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Geopolitical Risk and Military Spending in Poland

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ABSTRACT

Objective: To examine the impact of geopolitical risk on military spending in Poland in the years 1993–2022.

Research Design & Methods: Autoregressive distributed lags, error correction, and Granger causality test were used.

Findings: Polish budgetary spending on defence is influenced by geopolitical risk in both the short and long term.

Implications/Recommendations: An increase in geopolitical risk motivates the Polish government to increase its military spending.

Contribution: The research verifies the theoretical nexus between external security risk and defence burden in Poland, a study which had never been done.

Article type: original article.

Keywords: external security risk, defence burden, demand, expenditure, cointegration.

JEL Classification: C52, F51, H56.

1. Introduction

Geopolitical issues are garnering increasing attention due to the ongoing Russian-Ukrainian conflict, which places society and security at the heart of academic and public debate. As Smith (1980) observes, national security is both an objective measure and a subjective peace of mind that is based on the social sense of freedom from being attacked. According to the theory, war and terrorism have the greatest impact on the perception of national security in the international dimension. When external threats increase, individuals turn to the government and express their support for military spending (Eichenberg & Stoll, 2003). Rising defence spending is a clear sign to citizens that their government seeks to improve the country's military capability,[1] and to restore a sense of security.

While numerous studies have been done on the nexus between external security risk and economic security (Khan, Khurshid & Cifuentes-Faura, 2023), fewer have examined the relationship between geopolitical risk and military expenditures, and none have looked at geopolitical risk and military spending in the countries of Eastern Europe, though their strategic and geopolitical importance has risen substantially. Certainly, part of the problem resides in the lack of a well-published proxy for geopolitical risk (Sweidan, 2023).

To fill this void in the literature, we examined the effect of geopolitical risk on Polish military expenditure. The text is structured as follows. The first section presents the connections between the state demand for defence and geopolitical risk index, followed by an analysis of the values of geopolitical risk for Poland. The second part reports on the autoregressive distributed lags model that was used to examine whether the shifts in the geopolitical risk index had an impact on Polish fiscal spending on the army. The model was enhanced by an error correction mechanism and the Granger causality test. The final section discusses the results and conclusions.

The research proves that the geopolitical risk has a positive impact on military spending, both in the short- and long-term perspective. It also confirms that the Polish government reacted to changes in the external security risk by adjusting defence expenditure during the period under consideration.

2. Geopolitical Risk and Demand for Defence

The Geopolitical Risk Index (heather GPR) is a relatively new formula for measuring risks associated with wars, terrorist acts, and tensions between nations or political agents that affect the normal course of international relations. GPR meas-

[1] More trained soldiers, reliable equipment, proven procedures, etc. demonstrate the country's defensive strength in the event of war or conflict.

ures the possibility of an adverse event realisation and escalation by calculating the likelihood of both violent and non-violent acts occurring (Caldara & Iacoviello, 2022). The GPR index is constructed based on the automated text-search done within the electronic archives of six American, three British, and one Canadian newspapers.[2] These newspapers have high circulation, consistent coverage of international political events, and digital archives that span a long period (Caldara & Iacoviello, 2022). This approach to measurement reflects the intention to capture events that have global dimension and repercussions.

GPR is computed monthly, by examining the number of articles pertaining to adverse geopolitical events in each newspaper as a proportion of the total number of news articles. Eight distinct categories of text-related issues are tracked: war threats, peace threats, military build-ups, nuclear threats, terror threats, beginning of war, escalation of war, and acts of terror (Caldara & Iacoviello, 2022). The index takes values from 0 to 1. The greater the value of GPR, the higher the external risk to national security. The GPR measures the frequency with which articles discuss the geopolitical issues outlined above, using this formula:

$$\text{GPR} = \frac{\text{Articles mentioning adverse geopolitical events}}{\text{Total number of articles}}.$$

The GPR database provides access to the historical GPR (index since 1900), and the recent GPR (index since 1985). GPR is formulated as both a global and a national indicator (currently for 44 countries). The global GPR quantifies negative activities and security threats occurring around the world, but it affects the sense of security in different ways in different countries. The GPR for a nation counts country-specific factors such as geographic location, history, and social characteristics. Therefore, an index handled by country more accurately represents the national security situation because it captures the difference stemming from the strictly domestic factors that make one country more vulnerable to the same external risk than another due to the distance to the hostile country and the length of common borders.

Unfavourable events (acts and threats) that are calculated as GPR, such as terrorism or war, represent, at the same time, an external risk to national security. The security environment, in turn, is widely recognised as a fundamental factor influencing the demand for defence (Smith, 1980). Although national security encompasses both external and internal threats, as stated by Clements, Gupta and Khamidova (2021), advanced economies are more concerned with external secu-

[2] *Chicago Tribune*, *The Daily Telegraph*, *Financial Times*, *The Globe and Mail*, *The Guardian*, *The Los Angeles Times*, *The New York Times*, *USA Today*, *The Wall Street Journal*, and *The Washington Post* (Caldara & Iacoviello, 2018).

rity threats (Okamura, 1991). External security risk can be qualified as a strategic factor for more military spending owing to the objective perception of risk as well as public perception of insecurity (subjective one). Subjectivity plays a part here since individuals have a good deal of access to information about the global security environment that affects their perception of threats. In conclusion, increasing insecurity in society leads governments to spend more on the military (hereafter military spending, or MS) to build up defence capabilities and restore the perception of security (Waszkiewicz & Taksás, 2023).

