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Democracy and Militarization in Developing Countries: A Panel Vector Autoregressive Analysis

Democracy and militarization in developing countries:

A panel vector autoregressive analysis[*]

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Abstract

This study examines the dynamic relationship between democracy and the military in more than 40 developing countries from 1990 to 2017. We investigate the dynamic interaction between democracy and military institutions using a panel vector autoregressive model and impulse response functions as well as variance decomposition analyses. We show that democracy plays a significant role in the substitution of nonmilitary expenditures for defense expenditures. We also investigate the response of democracy to positive shocks in military and nonmilitary spending. We find that the responses of political system and different indexes of democracy including electoral, liberal, participatory, deliberative, and egalitarian democracy to positive shocks in military expenditures are negative and significant, whereas their responses to the shocks in nonmilitary expenditures are not significant. This result suggests that the political behavior of governments in developing countries is influenced more heavily by their spending on the military sector than by their spending on the nonmilitary sector.

Keywords: democracy; military spending; panel VAR model; developing countries

1. Introduction

Is dictatorship the result of militarism or the cause of it? Despite the significant body of literature that has examined how democracy impacts military systems, few studies have explored the political impact of military expenditures in developing countries. Militarism still occasionally emerges in developing countries despite recent advances toward democratization, indicating that democracy in developing countries has yet to fully flourish. The differences among developing countries in the relative size of their military burdens results from their different economic and political conditions (Maizels and Nissanke, 1986). A strand of literature argues that democracies spend less on the military than autocracies do (Kimenyi and Mbaku, 1996; Dunne and Perlo-Freeman, 2003; Fordham and Walker, 2005; Dizaji et al., 2016). In a democratic state, internal conflicts are settled by compromise and in nonviolent ways, providing the conditions by which external conflicts between democratic states can also be settled peacefully. Autocratic regimes' survival depends largely on military power, while democracies pay more attention to nonmilitary sectors (Yildirim and Sezgin, 2005; Dahlum and Knutsen, 2017; Dizaji, 2019a,b).

While political institutions can affect military expenditures, they may also be affected by the militarization process. Military pressure impedes citizens' demands for democracy. Non-democratic regimes spend greatly on the military and security sectors, which blunts their populations' democratic aspirations (Ross, 2008; Dizaji, 2019b). Moreover, military expenditure may crowd out productive nonmilitary expenditures such as education and health expenditures, which are essential for establishing and promoting democracy (Evans and Rose, 2007).

Political institutions and military expenditures are both endogenous, and conventional methods that implicitly treat political institutions as exogenous variables may be biased because political institutions also respond to militarization. To the best of our knowledge, few studies have investigated the simultaneous relationships between political development and militarization. This study contributes to the literature by investigating the dynamic simultaneous interactions between militarization and democracy.

We design a panel vector autoregression (PVAR) model for 47 developing countries that focuses on the dynamic relationship between the military and political systems, enabling us to examine how democracy affects government budgets and spending on the military and nonmilitary sectors and how military expenditures influence democracy indexes. Vector autoregression models can

treat all variables as endogenous and reveal the dynamic interactions between them (Sims, 1980; Enders, 1996). This is an important advantage, which has been neglected in most previous studies, which have applied static single-equation models. Moreover, while most of the studies on the military–democracy nexus have used a single measure of democracy (e.g., Polity index), we use a newly released democracy-measuring dataset from the Varieties of Democracy project, which categorizes democracy into electoral, liberal, deliberative participatory, and egalitarian components. This dataset allows us to investigate democratization using measures that are more reliable, valid, comprehensive, and nuanced than those used in previous studies (Bergougui and Murshed, 2019).

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature. Section 3 describes the study's data and methodology. Section 4 reports the empirical results. Finally, Section 5 provides concluding remarks.

2. Literature review

The interaction between political regimes and military spending has been a research issue for years. Studies have examined this nexus from different analytical and methodological perspectives. We review some of these studies and then explain the research design we use to shed more light on the dynamic relationship between political institutions and military spending.

Kotera and Okada (2017) address the question "*How does democratization affect the composition of government expenditure?*" using panel fixed effects estimation and a difference-in-differences model for data drawn from a sample of 125 countries covering 1972 to 2010. They explain the variation in the log of government expenditure as a share of GDP with a set of explanatory variables, including democratization, GDP per capita, population, fraction of population below 14 and beyond 65 years of age, and trade openness. Their results show that democratization does not have a significant impact on total expenditure but increases expenditure on health, and that an improved quality of political systems decreases military expenditures.

