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Geopolitical risk and military expenditures: Evidence from the US economy

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Abstract

Exploring the nexus between geopolitical risk (GPR) and military expenditures (ME) has been limited during the past period. It is justified by the absence of a well-published proxy for GPR. Recently, the work of Caldara and Iacoviello (2022) stimulated scholars to examine the consequences of GPR. Our paper seeks to understand the relationship between GPR and ME in the United States (US). It designs a theoretical framework and computes an econometric model using the Autoregressive Distributed Lag methodology based on annual data (1960–2021). In addition, it uses the pairwise Toda–Yamamoto causality test. The results show that the relationship between GPR and ME is one of unidirectional causality and runs from ME to GPR in the US. Further, this relationship is statistically significant and positive in the short and long run. This finding supports our hypothesis that the US GPR is a consequence of resource allocation, i.e., ME, and can be controlled, directed, and mitigated. Thus, ME is a tool to achieve the US international hegemony's strategic goals. From a policy implication perspective, it has been proved that GPR has broad negative consequences for various economies. Thus, moving toward cooperation and coordination with other nations instead of accumulating ME tends to support the international economy.

Keywords: geopolitical risk, military expenditures, US economy, ARDL model.
JEL classification: C12, C22, E02, F51, H56.

1. Introduction

During the past five years, many scholars have successfully extracted evidence about the crucial consequences of geopolitical risk on numerous economic activities (for instance, see Sweidan, 2021, 2023b; Wu et al., 2022; Riti et al., 2022; Phan et al., 2022; Qian et al., 2022; Hailemariam and Ivanovski, 2021).

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Geopolitical risk produces institutional ambiguity that arises from economic disputes and conflicts of interest, which lead to wars, tensions, and military-like activities. The current best evidence of such high uncertainty and conflict of interest is the Russia–Ukraine conflict. It started in February 2022 and caused a massive wave of geopolitical risk in Europe with severe international economic and social impacts. For this reason, international institutions, such as the World Bank and International Monetary Fund, monitor and analyze geopolitical events to accurately predict current and future international economic outcomes (Caldara and Iacoviello, 2022). It is confirmed that high level of uncertainty and risk hinder various vital economic decisions necessary for economic prosperity (Bhattarai et al., 2020; Baker et al., 2016; Bloom, 2014).

A strong army with a high level of military expenditure guarantees security and peace for any nation. Thus, it generates a stable economic environment that is necessary for economic development. However, high military spending diverts resources out of the development process and encourages military clashes and tensions (Yakovlev, 2007). Some scholars (Jarzabek, 2016; Dunne and Tian, 2015), argue that rising military expenses stimulate geopolitical risk and uncertainty.

Exploring the mutual relationship between geopolitical risk and military expenditures was indirect and not apparent in the past. One of the crucial reasons is the need for a well-published proxy for geopolitical risk. Besides, the previous empirical studies worked on a one direction assumption, which is that military spending is a function of several factors such as clashes, wars, and threats. However, the opposite assumption is missing. Consequently, the literature has enormous studies that investigated the determinants of military expenditures[1] but has minimal research on the determinants of geopolitical risk. The recent work of Caldara and Iacoviello (2022), including the earlier versions of their paper, created a geopolitical risk index. The main feature of their index compared to the other indices is its monthly frequency and coverage period. It covers the period from 1900 to the present. Undoubtedly, their contribution inspired scholars from different disciplines to perform empirical research in this critical area. Within this new data availability, Khan et al. (2022) tested the existence of a crucial relationship between military spending and geopolitical risk using the panel bootstrap Granger causality technique. Their sample includes eight countries covering the period 1991–2018. They found that geopolitical risk Granger causes military spending in China, India, and Saudi Arabia. Conversely, military expenditures Granger cause geopolitical risk in South Korea and Turkey. The findings reveal no connection between military expenditures and geopolitical risk in Russia, Israel, and Brazil. Compared to Khan et al. (2022) work, we differentiated our paper by its methodology, time horizon, and the targeted countries. Overall, the literature has limited studies on this vital research topic and needs more empirical work. The current paper's contribution to the literature fills this gap.

Our paper seeks to understand the relationship between geopolitical risk and military expenditures. More precisely, it attempts to investigate what Granger caused which by extracting evidence from the United States (US) economy. We argue that superior countries, like the US model, with massive production,

[1] Refer to Odehnal and Neubauer (2020) for a literature presentation about the determinants of military expenditure.

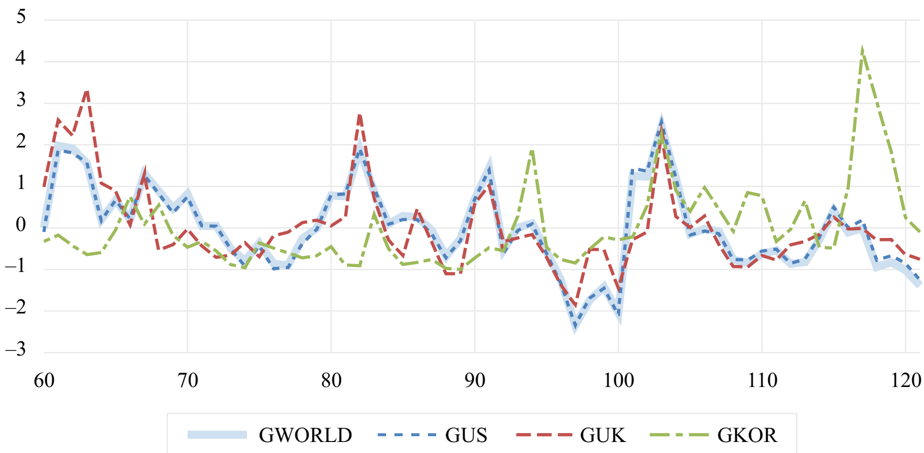

Fig. 1. The normalized geopolitical risk index for the world and three nations.