3. Quantifying External Security Risk – Empirical Literature Review

Since the Cold War, external threats have been associated with arms race theory, which focuses on the negative cooperation between nations in conflict. In effect, both opponents invest more and more in armament and manpower. Authors who have employed this methodology sought to assess external security risk by analysing the quantity of soldiers in the nations in conflict, their equipment, the quantity of long-range missiles and bombers (Murdoch & Sandler, 1982). The arms race model shows that both adversaries experience a spiral increase in budgetary outlays on the army, but neither feels safe, resulting in a security dilemma (Herz, 1950). Terrorist attacks in the USA and Europe at the start of the 21st century led researchers to link external threats to transnational terrorist incidents (Mickolus *et al*., 2011). The number of causalities (deaths) as an index gains interest not only because of terrorism, but also because of the wars (in Afghanistan and Iraq) in the first decade of the 21st century (Goldberg, 2018). Both George and Sandler (2018) and Flores (2011) consider a given country's location relative to its allies and potential enemies to determine the scale of the peripheral security threat.

Some authors have proposed their own indicators to calculate external security risk. Collier and Hoeffler (2002) estimated an arms race multiplier to demonstrate how rising expenditure on the army impacts the strategic policy of neighbouring states. Aizenman and Glick (2003) developed an indicator for the external threat a nation faces based on the number of wars it has been involved in, the number of adversaries it encounters in each war, and the duration of each war. Nordhaus, Oneal, and Russet (2012) have developed a means of predicting probability that a nation will be involved in a fatal militarised interstate dispute. Hou and Chi (2022) employ indicators of tensions based on data gleaned from the Global Database of Events, Language, and Tone (GDELT).

The GPR constructed by Caldara and Iacoviello (2022) presents a new method of assessing external security threats both to the world, and specific nations. Presented gauge records a duality of national security (Ficoń, 2020) quantifying the continuing process and the changing states of external security risk to the nation. In a similar vein, Khan, Su and Rizvi (2022), employing the panel bootstrap Granger causality method, examined a causal link between GPR and MS in 1991–2018 in China, India, and Saudi Arabia. Demirci and Ayyıldız (2023) likewise conducted a causality analysis on a panel based on GPR to MS. It confirmed the existence of a dependency for Mexico, Indonesia, South Korea, and Turkey during the period 1990–2021. Using the autoregressive distributed lags model, Sweidan (2023) examined the impact of GPR on MS for the United States (1950–2021). He does not provide any evidence of causality between GPR and MS.

In summary, prior to 2020 researchers used a variety of indicators to measure the scale of external security risk, and they were beneficial in particular circumstances – but not for comparative analysis. Furthermore, security risk was an additional explanation variable, not the leading one in the research. Lastly, while numerous studies examining external security risk based on the GPR index have been published, the number of papers looking at military expenditure remains insufficient.

4. Geopolitical Risk Index for Poland

For the nations of Eastern Europe, external security threats are intrinsically linked to Russia. The Russian-Ukrainian war has only further driven home this reality. Poland was chosen for analysis for two reasons. First, it has played a leading role in providing support to Ukraine since the start of the conflict (Francis, 2023). Second, the GPR index is calculated only for two post-soviet countries, Poland and Hungary. Although both states share a border with Ukraine, the Polish frontier is five times longer. The geopolitical situation of Poland is also different, as it plays a strategic role for Ukrainian defence. With this in mind, we used the recent GPR, which recorded the average annual trend presented in Figure 1.

Figure 1 shows GPR values for Poland (POL), which reveal that the first security shock happened in 2014, leading values to move higher, where they remain today. Having said that, GPR index was not stable in the years 1993–2013. In any case, the scale of the changes in GPR cannot be compared to the events of 2014, 2021, or 2022, all of which, and particularly the latter two, sent the index precipitously higher.

In 2021, the second shock in GPR occurred. It was linked to the issue of migration at the Polish-Belarusian border that had started in July of that year. From a strategic perspective, the refugee crisis presents non-confrontational operations running on non-military ground within the framework of a hybrid war (Hall, Flemming & Shotter, 2021). Certainly, such actions had a detrimental impact on Poland's national security. The third shock in GPR was recorded when the Russian--Ukrainian conflict began, causing the GPR index to peak for Poland in 2022.

When examining Poland, the key question is how MS reacted to the trajectory of the GPR. Whether the state respond to the increasing external security threat or whether the jumps in GPR happened after the rise in budgetary spending on the army? Figure 2 presents a preliminary answer.