The relationship between various democratic characteristics and states' fiscal capacity has been investigated by Rota (2016). Using a pooled OLS regression for 28 countries from 1880 to 1938, this study examines the variation in the ratio of military expenditure to GDP using various sets of democracy indicators. The study shows that political participation is most effective in reducing military spending, while other elements of democracy play a distant secondary role.

Dizaji et al. (2016) use vector autoregressive (VAR) models for data covering 1960 to 2006 to examine the impact of political institutions on various categories of government expenditure in Iran. Their results show that improvements in the political situation have a negative impact on military expenditures and a positive impact on nonmilitary expenditures such as education and health as well as domestic security expenditures.

In a related study, Töngür et al. (2015) ask whether one can confirm the negative relationship between democracy level and military burden. They use a dynamic panel model for 137 countries from 1963 to 2000. They explain the variation in the share of military expenditures as a percentage of GDP with a set of explanatory variables, such as armed forces per 1,000 people, the military spending of allies and other friendly states, real GDP growth, estimated income inequality index, several dummies to control for war or conflict years, and political regime type. Their results show that a country with a social democratic political regime is likely to spend less on the military. In another study, Töngür and Elveren (2015) examine the relationships between military expenditure, income inequality, welfare regime type, and political regime. Using a dynamic panel model for 37 countries from 1988 to 2003, they show a significantly negative relationship between social democratic welfare regimes and military expenditures.

Brauner (2015) also empirically investigates whether democracies have lower military expenditures than autocracies using fixed effects regressions on a sample of 112 countries from 1960 to 2000. She employs military burden as a dependent variable and explains it with a measure of democracy, intrastate war, interstate war, the logarithm (log) of GDP per capita, the log of population, and the log of trade openness. Her results show that democracies spend less on the military as a percentage of GDP than autocracies do, while an absolute dictatorship spends around 40% more on the military than a full democracy does.

Elbadawi and Keefer (2014) examine the apparently low military spending in democracies and its implications for democratization using a sample of more than 140 countries from 1960 to 2007 and ordinary least square regression of pooled data. They explain military spending/GDP with variables such as a war dummy, a democracy index, lagged military spending, average population of contiguous countries, length of war, share of rural population, age dependency ratio, US arms imports, income per capita, and natural resource rents as share of GDP. They conclude that the shift toward democracy in the Arab world (e.g., the 2011 Arab Spring) will not lead to a quick

decline in military spending because only deeper forms of democracy seem to have an effect, particularly in view of the high external risks confronting countries in the Middle East.

Albalate et al. (2012) investigate the relationships between the form of government (presidential vs. parliamentary), electoral rules (plural vs. proportional), concentration of parliamentary party groups, and military spending by employing a sample of more than 150 countries covering 1998 to 2006 and pooled ordinary least squares. They explain military spending with the help of explanatory variables such as civil war, previous war, emulation, alliance, population, GDP per capita, democracy, and freedom. They conclude that democracies have lower percentages of military expenditure than autocracies have, and that presidential systems and majoritarian voting rules favor military spending.

Lskavyan (2011) examines whether levels of democracy affect the income–military expenditure relationship, contributing to discussions on the role of political institutions in resource allocation decisions. His study covers more than 100 countries from 1988 to 2006 and uses the dynamic panel model of the Arellano–Bond Generalized Method of Moments (GMM). The study aims to explain the logarithm of military expenditures (in constant 2006 US dollars) as a dependent variable with the help of the lagged value of the logarithm of GDP (in constant 2006 US dollars), the lagged value of the level of autocracy, interaction terms, and other determinants of military expenditures such as the logarithm of population, the logarithm of Official Development Assistance (ODA), the logarithm of US military assistance, and the number of internal and external conflicts for each country. The results show that, for a panel of developing and less-developed countries, the sensitivity of military expenditures to income changes decreases along with the level of democracy.

The empirical relationship between military expenditure and the level of democracy is also investigated by Yildirim and Sezgin (2005) using cross-country and panel data estimation techniques for 92 countries covering 1987 to 1997. Their main hypothesis proposes that, as the level of democracy increases, states become more peaceful and conflicts between democratic states tend to be resolved nonviolently. They employ panel fixed effects and GMM models and use the ratio of military expenditure to GNP as well as the ratio of military spending to total government spending as dependent variables. Their set of explanatory variables includes the combined democracy index, government consumption of GNP, GNP (1997 prices), and armed forces per

1,000 people. They reveal an inverse relationship between the level of democracy in a country and its military spending. They add that worldwide attempts to increase levels of democracy may result in a more peaceful world by reducing military expenditures and hence wars.