Source: Author's calculations based on Caldara and Iacoviello (2022).

dominant currency, military power, and international financial and political lobbying, have the capability to generate global geopolitical risk or waves to achieve their international strategic goals. Besides, the US is the best model to generate conclusions from its behavior on such an exciting topic. Fig. 1 presents the normalized geopolitical risk index for the world and three countries: the US, the United Kingdom, and South Korea. It reveals that the US geopolitical risk index mimics or has the exact directions of the world index compared to that of the United Kingdom and South Korea. It confirms the primary effect of the US political and military actions on the international scene. Geopolitical risk is a consequence of dominant countries' lobbying mechanisms and political plans to satisfy their pecuniary interests and political values.

Our argument implies the presence of a causality between military expenditures and geopolitical risk in the US. Thus, we test our hypothesis in the current paper and have four potential outcomes. If the causality runs from military expenditures to geopolitical risk, then it is an indicator that economic resources motivate geopolitical risk. Technically, geopolitical risk is part of resource allocation and can be controlled, directed, and mitigated. However, if the causality runs from geopolitical risk to military spending, it denotes that geopolitical risk is not part of the resource allocation or it is an unplanned event. Therefore, in this case, geopolitical risk represents an external shock and needs an opposite military action and power to control it. The third option may state a bidirectional relationship between the two variables. The fourth option may reach no relationship between the two variables.

Our paper uses the time series analysis covering the period 1960–2021 and employs the Autoregressive Distributed Lag (ARDL) approach to reach its target. It checks the existence of a long-run relationship between our model's variables and estimates both short-run and long-run effects. Moreover, a co-integration relationship indicates the validity of a Granger causality association between the dependent and independent variables. It can be tested by using the regressor's *t*-statistics and Wald coefficient test. Further, our paper utilizes the pairwise Toda–Yamamoto causality test (Toda and Yamamoto, 1995) between the US geopolitical risk and military expenditures. The remaining parts are prepared as follows. The second section introduces a relevant literature review of the current topic. The third section discusses the current study's theoretical basis, data, and methodology. The fourth section offers empirical findings and analyses. Conclusions and policy implications are included in the fifth section.

2. Literature review

The historical data of the Stockholm International Peace Research Institute shows that international military expenditure increased from $0.073 trillion in 1960 to $2.01 trillion in 2021. In a simple calculation, military expenditure increased 29 times during the period 1960–2021. Meanwhile, its ratio to the international gross domestic product (GDP) decreased from 5.25% in 1960 to 2.16% in 2021. On the other hand, the historical geopolitical risk fluctuated significantly during the same period. Fig. 2 offers the normalized international geopolitical risk and the ratio of military expenditure to GDP. It displays the dynamic behavior of both indicators.

Studying the nexus between geopolitical risk and military spending was incidental and not apparent during the past period. The link between the two variables appeared for three main reasons.[2] First, some institutions, i.e., the World Bank, generated proxies for country risk that encouraged scholars to test the relationship between the two variables. For example, the World Bank established the Worldwide Governance Indicators on six broad governance dimensions for more than 200 countries during 1996–2021.[3] The International Country Risk Guide (ICRG) created the country risk components.[4] Second, scholars are interested in investigating the drivers of the various nations' military expenditure. It requires highlighting economic, political, and security indicators. Third, justifying the contradiction in governments' behavior. More precisely, governments announce their goals to increase economic prosperity, encourage joint investment, and coordinate with other nations. On the contrary, they increase their military expenditure simultaneously with the abovementioned announcements. For instance, Chen and Feffer (2009) explained the increase in China's military expenditure to face internal and external security threats and neighboring countries' border clashes. Likewise, Kollias et al. (2018a) stated that military expenditure is driven by internal threats, external or border conflicts, and the military expenditure of competing nations. Kollias, and Panayiotis (2022) showed that border geopolitical considerations across the European Union (EU27) have increased the share of the European Defence Technological and Industrial Base origin imports of their total arms imports. They tested their convergence hypothesis by using β and club convergence methodologies. Fonfria and Marin (2012) inspected the drivers of military expenditure in countries that are members of the North Atlantic Treaty Organization (NATO). They demonstrated that a greater risk of conflict increases military spending. However, their empirical

2 The literature has massive empirical studies on the relationship between military expenditure and economic growth. For instance, see Aye et al. (2014), Dunne and Tian (2015), Pan et al. (2015), and Furuoka et al. (2016).

3 The six dimensions include voice and accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, the rule of law, and control of corruption.