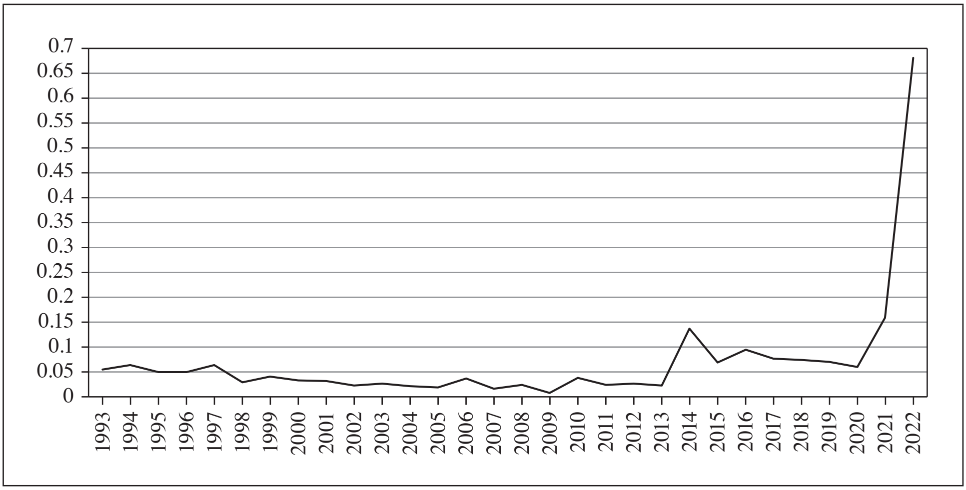

Fig. 1. GPR for Poland (Annual Average), 1993–2022
Source: the author, on the basis of GPR Statistics.

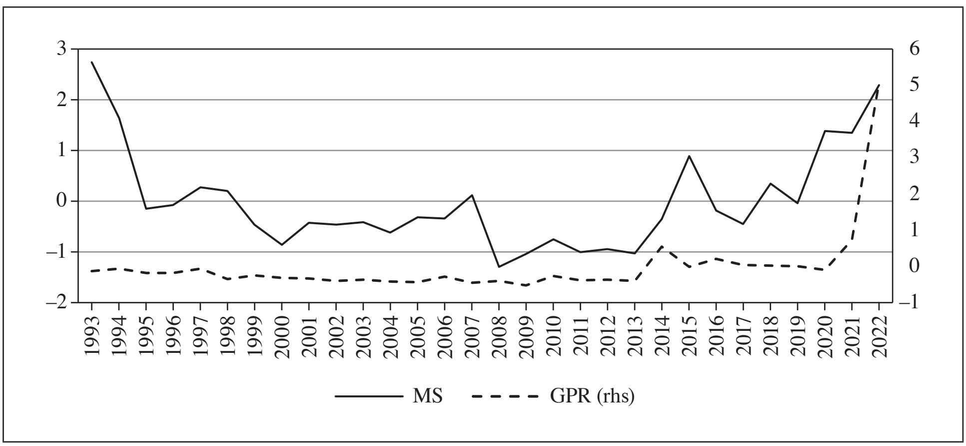

Fig. 2. MS and GPR in Poland (Annual Average, Normalised Values), 1993–2022
Source: the author, on the basis of GPR Statistics and SIPRI Statistics.

As Figure 2 shows, a relatively small increase (decrease) in GRP induced greater adjustment within budgetary spending on defence. That is clearly visible after 1997, 2006, 2014, and more clearly after 2020. The changes in the trends of GPR and MS justify an in-depth econometric analysis to look for a causal relationship.

5. Empirical Analysis

5.1. Arrangements and Data

According to Smith (1980), the demand for defence (MS) is a function of civilian output in the national economy (GDP) and security environment that is associated with external security risk (GPR). On that basis, the following model was constructed:

$$MS = \text{function}\ (GDP, GPR).$$

Benoit (1973) examined the relationship between economic growth and military spending, while numerous empirical studies have provided mixed results (Topcu & Aras, 2017; Topal, Unver & Türedi, 2022). Both Eichenberg and Stoll (2003) and Hartley and Russett (1992) showed that society anticipates the government will allocate more funds to the military sector when external threats increase. Table 1 presents the characteristics of time series from the literature.

Table 1. Characteristics of Applied Time Series

Data	Source	Time Range	Units
Military spending (MS)	SIPRI Statistics	1993–2022	percent of GDP
Geopolitical Risk Index (GPR)	GPR Statistics	1993–2022	points
Gros domestic product (GDP)	World Bank Statistics	1993–2022	growth rate (year/year)

Source: the author.

Concerning Table 2, original data present annual frequency with 30 observations each. GPR is characterised by the highest instability, while MS exhibits the lowest.

Table 2. Descriptive Statistics (Original Data)

Statistics	Variable		
	MS	GDP	GPR
Mean	0.019	4.161	0.070
Maximum	0.024	7.102	0.681
Minimum	0.017	–2.020	0.007
Standard deviation	0.001	2.035	0.120
Observations	30	30	30

Source: the author.

Furthermore, two difficulties occurred during the data preparation. First, the GPR statistics needed to be recalculated from monthly to annual data (the average of 12 months). Second, all input values were converted into logarithms to improve the data features. As the GDP growth rate was negative for the years of the COVID-19 pandemic, we changed the logarithm base according to the formula: $\min(Y + a) = 1$, where a remains constant (3.020). This converted all observations to positive ones before log transformation.

