP*

	H_0:CAP does not cause MIL					H_0:MIL does not cause CAP				
Countries	Coef.	Wald.stat.	Critical values			Coef.	Wald.stat.	Critical values		
			%10	%5	%1			%10	%5	%1
Brazil	0.414	9.022*	7.955	11.620	21.163	-0.056	0.201	8.439	11.979	22.157
China	0.331	6.288	18.511	25.381	40.575	0.327	27.645*	20.498	28.046	59.309
India	0.239	6.411	12.082	18.377	33.117	0.089	0.207	9.360	13.762	24.994
Indonesia	0.818	16.063**	8.872	14.375	24.010	-0.028	0.739	9.344	13.753	27.831
S. Korea	0.122	3.976	7.367	11.061	22.742	0.393	13.573**	8.177	11.834	21.714
Mexico	0.197	4.454	11.625	18.969	32.383	-0.298	4.971	7.644	11.634	18.797
Russia	1.194	60.879***	12.748	18.251	31.710	-0.372	3.696	6.874	9.829	19.710
S. Africa	-0.070	2.073	8.545	11.996	24.878	0.243	14.838**	7.352	11.066	21.241
Turkey	-0.026	0.184	7.396	10.829	22.435	0.955	12.174*	9.303	13.479	25.387

Note: *, ** and *** indicate statistical significance at 10, 5 and 1 percent levels, respectively. Critical values are based on 10000 bootstrap replications.

6. Conclusions

This paper examined the causal relationship between military expenditure per capita, real capital stock per capita, and real gross domestic product for BRICS countries (Brazil, Russia, India, China and South Africa) and MIST countries (Mexico, Indonesia, South Korea and Turkey) from 1990 to 2013, utilising the bootstrap panel causality method, which allows for both cross-section dependency and country specific heterogeneity.

Empirical results indicate that positive unidirectional causality from military expenditure to economic growth exists only for China. This means the growth hypothesis is valid for China and increasing military expenditure leads to an increase in economic growth through increasing aggregate demand. By contrast, a negative unidirectional causality from military expenditure to economic growth is noted for Turkey. Therefore, the growth detriment hypothesis is confirmed, and it can be said that increasing military expenditure may be harmful to economic activities in Turkey. In the case of Russia, there is bidirectional causality between economic growth and military expenditure. This means that increasing the military expenditure of Russia leads to an increase in its economic growth, and vice versa. The neutrality hypothesis is supported for Brazil, India, Indonesia, South Korea, Mexico and South Africa; therefore, it is concluded that military expenditure does not play any important role in the economic activities of these countries. Moreover, a positive unidirectional causality from real capital stock to military expenditure is noted in Brazil, Indonesia, and Russia. That having been said, unidirectional causality from military expenditure to real capital stock is confirmed for China, South Korea, South Africa and Turkey.

According to the results obtained, the technological spin-off effect is valid for China and Russia. It can be said that military investments are productive in these countries. On the other hand, the military expenditure of Turkey may have crowding-out effects on the private investments of this country; therefore, reducing military expenditure would be a rational policy for Turkey. Moreover, due to the validity of the neutrality hypothesis, the governments of Brazil, India, Indonesia, South Korea, Mexico and South Africa should change their military policies, redirecting, for instance, military investments to more productive military R&D areas.

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