4 It consists of 12 components.

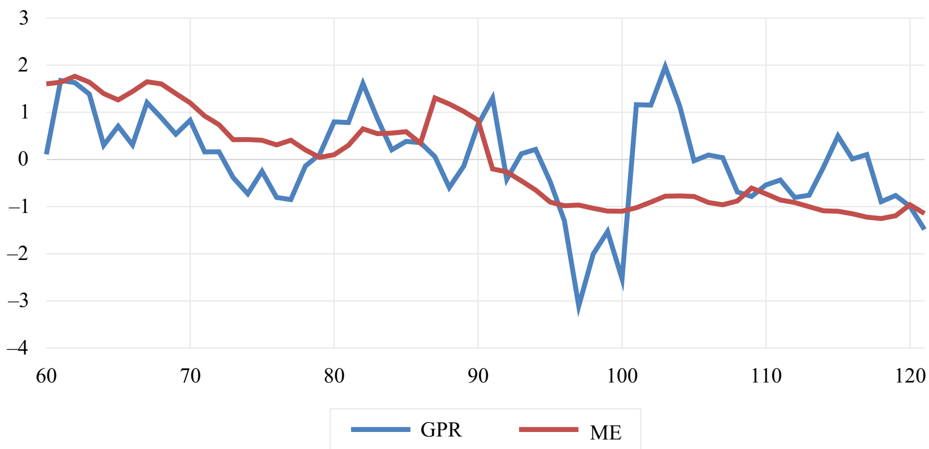

Fig. 2. The international geopolitical risk and military expenditure.

Source: Author's calculations.

results exposed that the risk of conflict has an insignificant effect on military expenditure. They measured the risk conflict by the kilometers of the border shared with the non-NATO states. Zhong et al. (2017) clarified the engagement of the BRICS countries in significant military spending to regional disputes, conflicts, and threats.[5] For example, India has conflicts with the Naxalite group and persistent disputes over Kashmir with Pakistan. China is concerned about the US intervening in the region, particularly the likely conflict over Taiwan. Likewise, Russia views NATO expansion on its border as a threat. Albalate et al. (2012) examined the effects of political institutions on military expenditure. Their sample includes 157 countries and covers the period 1988–2006. They found that political institutions do not have an identical influence on establishing all public goods, such that presidential democracies spend more than parliamentary systems on military operations and defense.

The previous empirical studies focused on the drivers of military spending. Thus, different proxies of geopolitical risk were used and tested. For instance, Clements et al. (2019) examined the factors of military expenditure of 140 nations during the period 1970–2018. They used different proxies for geopolitical risks, such as political stability, absence of violence, and terrorism indicators extracted from the World Bank via the World Governance Indicators' website. Clements et al. (2019) found that higher political stability only reduces short-run military expenditure in developed countries. Similarly, Nordhaus et al. (2012) explored the drivers of military expenditure in 165 countries over the period 1955–2000. The authors estimated and employed the fatal militarized interstate dispute as a proxy for geopolitical or security risk. They concluded that external threats affect military spending significantly. Carter and Fay (2019) checked the nexus between US military activity and transnational terrorism covering the period 1971–2014. They utilized the terror index as an indicator for geopolitical risk. They found that terrorism Granger causes military expenditure. Odehnal and Neubauer (2020) tested the drivers of military spending in 27 NATO nations over the period

[5] The BRICS countries include Brazil, Russia, India, China, and South Africa.

2001–2017. They inspected economic, security, and political factors as potential determinants, and employed four variables as a proxy for the security uncertainty. These variables are ethnic tension, terrorism, cross-border clashes, and external countries' pressure. Their outcomes reveal mixed results. Kollias et al. (2018b) estimated the demand for army spending in 12 Latin American nations during the period 1965–2015 as a function of economic, strategic, political, and security factors. They used dummy variables as a proxy for interstate and intrastate conflicts. Their results showed that conflict and military-like activities significantly and positively affect military expenditure.

There was a long Cold War between the US and the former Soviet Union (USSR). This war lasted for 45 years and ended in 1991 by dissolving the USSR. Each country worked continuously against the ideology and economic thoughts of the other country. It caused prolonged geopolitical tension at an international level. After the Second World War, the US focused its resources on ensuring American's leadership through a new world-order system (Stokes, 2018). Moreover, worldwide hegemony is the primary goal of the US great strategy in the 21st century. Achieving this grand goal needs various instruments, such as interference in the crude oil and the international foreign exchange markets (İşeri, 2009; Blanchard, 2017). In addition, it involved providing political and military support to specific nations or a political party inside a particular country. Currently, the best example of this behavior is the military aid from President Biden's administration to Ukraine. The assistance took the form of direct transfers of equipment from the U.S. Department of Defense to support the Ukrainian military.[6] This interference will hurt some countries and reward others. Therefore, it will increase geopolitical tensions and conflicts among nations. The US became the sole dominant international force in 1991. After around 15 years, the world started to move back to the multipolar system. That started with the Great Recession of 2007–2009 and the rise of the BRICS countries (Sweidan, 2022). Currently, China and Russia are geopolitical competitors rather than partners in the hegemonic plan of the US (Mastanduno, 2019). Recently, Sweidan (2022) showed a substantial consequential link between US economic indicators and global political risk. Thus, the US as a dominant player in the global scene with enormous political and pecuniary capability, can leverage the international political risk.

3. Theoretical context, data, and methodology

3.1. Theoretical context

Our study investigates the existence of a long-run relationship between the US geopolitical risk and the US military expenditure as a ratio to GDP. More precisely, we seek to recognize the direction of causality between geopolitical risk and military expenditure in the US. Is it unidirectional or bidirectional, or is there no relationship between the two variables? The available literature regarding the determinants of military expenditure (Khan et al., 2022; Odehnal and

[6] https://www.whitehouse.gov/briefing-room/statements-releases/2022/03/16/fact-sheet-on-u-s-security-assistance-for-ukraine/