5.2. Method Applied

The autoregressive distributed lags (ARDL) model was proposed by Pesaran and Pesaran (1997) and Pesaran, Shin and Smith (2001). In that procedure, bound test cointegration is used to verify long-run relations between integrated variables. Traditional cointegration methods may suffer from the difficulties with endogeneity, while the ARDL method can distinguish dependent and independent variables. Thus, estimates obtained from the ARDL method are unbiased and efficient, since they avoid the problems that may arise in the presence of serial correlation and endogeneity (Dimitraki & Win, 2021). If the cointegration relation exists, the model can be changed into an error correction model (ECM) that combines short-run dynamics with long-run equilibrium (Nkoro & Uko, 2016). As the only joint causality is established by the ECM, we also applied the Granger causality test to find the long-term relationship between individual regressors and the dependent variable.

The ARDL technique was selected for its efficiency with small samples. Furthermore, The ARDL model also makes it possible to use variables with varying order of integration, including initially non-stationary data. The ADF unit roots test was therefore first applied to evaluate the stationarity of the data. Then, using the test for optimal lag specification (Akaike, Schwarza, and Hanna-Quinna), the appropriate lag interval and leading information criterion were selected for our model.

As each system is susceptible to external shocks (shifts in economic policy or unexpected geopolitical events), it is advisable to verify whether there are any structural breaks in the model. A DF unit root with break test for individual series, and Bai-Perron test to seek for time of structural break were therefore performed. The breaking points were then verified using the Chow test.

The final ARDL model was then formulated as a linear equation (equation 1).

$$\begin{aligned}\Delta \ln \mathrm{MS}_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta \ln \mathrm{MS}_{t-i} + \sum_{i=1}^{p} \beta_{2i} \ln \mathrm{GDP}_{t-i} + \sum_{i=1}^{p} \beta_{3i} \ln \mathrm{GPR}_{t-i} + \\ + \beta_4 \Delta \ln \mathrm{MS}_{t-i} + \beta_5 \Delta \ln \mathrm{GDP}_{t-i} + \beta_6 \Delta \ln \mathrm{GPR}_{t-i} + \varepsilon_t,\end{aligned} \tag{1}$$

where ln represents a natural logarithm, $t = 1, 2$ determines the time (lag) and ε_t identifies the standard error terms.

Based on the ARDL model, a bound cointegration test that assumes a maximum of one cointegration relationship was conducted. The verification procedure is connected to asymptotic critical values between two extremes, namely between the lower bound critical value I(0) and the upper bound critical value I(1). The only test statistics above I(1) confirm the existence of the cointegration vector. ECM is derived from the ARDL model through a simple linear transformation that integrates short-run adjustments with long-run equilibrium without losing long-run information (equation 2). Error correction term (ECT) informs how quickly long-term balance is restored in the model.

$$\begin{aligned}\Delta \ln MS_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta \ln MS_{t-i} + \sum_{i=1}^{p} \beta_{2i} \ln GDP_{t-i} + \\ + \sum_{i=1}^{p} \beta_{3i} \ln GPR_{t-i} + \alpha_1 ECT_{t-1} + \varepsilon_t.\end{aligned} \tag{2}$$

With a view to completing the model's correctness, it was evaluated for serial correlation, normal distribution, heteroscedasticity, model stability, and functional form. To do this, four tests were used: the Breusch-Godfrey, the Breusch-Pagan, the Jarque-Bera, cumulative sum of squares (CUSUM), and the Ramsey reset.

The Granger causality test yields crucial information about the dependency between individual regressors and the dependent variable. If the past observations of X help to predict the current state of Y, there is a causal relationship between time series (Granger, 1969). Our examination focuses on the two equations in the GPR-MS relation (3a and 3b). A similar pair of equations needs to be investigated for GDP-MS (3c and 3d).

$$LMS_t = \sum \alpha_1 LMS_{t-i} + \sum \alpha_2 LGPR_{t-i} + \varepsilon_{i,t} \tag{3a}$$

$$LGPR_t = \sum \beta_1 LGPR_{t-i} + \sum \beta_2 LMS_{t-i} + \varepsilon_{i,t} \tag{3b}$$

$$LMS_t = \sum \beta_1 LMS_{t-i} + \sum \beta_2 LGDP_{t-i} + \varepsilon_{i,t} \tag{3c}$$

$$LGDP_t = \sum \beta_1 LGDP_{t-i} + \sum \beta_2 LMS_{t-i} + \varepsilon_{i,t} \tag{3d}$$

5.3. Calculations and Outcomes

We began by examining the order of integration for MS, GDP, and GPR based on augmented Dickey-Fuller test (Table 3) and Phillips-Perron test (Table A.1 in Appendix 1). In all tests, a significance level of 5% or 1% was accepted.

Both methodologies confirm that our time series exhibits a mixed order of integration.[3] The dependent variable is I(1), whereas the independent variables present

[3] The KPSS test confirms the identical order of integration for individual variables.

I(0) and I(1) order of integration. The ARDL model can thus be said to be well--adjusted to the characteristics of the data employed.