Fordham and Walker (2005) investigate whether democracies allocate fewer resources to their militaries than autocracies do using a sample of more than 150 countries from 1816 to 1997 and time-series cross-sectional regressions. They examine cross-country variation in military spending as a percentage of GDP (1950–1997), military personnel as a percentage of the state population (1816–1997), and a regression-based index of military allocation (1816–1997). They also use explanatory variables such as the Polity index, external war battle deaths (percentage of population), internal war battle deaths (percentage of population), rivals' composite index of national capability (CINC), allies' CINC score, and population. They find empirical support for the hypothesis that democracy has a demilitarizing effect, as expected in classical liberal theory. The negative effect of democracy on military spending persists even after other factors such as war, international threats, alliances, and overall wealth are controlled for.

Pereira (2004) examines similar questions: Do political regimes affect military budgets, and does a country's level of democracy/autocracy influence military activity? He uses OLS regression and pooled data for a sample of more than 150 countries covering 1987 to 1997, explaining cross-country variation in the log of military expenditures with the help of GNP per capita, dummy variables for involvement in wars from 1980 to 1999 (civil, ethic, international wars), and democracy. His results reveal a significantly negative relationship between democracy level and defense expenditures.

Kimenyi and Mbaku (1996) examine the relationship between resources allocated to the military and the degree of democracy. Their main hypothesis is that rents to the military increase as the degree of democracy declines. They use an instrumental variable approach for 1980 data taken from a sample of 87 countries and explain cross-country variation in military expenditures as a percentage of central government expenditures by considering such factors as government size measured by central government expenditures per capita (1980), a measure of political democracy or competition, and population in mid-1980 in millions. The results confirm the existence of a negative relationship between military expenditures and democracy in developing countries.

Bowman (1996) examines the drivers of the wide differences in democracy levels across Latin America during the Cold War. His main hypothesis concerns the role of militarization and military spending in shaping the quality of political institutions in Latin America. He employs an OLS regression on pooled data for 18 countries in Latin America from 1973 to 1986 and the Democracy Index as the dependent variable. As explanatory variables, he uses the one-year lag of several determinants of democracy, such as military spending as a share of GDP, the log of GDP per capita, adult literacy, the military participation ratio, the Gini coefficient, and the GDP per capita growth rate. His estimations show that (a) military spending has a significantly negative effect on democracy scores over time and (b) military participation ratios have a more robust negative impact.

Overall, the literature shows that democracy and military spending affect each other. Thus, a methodological approach such as the panel VAR model, which considers this dynamic and controls for other transmission channels, is an appropriate analytical tool. We measure the response of political institutions to a positive shock in military spending and investigate the response of military spending to a positive shock in the quality of political institutions, while controlling for other factors.

3. Research design

3.1. Data description

We consider a panel of annual data from 47 developing countries covering 1990 to 2017 according to data availability. The list of countries is presented in the appendix. We consider the following variables to analyze the dynamic interrelations between military factors (military expenditures, arms imports, armed forces), government budget, and democracy: the arms imports to GDP ratio (*armimp*), military expenditures to GDP ratio (*milex*), nonmilitary expenditures to GDP ratio (*nonmilex*), armed forces personnel to total labor ratio (*armforce*), government revenue to GDP ratio (*govreven*), military in politics index (*militpolit*), and the Polity2 index (*polity*). The nonmilitary expenditures to GDP ratio is the difference between the total general government expenditures to GDP ratio and the military expenditures to GDP ratio. The data on military expenditures, arms imports, and armed forces are collected from the World Bank's *World Development Indicators* (WDI) online database (World Bank, 2019). The data on total general government expenditures

and government revenues are taken from the International Monetary Fund's *World Economic Outlook Database* (October 2019).[1]

Data for the military in politics index (*militpolit*) are collected from the International Country Risk Guide (ICRG, 2019). The index ranges from 0 to 6; higher scores indicate lower degrees of military involvement in politics, and lower scores indicate higher levels.

We consider several democracy components, using indexes for electoral democracy (*elecdem*), liberal democracy (*liberdem*), deliberative democracy (*delibdem*), egalitarian democracy (*egalitdem*), and participatory democracy (*participdem*), as reported by the Varieties of Democracy (V-Dem) project, version 9. The V-Dem dataset captures annual changes in politics and the quality of various aspects of democracy. It captures a greater range of variation and has the advantage of considering a variety of sub-components that are helpful in capturing more aspects of democracy. All of these democracy indexes range between 0 and 1, with higher values indicating a higher quality of democracy.

In our robustness tests, we also use the Polity2 indicator (*polity*) as a measure of political systems, ranging from -10 (full autocracy) to 10 (full democracy). This index represents combinations of the autocratic and democratic characteristics of political institutions for various years (Marshall et al., 2017). Table A in the appendix presents the summary statistics of our variables.