Neubauer, 2020; Kollias et al., 2018b; Brauner, 2015) found that it is determined by four main categories of variables: economic, political regimes, demographic, and political stability and security. On the other hand, empirical works on the geopolitical risk determinants are limited. Most of the available studies in this research area focused on the effects of geopolitical uncertainty on many financial and economic series. However, Sweidan (2022) found that geopolitical risk is affected by macroeconomic variables. Thus, we assume that economic factors determine the two vital variables to design a consistent empirical model subject to the same determinants. Implicitly, we assume that geopolitical risk is motivated by economic indicators, and thus it is a tool to achieve the nation's goals.[7] This statement has solid evidence from the facts on the ground. For example, the chaos in the Middle East, i.e., changing regimes in Syria and Iraq, during the past two decades is an obvious example. The Russia–Ukraine conflict is another example of that. Generating geopolitical risk in some areas of the world requires decision-making and resource transformation to create facts on the ground and suggest solutions. Likewise, we assume that the economic resources and costs restrict military expenditure. Therefore, we postulate that the US geopolitical risk and military expenditure are determined as follows:

$$GPUS_t = F(MEUS_t, YUS_t, RSUS_t, OP_t), \quad (1)$$

$$MEUS_t = F(GPUS_t, YUS_t, RSUS_t, OP_t), \quad (2)$$

where $GPUS_t$ is the US geopolitical risk index; $MEUS_t$ denotes the US military expenditure as a ratio to the US GDP; YUS_t indicates the US economic growth measured in constant 2015 prices; $RSUS_t$ represents the share of US resources, it is measured by the relative importance of the US GDP to the world GDP; OP_t stands for West Texas Intermediate crude oil prices. The natural logarithm is used to transform the data of this work.

Generally speaking, when more economic resources are available to a dominant nation, it tends to generate more geopolitical risks to preserve its dominance and economic power. For example, Blanchard (2017) found that the advanced economies, i.e., the US and EU, implemented monetary policies during the Great Recession (2007–2009) that had significant spillover influences on emerging market economies. Accordingly, the exchange rate oscillations will harm some groups and benefit others. These policies created geopolitical tension between the countries. As a result, in 2010, Brazilian Finance Minister warned the international community of the currency war.[8] Similarly, Bhattacharyya (2021) illustrated that the trade war between China and the US affected not only those two countries, but also other nations' economic growth, such as Canada, European Union, and Russia. At the same time, more economic resources stimulate the nation to spend more on its military power to enhance its power and dominance. Oil prices are one of the significant cost constraints for the American consumers. Thus, rising oil prices restrict the US military spending and force the US govern-

[7] Recently, Faruk et al. (2022) and Sweidan (2023a) found that the international geopolitical risk spillover among nations.

[8] Financial Times, September 27, 2010. https://www.ft.com/content/33ff9624-ca48-11df-a860-00144feab49a

Table 1
Descriptive statistics.

	$\ln GPUS_t$	$\ln MEUS_t$	$\ln YUS_t$	$\ln RSUS_t$	$\ln OP_t$
Mean	1.056	1.607	2.905	3.345	2.973
Std. dev.	0.241	0.317	2.154	0.169	1.114
Min	0.315	1.130	–3.464	3.050	1.072
Max	1.543	2.208	6.987	3.664	4.601
N obs.	62	62	62	62	62

Source: Author's calculations.

ment to generate pressure to reduce it (Samaras et al., 2019). For instance, the US administration opened a frequent debate and pressurized the Organization of the Petroleum Exporting Countries (OPEC) not to cut oil production or decrease oil prices. This pressure intensified after the oil price increased by around 19% in March 2022 because of the Russia–Ukraine conflict.

3.2. Data

The current paper extracted its data from four sources. The geopolitical risk index is extracted from Caldara and Iacoviello (2022).[9] They generated the geopolitical risk index with an algorithm that calculates the share of articles citing geopolitical conflicts of global interest in top newspapers published in Canada, the United Kingdom, and the US. The international geopolitical index is estimated monthly and standardized to 100. Caldara and Iacoviello (2022) computed two indexes. The historical index starts from 1900 to the present, while the recent index begins from 1985 to the present. They created two components of each index, the geopolitical threats, and the geopolitical acts indices. On the country level, they established country-specific measures of the index for 43 countries by counting common occurrences in newspapers of geopolitical events and the country's name, its capital or main city, in question.

The US military expenditure is taken from the Stockholm International Peace Research Institute,[10] while the oil prices are extracted from Saint Louis Federal Reserve Bank.[11] The source of the US resource share and economic growth is the World Bank Development Indicators. The current paper sample study covers the period 1960–2021. Table 1 presents the descriptive statistics of our primary data.

3.3. Methodology

This paper uses the ARDL technique to compute the empirical part. It is a useful means for this study because of two reasons. It tests the existence of a long-run association between the model's independent and dependent series. Thus, it produces short-run parameters, long-run coefficients, and an error correction term toward the long-run equilibrium. Tracing these parameters provides deep insight into the relationship among the variables. Besides, this approach

[9] It is from the Economic Policy Uncertainty (EPU) website: https://www.policyuncertainty.com/index.html
[10] See https://www.sipri.org/databases/milex
[11] See https://www.stlouisfed.org

tells if a Granger causality runs from the explanatory variables to the dependent variable. This approach is known and established in macroeconomic time series analysis and developed by Pesaran et al. (2001). The ARDL method can be utilized even if the series have different integration order. This requires the data to be integrated of order zero (I (0)) or order one (I (1)) or a collection of both, but not of order two (I (2)). Moreover, it is highly advised to use the ARDL technique with a small data sample because it works well.