Table 3. Test for Unit Roots (ADF)

ADF Unit Roots	I(0)		I(1)	
	T-stat.	*p*-value	T-stat.	*p*-value
LMS				
Intercept	–2.61	0.10	–5.51	0.00***
Trend and intercept	–2.55	0.29	–6.39	0.00***
None	–0.05	0.69	–5.64	0.00***
LGDP				
Intercept	–5.62	0.00***	–	–
Trend and intercept	–6.00	0.00***	–	–
None	–0.89	0.31	–6.46	0.00***
LGPR				
Intercept	0.13	0.96	–7.62	0.00***
Trend and intercept	–1.71	0.71	–8.45	0.00***
None	–0.80	0.36	–7.63	0.00***

Notes: Significance level: *** 1%.

Source: the author.

Next, a possible lag interval was verified (Table A.2 in Appendix 1), with lag-length selection based on the minimum information criteria values. The results obtained show that the AIC criteria plays a leading role. There should be no more than 2 lags in the final model to guarantee a stable economic system. ARDL model (1.0.1) was selected and is presented in Table 4.

We also examined whether there was a structural break in the particular time series and in the whole model was examined, and models were built with a structural break according to Table A.3 in Appendix 1. Unfortunately, none of them proved that the dummy variable is significant. The main model was therefore reparametrised, ultimately yielding an ECM model (Table 5).

The results proved ECT can restore over 60% of long-term equilibrium to the system. That indicates that all regressors (MS, GDP, and GPR) jointly impact MS. From the long-term perspective, GDP presents a negative sign whereas GPR is a positive one. The pairwise Granger causality test was then applied to establish long-term causality between individual independent variables and the dependent one. The results are presented in Table 6.

Table 4. ARDL Model and Bound Cointegration Test

Variable	Coefficient	Standard Error	T-stat.	*p*-value
ARDL (1.0.1)				
LMS(–1)	0.35	0.13	2.56	0.02**
LGDP	–0.32	0.02	–1.64	0.11
LGPR	0.03	0.01	2.41	0.02**
LGPR(–1)	0.03	0.02	1.95	0.06***
C	–2.27	0.52	–4.34	0.00
R-sq.	0.70	Mean dependent var		–3.93
Adj. R-sq.	0.66	S.D. dependent var		0.07
F-stat.	14.44***	AIC		2.23
Bound Cointegration Test				
F-stat. = 8.10	5%		1%	
Sample size	I(0)	I(1)	I(0)	I(1)
30	3.53	4.42	5.15	6.26
Asymptotic	3.10	3.87	4.13	5.00

Notes: Significance level: *** 1%, ** 5%.

Source: the author.

Table 5. Error Correction Model (ARDL 1.0.1)

Variable	Coefficient	Standard Error	T-stat.	*p*-value
LMS(–1)	–0.64	0.14	–4.69	0.00***
LGDP	–0.03	0.01	–1.64	0.11
LGPR	0.06	0.01	4.04	0.00***
Cointegration Coefficients				
LGDP	–0.05	0.03	–1.44	0.16
LGPR(–1)	0.10	0.02	4.75	0.00***
C	–3.51	0.11	–28.08	0.00***

Notes: Significance level: *** 1%.

Source: the author.

In the long-term perspective, MS is strongly impacted by GPR. The cumulative effect of a GPR shock on MS unfolds over four years (Fig. A.1 in Appendix 2). A rapid increase in MS reflects a government's reaction to external security risk. Such a scenario can happen as the result of a trade-off within the budget (Waszkiewicz, Kutasi & Marton, 2025). We can also conclude that MS (after shock) remains higher than it was before due to the continuation of armament programmes and the

Table 6. Pairwise Granger Causality Tests

Null Hypothesis	F-stat.	*p*-value
LGDP does not Granger cause LMS	3.29	0.055*
LMS does not Granger cause LGDP	0.70	0.505
LGPR does not Granger cause LMS	5.71	0.00***
LMS does not Granger cause LGPR	1.38	0.27

Notes: Significance level: *** 1%, * 10%.

Source: the author.

Table 7. Diagnostic Tests for ARDL Model (1.0.1)

Verification	Test	Stat	*p*-value
Normal distribution	Jarque-Bera	1.42	0.49
Serial correlation	Breusch-Godfrey	0.17	0.84
Heteroscedasticity	Breusch-Pagan	0.81	0.59
Functional form	Ramsey RESET	1.14	0.33
Model stability	CUSUM sq.	Stable	

Source: the author.

increased number of soldiers. Furthermore, MS might be impacted by GDP in the long run because the significance level is only slightly above 5%. In consequence, the question still requires further empirical analysis. Nonetheless, there is no impact from MS to GDP or to GPR. Lastly, the system's correctness was examined based on residuals. All diagnostic tests show that the ARDL model was specified correctly (Table 7). CUSUM square test confirms the model's stability (Fig. A.2 in Appendix 2).

6. Results Discussion

Due to the recent increase in GPR, we have attempted to examine its effects on national defence. Theory has shown that a perception of insecurity can pose a determinant of the scale of military spending. Yet, there is a lack of literature examining this issue in the context of countries from NATO's eastern flank. Both the country's geographical location and the accessibility of the GPR for the individual states of Eastern Europe impacted the decision to select Poland for analysis. The objective was to examine whether Polish military spending reacted to changes in GPR between 1993 and 2022. To achieve this goal, the ARDL model was used with an error correction mechanism, followed by the Granger causality test.