Our main hypotheses are as follows:

H1: An improvement in the quality of political institutions decreases government expenditures on defense and increases non-defense expenditures and revenues.

H2: Militarization has a negative impact on a government's non-defense expenditures and political behavior.

H3: Nonmilitary expenditures improve government revenues and democracy components, while military expenditures have detrimental effects on government budgets and democracy.

3.2. Methodology

This study applies a panel vector autoregressive (PVAR) model to estimate the possible interrelationships among the variables. Using PVAR models is appropriate for this research

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[1] https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx.

because they enable the investigation of dynamic simultaneous effects and interactions between military expenditures, government budget, and political institutions. We can thus capture the long-run variations in political institutions, military factors, and government budgets over time influenced by military expenditures and democracy shocks using the VAR approach. The VAR methodology is helpful in the absence of a priori theory regarding the simultaneous relationships among military factors, political institutions, and government budgets because it deals with all variables as if they were jointly endogenous and does not force any priori restrictions on the structural relationships among them. The PVAR model merges the standard VAR method with the panel-data approach (Love and Zicchino, 2006). The VAR model defines the variables on the left-hand side of the system based on predetermined lagged variables (Filippaki and Mamatzakis, 2009). The econometric reduced-form model is given as follows:

$$Z_{it} = \Gamma(L)Z_{it} + \mu_i + \varepsilon_{it} \tag{1}$$

where i denotes the country, $t = 1,...T$, Z_{it} includes a vector of stationary variables, $\Gamma(L)$ denotes a matrix polynomial in the lag operator with $\Gamma(L) = \Gamma_1 L^1 + \Gamma_2 L^2 + \cdots + \Gamma_P L^P$, μ_i is the vector of country-specific effects, and ε_{it} represents the error term. Since only lagged values of the endogenous variables appear on the right-hand side of the VAR model, simultaneity is not a problem, and the OLS estimations are consistent. In standard VAR models, the disturbance terms are generally characterized by simultaneous correlations, so that the reactions of the system to changes in a particular variable indicate the responses of all those variables that have simultaneous correlations with it. However, this simultaneous correlation is purified by the Cholesky orthogonalization mechanism. The dynamic changes of variables in response to shocks in a specific variable are illustrated by impulse response functions (IRFs), which enable us to investigate the dynamic impacts of shocks to a particular variable (e.g., military expenditures) on the other variables in the model. The IRFs allow us to identify the magnitude and statistical significance of such responses to a one standard deviation decrease (or increase) in arms imports (Stock and Watson, 2001). The whole system is examined by using variance decomposition analyses. Variance decomposition attributes the variance of forecast errors in a particular variable to its own shocks and the shocks to the other variables in the system (Brown and Yücel, 1999).

4. Empirical results

To avoid spurious regression results, it is essential to test the stationarity of the variables before performing the panel VAR analysis. Therefore, the series are tested to check for the existence of unit roots. Levin et al. (2002), Im et al. (2003), Maddala and Wu (1999), and Choi (2001) have offered different tests for unit roots in panel data. Levin et al. (2002) suggest a common unit root under the null hypothesis against the alternative of stationarity of all individuals, whereas the other tests assume individual unit roots under the null hypothesis. The results of the panel unit root test are presented in Table 1. We include a constant but not a time trend (Dickey and Fuller, 1979). The results in Table 1 reveal that all of the variables are stationary at their level based on the different unit root tests.[2] When the variables are stationary in levels, an unrestricted VAR model is employed.

Table 1: Panel unit root tests

Variables	Levin, Lin & Chu	Im, Pesaran and Shin	ADF-Fisher	PP-Fisher
armimp	-15.16[**]	-15.49[**]	436.2[**]	489.84[**]
milex	-7.84[**]	-6.85[**]	210.65[**]	230.26[**]
militpolit	-4.27[**]	-4.80[**]	151.1[**]	164.46[**]
elecdem	-2.69[**]	-3.11[**]	198.83[**]	238.83[**]
Polity2	-1.51[*]	-1.47[*]	98.86[**]	106.96[**]
non-milex	-4.83[**]	-5.65[**]	201.82[**]	180.31[**]
govreven	-3.95[**]	-4.50[**]	171.92[**]	158.60[**]
armforce	-0.92	-1.57[*]	131.76[**]	129.97[**]

Note: Automatic lag length selection (Schwarz information criteria) is used. The null hypothesis for the Levin, Lin, and Chu test is a unit root that assumes a common unit root process. For the other three tests, the null hypothesis is a unit root that supposes an individual unit root process. ** indicates significance at the 5% level; * indicates significance at the 10% level.