The ARDL (p, q) approach specification form is:

$$Y_t = \delta + \sum_{k=1}^{p} \theta Y_{t-k} + \sum_{j=0}^{q} \gamma W_{t-j} + e_t, \tag{3}$$

where Y_t stands for the dependent variable; W_t denotes a list of explanatory variables; δ, θ, and γ are the model's estimated coefficient; e_t is the random disturbance.

Equations (1) and (2) are modified to fit the current paper's empirical technique:

$$\begin{aligned}\Delta\ln GPUS_t = \theta_0 &+ \sum_{k=1}^{n} \theta_1 \Delta\ln GPUS_{t-k} + \sum_{k=0}^{n} \theta_2 \Delta\ln MEUS_{t-k} + \\ &+ \sum_{k=0}^{n} \theta_3 \Delta\ln YUS_{t-k} + \sum_{k=0}^{n} \theta_4 \Delta\ln RSUS_{t-k} + \\ &+ \sum_{k=0}^{n} \theta_5 \Delta\ln OP_{t-k} + \gamma_1 \ln GPUS_{t-1} + \gamma_2 \ln MEUS_{t-1} + \\ &+ \gamma_3 \ln YUS_{t-1} + \gamma_4 \ln RSUS_{t-1} + \gamma_5 \ln OP_{t-1} + e_t,\end{aligned} \tag{4}$$

$$\begin{aligned}\Delta\ln MEUS_t = \theta_0 &+ \sum_{k=1}^{n} \theta_1 \Delta\ln MEUS_{t-k} + \sum_{k=0}^{n} \theta_2 \Delta\ln GPUS_{t-k} + \\ &+ \sum_{k=0}^{n} \theta_3 \Delta\ln YUS_{t-k} + \sum_{k=0}^{n} \theta_4 \Delta\ln RSUS_{t-k} + \\ &+ \sum_{k=0}^{n} \theta_5 \Delta\ln OP_{t-k} + \gamma_1 \ln MEUS_{t-1} + \gamma_2 \ln GPUS_{t-1} + \\ &+ \gamma_3 \ln YUS_{t-1} + \gamma_4 \ln RSUS_{t-1} + \gamma_5 \ln OP_{t-1} + e_t,\end{aligned} \tag{5}$$

where the mathematical sign Δ denotes the first difference. The short-run parameters are offered by θ_1 to θ_5 in equations (4) and (5), whereas γ_2 to γ_5 are the long-run coefficients after normalizing them by the parameter γ_1. This methodology proposed two techniques to examine the occurrence of a cointegration relationship between the series. Scholars compare and contrast the computed F-statistics with the critical values. Pesaran et al. (2001) approximated asymptotic F-values, while Narayan (2005) estimated the infinite values suitable for the current empirical work. The F-values have lower and upper limits. If the computed F is above the upper limit, the null hypothesis of no co-integration association can be rejected. On the contrary, if the estimated F is below the lower limit, the null hypothesis cannot be rejected. If the calculated F is between the lower and upper limits, the outcome is indecisive. Second, this method estimates the errors or the error correction term (ECM_t) from the long-run variables and replaces it in the model instead of the model's long-run variables. If the coefficient of ECM_t is significant and negative, the long-run connection between the series is valid.

4. Empirical results

Examining if a unit root exists in the series of our empirical model is the first move in approximating an ARDL model. It ensures that the variables are integrated in the correct sequence. Three common unit root assessments are used. These tests are Augmented Dickey–Fuller (1981)—ADF, Phillips–Perron (1988)—PP, and Ng and Perron (2001)—NP. The H_0 of these three tests is identical and declares that the series suffers a unit root. Table 2 reports the three tests' results. It reveals that some variables are stationary at the level and the first difference. Hence, the current research variables are integrated of orders zero and one. For this reason, the ARDL model is an appropriate tool to approximate the model's parameters and analyze the results.

Then, we test the existence of cointegration relationships in equations (4) and (5) using F-statistics. The ARDL model is sensitive to the number of lags. For this reason, we estimate standard vector autoregressive models and use the lag length criteria, i.e., Akaike information criterion (AIC) and Schwarz information criterion (SIC), to select the ideal lags of the two ARDL models. The lag selection standards employ eight lags, and the results tell that the optimal lag is six for equation (4) and two for equation (5). Table 3 reports the F-statistics of the two models. It is larger than the upper bound critical values for model 1 (equation (4)) but not for model 2 (equation (5)). Accordingly, we can reject the null hypothesis of no co-integration for model 1 but not for model 2. It means that the variables in model 1 have a long-run relationship, while the variables in model 2 do not have such an association. Empirically, the finding of model 1 supports the hypothesis that military expenditure Granger causes geopolitical risk. The results of model 2, on the other hand, state that geopolitical risk does not Granger cause military spending. We conclude that the connection between geopolitical risk and military spending is a unidirectional causality relationship and runs from the latter to the former. This conclusion enhances the statement

Table 2
Standard unit root tests.

	The level			The first difference		
	ADF	PP	NP	ADF	PP	NP
$\ln GPUS_t$	-3.526^{***}	-3.571^{***}	-10.925^{***}	–	–	–
$\ln MEUS_t$	-2.833	-2.151	-14.920^{*}	-4.549^{***}	-4.596^{***}	-22.288^{***}
$\ln YUS_t$	-6.007^{***}	5.999^{***}	-28.458^{***}	–	–	–
$\ln RSUS_t$	-3.106	-2.375	-17.951^{**}	-4.897^{***}	-4.832^{***}	-24.455^{***}
$\ln OP_t$	-1.913	-1.962	-6.948	-7.253^{***}	-7.254^{***}	-29.474^{***}

Note: *** indicates significance at 1% level.
Source: Author's calculations.