The ARDL model has confirmed a one-directional causality between GPR and MS, both in a short- and long-term perspective. A positive relation indicates that a growing external security risk impacts the rise in public spending on defence. Timely government responses can turn insecurity into a temporary driver, but this requires avoiding time lags in budgetary decisions regarding higher defence expenditure.

Our empirical outcomes are in line with theory presented by Smith (1980), Okamura (1991), and Eichenberg and Stoll (2003): external security threats, when rising, urge national government to finance deterrence capability. The results are also convergent with our preliminary analysis of statistical figures for Poland, indicating an interrelation between the trends in original data. Furthermore, our findings are in accordance with empirical studies conducted by Khan, Su and Rizvi (2022) and Demirci and Ayyıldız (2023). Further, the outcomes confirm that it is highly possible that there is one-directional causality from GDP to MS. This could suggest that rising military spending is not an effect of economic growth, but of temporal shocks in the geopolitical environment.

This contribution advances the literature in three ways. First, it confirms that GPR has a robust impact on MS. This means that people might want the government to spend more money on the army when there are more strategic dangers outside. Second, policymakers must bear in mind that timely budgetary reaction mitigates a sense of insecurity within society. Lastly, GPR is a reliable measure of external security risk, being capable of expressing the state's insecurity as a current state and a continuous process.

The strategic approach to military spending (its level) is an interesting academic issue today. Furthermore, there are other opportunities for research on GPR and MS, including nonlinear methods. At the same time, numerous theoretical and empirical inquiries remain unanswered, such as whether the increase in military expenditure in one country can adversely impact external security risk in neighbouring states.

7. Concluding Remarks

The Russian incursion on the Crimean Peninsula and the conflict between Russia and Ukraine that started in 2022 led to escalation and materialisation of military and paramilitary threats in the region. The changing geopolitical environment, including Poland's growing strategic role, should encourage us to examine if external security risks have affected Polish defence expenditure. On theoretical grounds, the relationship between security risk and budgetary outlays on the army is undisputed, though empirical research returns mixed results.

Taking this all into consideration, we examined the nexus between GPR and MS in Poland for the last three decades. We have found that GPR has had a positive impact on the level of MS in Poland, both in a short- and long-term perspective. It was noted that GPR can induce only a temporary security shock, provided that the government's budgetary response is adequate and not delayed. Furthermore, GPR might be a reliable indicator for measuring the duality of national security.

Conflict of Interest

The author declares no conflict of interest.

Appendix 1

Table A.1. Unit Roots Test (Phillips-Perron)

Phillips-Perron	I(0)		I(1)	
	T-stat.	*p*-value	T-stat.	*p*-value
LMS				
Intercept	–2.67	0.09*	–5.64	0.00***
Trend and intercept	–2.46	0.34	–14.16	0.00***
None	–0.06	0.69	–5.77	0.00***
LGDP				
Intercept	–5.69	0.00***	–	–
Trend and intercept	–8.57	0.00***	–	–
None	–1.50	0.12	–27.14	0.00***
LGPR				
Intercept	–0.84	0.79	–7.61	0.00***
Trend and intercept	–1.38	0.84	–13.46	0.00***
None	–0.87	0.32	–7.63	0.00***

Notes: Significance level: *** 1%, ** 5%, * 10%.

Source: the author.

Table A.2. Lags Selection

Variable	AIC	SC	HQ	Final Selection
LMS	1	1	1	1
LGPR	2	2	2	2
LGDP	0	0	0	0
Model	2	1	2	2

Source: the author.

Table A.3. Structural Break Points

Individual Time Series			
DF unit root with break	T-stat.	*p*-value	Year
LMS	4.49	0.044**	2019
LGPR	3.24	0.539	2014
LGDP	5.63	0.000***	1999
System Break Point			
Multiple breakpoint test (Bai-Perron test)	F-stat.	Crit. value	Year
	9.28	8.58	1999
Chow Test			
Year	F-stat.	*p*-value	
1999	0.27	0.76	
2014	7.82	0.00***	
2019	7.34	0.00***	

Notes: Significance level: *** 1%, ** 5%.

Source: the author.