Table 3
The ARDL co-integration test.

Co-integration hypotheses	F-statistics	Comments
Model 1: $\ln GPUS_t = F(\ln MEUS_t, \ln YUS_t, \ln RSUS_t, \ln OP_t)$	6.676^{***}	Long run relationship exists
Model 2: $\ln MEUS_t = F(\ln GPUS_t, \ln YUS_t, \ln RSUS_t, \ln OP_t)$	2.683	Long run relationship does not exist

Note: *** indicates significance at 1% level. The critical values of the upper bound by Pesaran et al. (2001) are 3.87 and 4.37 at 2.5% and 1% significant levels, respectively, and by Narayan (2005) are 3.813 and 4.947 at 5% and 1% significant levels, respectively.
Source: Author's calculations.

Table 4
The variance inflation factor of the ARDL model.

Variables	VIF	Variables	VIF
$\Delta\ln GPUS_{t-1}$	2.4	$\Delta\ln RSUS_{t-2}$	1.8
$\Delta\ln GPUS_{t-2}$	2.1	$\Delta\ln RSUS_{t-3}$	1.7
$\Delta\ln GPUS_{t-3}$	2.1	$\Delta\ln OP_t$	1.5
$\Delta\ln GPUS_{t-4}$	1.9	$\ln GPUS_{t-1}$	5.4
$\Delta\ln GPUS_{t-5}$	4.2	$\ln MEUS_{t-1}$	4.2
$\Delta\ln YUS_t$	1.3	$\ln YUS_{t-1}$	1.3
$\Delta\ln RSUS_t$	1.7	$\ln RSUS_{t-1}$	7.4
$\Delta\ln RSUS_{t-1}$	2.0	$\ln OP_{t-1}$	6.0

Source: Author's calculations.

that geopolitical risk is motivated by economic resources, such as military expenditure. Thus, it is a consequence of resource allocation and can be controlled, directed, and mitigated.

We estimate model 1 to understand in-depth the nature of the unidirectional causality relationship from military expenditure to geopolitical risk. The ARDL model's results are presented in Table 4. It contains three groups of outcomes: the short-run parameters, the long-run coefficients standardized by the lagged coefficient of $\ln GPUS_t(\gamma_1)$, and the diagnostics assessments. These assessments examine if our model suffers serial correlation and heteroskedasticity. Specifically, this paper implements the Breusch–Godfrey serial correlation LM test, Harvey heteroskedasticity test, and the ARCH–LM tests. Additionally, this work performs two stability tests, CUSUM and CUSUMSQ.[12] The two stability tests are displayed in Fig. 3. The diagnostic evaluation ensures that the approximation of our ARDL model meets the standard linear regression assumptions. Furthermore, the current paper estimates the Variance Inflation Factors (VIF) to check if our model has multicollinearity symptoms. The results in Table 4 verify that our ARDL model is free from these symptoms. If the VIF exceeds 10, it is a significant sign of multicollinearity syndrome among the explanatory variables (Chatterjee and Hadi, 2012). After that, we estimate the current paper's ARDL model, and the results are reported in Table 5.

In the short run, our results reveal that the effect of $MEUS_t$ on $GPUS_t$ is instantaneous positive and statistically significant at the 6% level. It assures the existence of a Granger causality running from $MEUS_t$ to $GPUS_t$. Also, the YUS_t impacts $GPUS_t$ negatively and immediately at a significance level of 3%. The effect of $RSUS_t$ on $GPUS_t$ is statistically significant, but its influence swings between positive and negative signs with a time lag. On the contrary, the short-run influence of PO_t on $GPUS_t$ is statistically insignificant. In the co-integration analysis, the long-run link among the variables under inspection communicates more accurate facts about the core of this association. Usually, the short-run connection among the variables transfers recent data on the core of the relation. Over the short run, nations may coordinate and cooperate, adding new information to the relationship, thus adjusting the responsiveness of geopolitical uncertainty to changes in the explanatory variables.

[12] The cumulative sum of the recursive residuals (CUSUM) and the cumulative sum of the squared recursive residuals (CUSUMSQ).

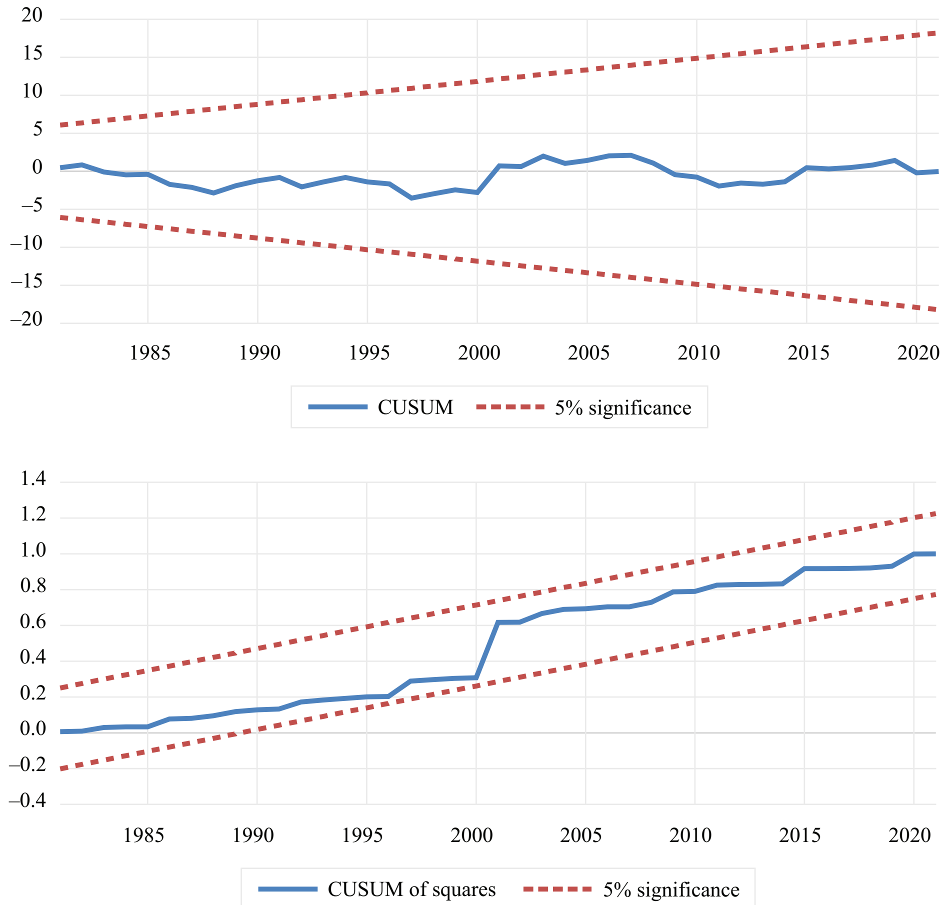

Fig. 3. The CUCUM and CUCUMSQ of the ARDL model.

Source: Author's calculations.

In the long run, the statistically significant negative parameter of the ECM_t, Table 5, approves the presence of a long-run Granger causality from the independent series to the $GPUS_t$. The ECM_t parameter has a high adjustment speed that reaches 99%. The ECM_t coefficient illustrates the speed by which the former years' errors are amended in the present time. Additionally, the current paper performs a pairwise Toda–Yamamoto causality test. The findings are presented in Table 6.[13] The ultimate conclusion states that $MEUS_t$ Granger causes $GPUS_t$, but $GPUS_t$ does not Granger cause $MEUS_t$.

As for the long-run explanatory variables, the results are similar to the short-run with some improvement. The outcomes in Table 5 show that $MEUS_t$, $RSUS_t$, and OP_t have statistically significant positive influences on $GPUS_t$. While the effect of YUS_t on $GPUS_t$ is adverse and statistically significant. Our outcomes display that the economic factors $RSUS_t$, and OP_t have positive effects, while YUS_t has a negative impact. This conclusion indicates that the economic resources which can be severely affected by external policies will increase geopolitical risk if

[13] The diagnostic tests display that none of the AR root lies outside the unit circle, and the null hypothesis of no serial correlation at lag h cannot be rejected.

Table 5
The ARDL model estimation.

Parameters	Coefficients	Standard errors
A) Short-run parameters		
Constant	–1.804	1.227
$\Delta\ln GPUS_{t-1}$	0.377^{**}	0.152
$\Delta\ln GPUS_{t-2}$	0.481^{***}	0.140
$\Delta\ln GPUS_{t-3}$	0.463^{***}	0.140
$\Delta\ln GPUS_{t-4}$	0.164	0.134
$\ln MEUS_t$	0.266^{*}	0.139
$\Delta\ln YUS_t$	-0.025^{**}	0.010
$\Delta\ln RSUS_t$	–0.497	0.555
$\Delta\ln RSUS_{t-1}$	–0.120	0.597
$\Delta\ln RSUS_{t-2}$	1.071^{*}	0.564
$\Delta\ln RSUS_{t-3}$	-1.148^{**}	0.546
$\Delta\ln OP_t$	–0.122	0.089
B) Long-run parameters		
Constant	-1.816^{*}	0.995
$\ln MEUS_{t-1}$	0.268^{***}	0.102
$\ln YUS_{t-1}$	-0.025^{**}	0.010
$\ln RSUS_{t-1}$	0.685^{**}	0.291
$\ln OP_{t-1}$	0.076^{**}	0.035
ECM_{t-1}	-0.993^{***}	0.148
C) Diagnostics tests		Probability
Adj. R^2	0.531	
Jarque-Bera	3.596	0.166
LM – Stat. (BG test), F (3, 38)	1.286	0.293
Heteroskedasticity (Harvey-test) F (14, 41)	0.627	0.827
Heteroskedasticity (ARCH-test) F (1, 53)	0.692	0.409
Ramsey RESET (*F*-test), F (3, 38)	1.879	0.150
CUSUM	Stable	
CUCUMSQ	Stable	

Note: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.
Source: Author's calculations.

Table 6
Pairwise Toda–Yamamoto causality (modified Wald) test.

Variable	Chi-sq	df	Prob.
Dependent variable: $\ln GPUS_t$			
$\ln MEUS_t$	7.348	2	0.0254
Dependent variable: $\ln MEUS_t$			
$\ln GPUS_t$	3.146	2	0.207

Source: Author's calculations.

the policy change does not satisfy the US goals. The best example, as stated above, is the tension between the US administration and OPEC because of the increase in the oil price when the Russia–Ukraine conflict started. This tension spills over to the relationship between the US and Saudi Arabia as the largest oil producer in OPEC. In contrast, if the economic resources can be entirely controlled by the US policy, then an increase in this resource will reduce geopolitical risk.