Appendix 2

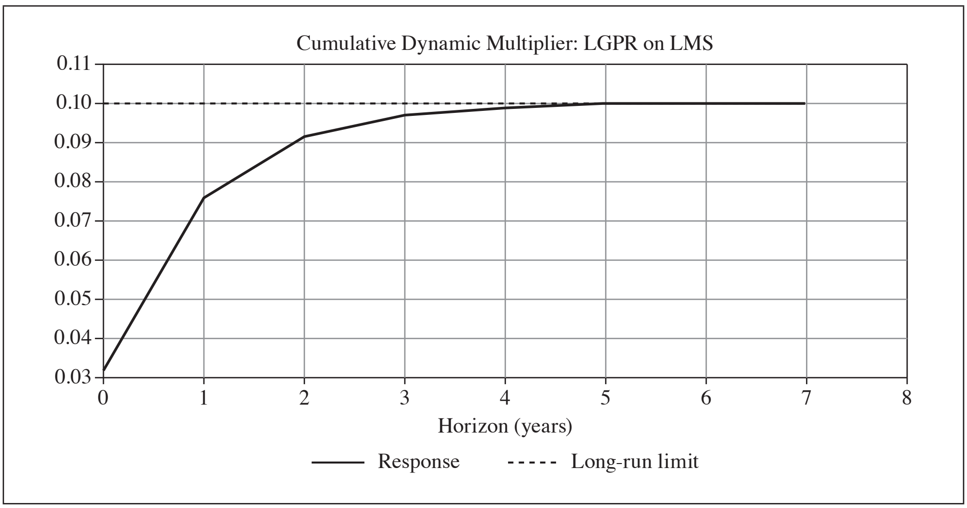

Fig. A.1. GPR Shock and MS

Source: the author.

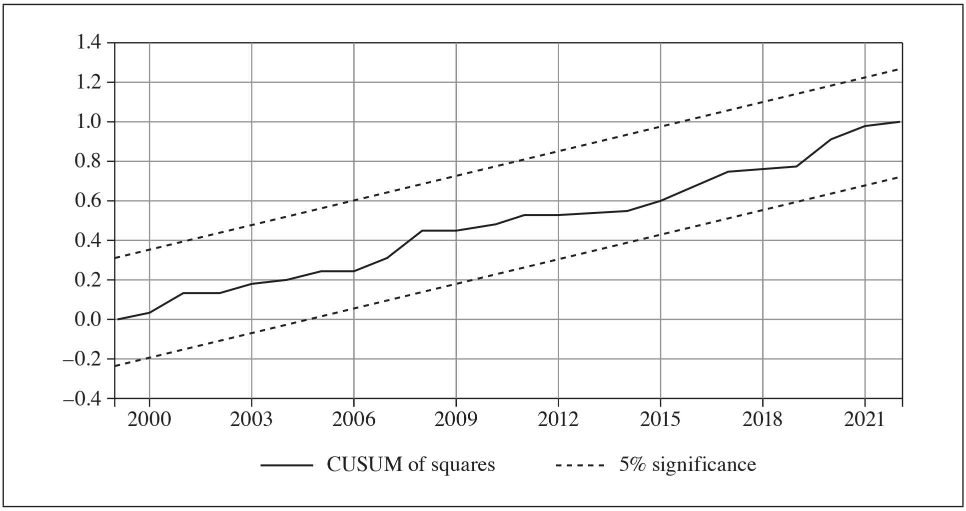

Fig. A.2. CUSUM Square Test

Source: the author.

References

Aizenman, J., & Glick, R. (2003). *Military Expenditure, Threats, and Growth* (NBER Working Paper No. 9618). National Bureau of Economic Research.

Benoit, E. (1973). *Defense and Economic Growth in Developing Countries*. Lexington Books.

Caldara, D., & Iacoviello, M. (2022). Measuring Geopolitical Risk. *American Economic Review*, *112*(4), 1194–1225. https://doi.org/10.1257/aer.20191823

Clements, B. J., Gupta, S., & Khamidova, S. (2021). Is Military Spending Converging to a Low Level across Countries? *Economic Modelling*, *94*, 433–441. https://doi.org/10.1016/j.econmod.2020.10.010

Collier, P., & Hoeffler, A. (2002). *Military Expenditure: Threats, Aid and Arms Races* (Policy Research Working Paper No. 2927). World Bank.

Demirci, O., & Ayyıldız, F. V. (2023). Jeopolitik Risklerin ve Savunma Harcamalarının İktisadi Büyümeyle İlişkisi: MIST Ülkeleri Örneği [The Relationship of Geopolitical Risks and Defense Expenditures with Economic Growth: The Example of MIST Countries]. *Fiscaoeconomia*, *7*(3), 1929–1947. https://doi.org/10.25295/fsecon.1277050

Dimitraki, O., & Win, S. (2021). Military Expenditure Economic Growth Nexus in Jordan: An Application of ARDL Bound Test Analysis in the Presence of Breaks. *Defence and Peace Economics*, *32*(7), 864–881. https://doi.org/10.1080/10242694.2020.1730113

Eichenberg, R. C., & Stoll, R. (2003). Representing Defense: Democratic Control of the Defense Budget in the United States and Western Europe. *The Journal of Conflict Resolution*, *47*(4), 399–422.

Ficoń, K. (2020). *Bezpieczeństwo narodowe i jego typologie*. Bel Studio.

Flores, A. Q. (2011). Alliances as Contiguity in Spatial Models of Military Expenditures. *Conflict Management and Peace Science*, *28*(4), 402–418. https://doi.org/10.1177/0738894211413064

Francis, D. (2023). Poland is Leading Europe's Response to the Russian Invasion of Ukraine. *Atlantic Council*. Retrieved from: https://www.atlanticcouncil.org/blogs/ukrainealert/poland-is-leading-europes-response-to-the-russian-invasion-of-ukraine/ (accessed: 10.02.2024).