The long-run effect of $MEUS_t$ is consistent with its influence in the short run. This end result presents $MEUS_t$ as a driver and controller to $GPUS_t$. This outcome is consistent with the empirical findings of Khan et al. (2022) and Carter and Fray

(2019) regarding the Granger causality from $MEUS_t$ to $GPUS_t$. Also, our outcomes are consistent with the justifications of Chen and Feffer (2009) and Zhong et al. (2017) to this relationship. Our finding opens a new understating of $GPUS_t$ by introducing it as a political and military tool to achieve the nations' desires since it is directly associated with the $MEUS_t$ or the federal military budget. Recall that our paper did not find a Granger causality relationship from the $GPUS_t$ to the $MEUS_t$. Within the same context, the influence of the three resource variables, YUS_t, $RSUS_t$, and OP_t, on $GPUS_t$ are all statistically significant. It supports the hypothesis that resources-based factors drive the $GPUS_t$. Thus, establishing geopolitical risk worldwide is an intelligent tool for reallocating economic resources to achieve economic and political targets. This part of our results is consistent with that of Sweidan (2022).

Within the same framework, the recent empirical works (Faruk et al., 2022; Sweidan, 2023a) on the determinants of geopolitical risk found geopolitical risk spillover across borders between nations. The conclusion of our paper adds to this research strand by justifying why such spillover between nations occurs. Alternatively, controlling military expenditure will limit not only the geopolitical risk of a single nation, but also the spillover effect among countries.

5. Conclusions and policy implications

Examining the nexus between geopolitical risk and military expenditure was not profoundly explored over the past period. The absence of a well-published proxy for geopolitical risk was the fundamental reason for such a deficiency. Additionally, the previous empirical research considered one direction assumption, which is that military expenditure relies on wars, clashes, and political instability. Recently, the work of Caldara and Iacoviello (2022), along with earlier versions of their work, produced a geopolitical risk index. It encourages researchers from various disciplines to execute empirical research in this vital area. Lately, Khan et al. (2022) explored the causal association between geopolitical risk and military expenses. They used the panel bootstrap Granger causality method on data from eight nations during the period (1991–2018).

Our paper argues that a developed dominant nation, such as the US, with massive economic and military power and international economic and political lobbying, can create international geopolitical waves to accomplish its international hegemony's strategic goals. For this reason, the US is the best model to produce conclusions from its behavior on such a crucial topic. For this reason, we assume that if the causality moves from military spending to geopolitical risk, it is a sign that economic resources motivate geopolitical risk. Thus, it is part of the US hegemony strategic plan. Alternatively, geopolitical risk is part of resource allocation and can be controlled, directed, and mitigated. Nevertheless, if the causality goes from geopolitical risk to military spending, it means that geopolitical risk is not part of the resource allocation or an unplanned event. Thus, geopolitical risk denotes an external shock and requires military action and power to resist it.

We create a theoretical context, construct an econometric model, and compute its coefficients by applying the ARDL approach to examine our paper's hypothesis. This methodology is helpful for the current study because it calculates short-run parameters, long-run coefficients, and an error correction term. Additionally, a cointegration relation among the variables means the validity of a Granger causality link between the explanatory and dependent variables. Besides, the current paper performs the pairwise Toda–Yamamoto causality test between the US geopolitical risk and the US military expenses as a ratio to GDP.

The ARDL model results illustrate that the relationship between geopolitical risk and military expenses is unidirectional causality. It moves from military expenditure to geopolitical risk, but not in the opposite way. This finding supports our hypothesis that economic resources stimulate geopolitical risk. Hence, it is a consequence of resource allocation and can be controlled, directed, and mitigated. The detailed results show that the US military expenditure significantly and positively impact the US geopolitical risk. Moreover, the share of the US resources to the world resources and oil prices significantly stimulate the US geopolitical risk, while the US real economic growth decreases it.

The conclusion of our paper leads to exciting policy implications. First, it is obvious that the US geopolitical risk is stimulated, controlled, and directed by resource allocation via military spending. Hence, reducing the US military budget will diminish geopolitical risk worldwide. Second, controlling geopolitical risk via limiting military expenditure will reduce the spillover effect among countries, mainly those bordered nations. Third, the US expected military expenditure appears to be a good sign to predict the future geopolitical tensions around the world that may trigger an arms race and waste a significant portion of resources. Fourth, we claim that mitigating this kind of international tension is under the control of politicians and policymakers. It implies moving toward cooperation and coordination with other nations instead of increasing military equipment and tools to achieve strategic goals. Recall that the US geopolitical risk mimics the international geopolitical risk, as shown in Fig. 1. It has been confirmed that geopolitical uncertainties have broad negative consequences on the various nations' economic activities and sectors. We strongly believe that accumulating military tools will harm the international economy via two channels. First, reallocating the economic resources toward the wrong or unproductive sectors. Second, generating more international geopolitical risk or institutional uncertainty has additional negative impacts on the international economy.

The limitation of our study is the missing empirical works that investigate the determinants of geopolitical risk including military expenditure. More precisely, the empirical studies that explored the effect of military expenditure on geopolitical risk by using Caldara and Iacoviello (2022) index are very limited as stated above. It restricts the ability of our paper to generate comprehensive comparison results across these studies. Moreover, the military expenditure data is available on a yearly basis only. It controls the ability of scholars to expand their sample data and develop their hypothesis. For potential future research, the interesting results of our current paper open the channel to explore the existence of a nonlinear relationship between military expenditure and geopolitical risk.

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Supplementary material

Geopolitical risk and military expenditures

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Data type: Table

Explanation note: This paper seeks to understand the relationship between geopolitical risk (GPR) and military expenditures (ME) in the US. The results show that the relationship between them is unidirectional causality and runs from ME to GPR. The data underpin the analysis reported in this paper.

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