George, J., & Sandler, T. (2018). Demand for Military Spending in NATO, 1968–2015: A Spatial Panel Approach. *European Journal of Political Economy*, *53*, 222–236. https://doi.org/10.1016/j.ejpoleco.2017.09.002

Goldberg, M. S. (2018). Casualty Rates of US Military Personnel during the Wars in Iraq and Afghanistan. *Defence and Peace Economics*, *29*(1), 44–61. https://doi.org/10.1080/10242694.2015.1129816

GPR Statistics. Data downloaded from: https://www.matteoiacoviello.com/gpr.htm (accessed: 10.04.2023).

Granger, C. W. J. (1969). Investigating Causal Relations by Econometric Models and Cross-spectral Methods. *Econometrica*, *37*(3), 424–438. https://doi.org/10.2307/1912791

Hall, B., Flemming, S., & Shotter, J. (2021). How Migration Became a Weapon in a 'Hybrid War'. *Financial Times*. Retrieved from: https://www.ft.com/content/83ece7e4-cc71-45b5-8db7-766066215612 (accessed: 3.04.2023).

Hartley, T., & Russett, B. (1992). Public Opinion and the Common Defense: Who Governs Military Spending in the United States? *American Political Science Review*, *86*(4), 905–915. https://doi.org/10.2307/1964343

Herz, J. H. (1950). Idealist Internationalism and the Security Dilemma. *World Politics*, *2*(2), 157–180. https://doi.org/10.2307/2009187

Hou, N., & Chi, Z. (2022). Sino-U.S. Relations and the Demand for Military Expenditure in the Indo-Pacific Region. *Defence and Peace Economics*, *33*(6), 751–766. https://doi.org/10.1080/10242694.2021.1904358

Khan, K., Khurshid, A., & Cifuentes-Faura, J. (2023). Investigating the Relationship between Geopolitical Risks and Economic Security: Empirical Evidence from Central and Eastern European Countries. *Resources Policy*, *85*, 103872. https://doi.org/10.1016/j.resourpol.2023.103872

Khan, K., Su, C.-W., & Rizvi, S. K. A. (2022). Guns and Blood: A Review of Geopolitical Risk and Defence Expenditures. *Defence and Peace Economics*, *33*(1), 42–58. https://doi.org/10.1080/10242694.2020.1802836

Mickolus, E. F., Sandler, T., Murdock, J. M., & Flemming, P. A. (2011). *International Terrorism: Attributes of Terrorist Events, 1968–2010* (*ITERATE*). Vinyard Software.

Murdoch, J. C., & Sandler, T. (1982), A Theoretical and Empirical Analysis of NATO. *Journal of Conflict Resolution*, *26*(2), 237–263. https://doi.org/10.1177/0022002782026002003

Nkoro, E., & Uko, A. K. (2016). Autoregressive Distributed Lag (ARDL) Cointegration Technique: Application and Interpretation. *Journal of Statistical and Econometric Methods*, *5*(4), 63–91.

Nordhaus, W., Oneal, J. R., & Russet, B. (2012). The Effects of the International Security Environment on National Military Expenditures: A Multicountry Study. *International Organization*, *66*(3), 491–513. https://doi.org/10.1017/S0020818312000173

Okamura, M. (1991). Estimating the Impact of the Soviet Union's Threat on the United States–Japan Alliance: A Demand System Approach. *The Review of Economics and Statistics*, *73*(2), 200–207. https://doi.org/10.2307/2109509

Pesaran, M. H., & Pesaran, B. (1997). *Working with Microfit 4.0: Interactive Econometric Analysis*. Oxford University Press.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics*, *16*(3), 289–326. https://doi.org/10.1002/jae.616

SIPRI Statistics. https://www.sipri.org/databases (accessed: 30.04.2023).

Smith, R. P. (1980). The Demand for Military Expenditure. *The Economic Journal*, *90*(360), 811–820. https://doi.org/10.2307/2231744

Sweidan, O. D. (2023). Geopolitical Risk and Military Expenditures: Evidence from the US Economy. *Russian Journal of Economics*, *9*(2), 201–218. https://doi.org/10.32609/j.ruje.9.97733

Topal, M. H., Unver, M., & Türedi, S. (2022). The Military Expenditures and Economic Growth Nexus: Panel Bootstrap Granger Causality Evidence from NATO Countries. *Panoeconomicus*, *69*(4), 555–578. https://doi.org/10.2298/PAN170914002T

Topcu, M., & Aras, I. (2017). Military Expenditures and Economic Growth in Central and Eastern EU Countries: Evidence from the Post-Cold War Era. *European Review*, *25*(3), 453–462. https://doi.org/10.1017/S1062798717000114

Waszkiewicz, G., Kutasi, G., & Marton, Á. (2025). The Socio-economic Perspective for the Guns vs. Butter Trade-off in The European Union Countries. *Folia Oeconomica Stetinensia*, *25*(1), 337–353. https://doi.org/10.2478/foli-2025-0017

Waszkiewicz, G., & Taksás, B. (2023). Military Spending among European NATO Members. The Importance of Strategic Factors after 2014. *Journal of Security and Sustainability Issues*, *13*(1), 53–63. https://doi.org/10.47459/jssi.2023.13.5