The ordering of the variables is essential in VAR models, as different orderings may result in different responses within a VAR system. To test our first hypothesis regarding the impact of democracy on military expenditures and government budgets, we suppose that significant shocks in political institutions influence the other variables in the model simultaneously. Military factors (military expenditures [% of GDP], arms imports [% of GDP], and armed forces personnel [% of total labor force]) and government budgets (nonmilitary expenditures [% of GDP] and government

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[2] Armed forces personnel (as a percentage of the total labor force) is stationary with respect to Im, Pesaran and Shin, ADF-Fisher, and PP-Fisher tests.

revenue [% of GDP]) follow democracy factors (electoral democracy and military in politics indexes) in our Cholesky ordering.

Changes in political institutions affect government budgets by influencing expenditures (defense and non-defense) and government revenues. We employ an unrestricted panel-VAR model comprising seven variables to analyze the impact of democracy shocks on government expenditures and revenues in developing countries. The vector of endogenous variables in our PVAR model is given by

$$Y_t = [electromodern, militpolit, milex, armimp, armforce, non\text{-}milex, govreven] \qquad (2)$$

4.1. IRFs

Impulse response functions capture the effects of a one-time shock to electoral democracy on military factors, nonmilitary expenditures, and government revenues in the VAR model. If the disturbance terms ε_t are contemporaneously uncorrelated, interpreting the results of the impulse response functions is straightforward. The ith innovation ε_{it} is interpreted as a shock to the ith endogenous variable Z_{it}. The statistical significance of the impulse response is judged by the confidence bands around them (Runkle, 1987). In this study, 68% confidence intervals for the IRFs are estimated by operating 1,000 Monte Carlo simulations (Sims and Zha, 1999). In the estimated IRFs in Fig. 1, the middle line displays the response of the variables to a one-standard-deviation positive shock in electoral democracy.[3] The dotted lines represent the confidence bands. The impulse responses are judged to be statistically insignificant wherever the horizontal line lies between two confidence bands (Berument et al., 2010). The horizontal line in the IRFs displays the time line, and the vertical line represents the magnitudes of the responses to shocks.

The results of the estimated VAR may also be sensitive to the number of lags selected for the variables in the model. Statistical criteria such as LR, final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan–Quinn information

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[3] In general, the response of variable *j* to a unit shock (forecast error) in variable *k* is depicted graphically by IRFs to provide a visual impression of the dynamic interrelationships within the system. As economic variables and political indexes have different scales, we have considered innovations of one standard deviation rather than unit shocks in this study (Lutkepohl, 2005). In this case, IRFs choose the units at the vertical axes equal to the standard deviations of the residuals corresponding to the variables whose effects are considered. Such a rescaling offers a better picture of the dynamic relationships because the average size of the innovations occurring in a system depends on their standard deviation.

criterion (HQ) are usually applied to decide the optimal lag length in VAR models. As Table 2 shows, we select the lag length of one on the basis of the SC criteria, as it is known to be more parsimonious (Pesaran and Smith, 1998).[4]

**Table 2:** Panel VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-4999.04	-	0.00	14.92	14.96	14.93
1	1023.13	11900.76	0.00	-2.88	-2.50*	-2.73
2	1118.94	187.34	0.00	-3.02	-2.31	-2.74*
3	1175.05	108.53	0.00*	-3.04*	2.00	-2.64
4	1216.60	79.50	0.00	-3.02	-1.65	-2.49

* indicates lag order selected by the criterion, LR: sequential modified LR test statistic (each test at 5% level); FPE, Final prediction error; AIC, Akaike information criterion; SC, Schwarz information criterion; HQ, Hannan–Quinn information criterion.

Fig.1 shows the panel impulse responses of the democracy indexes, military factors, and government budgets to a one-standard-deviation positive shock in electoral democracy for the 1990–2017 period among the 47 developing countries.

Electoral democracy is the first variable in our PVAR; it is followed by military in politics, military expenditures (% of GDP), arms imports (% of GDP), armed forces personnel (% of total labor force), nonmilitary expenditures (% of GDP), and government revenues (% of GDP). We use the electoral component of democracy to mimic the effects of political institutions on military factors and government budgets in developing countries. Higher-quality political institutions will decrease military involvement in politics. This may influence military factors, including military expenditures, arms imports, and armed forces personnel. Finally, changes in the political behavior of the government and its defense expenditures may affect its spending on non-defense sectors and improve government revenues.

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[4] We have also estimated our PVAR model by applying two lags (according to HQ) and three lags (according to FPE and AIC). The overall results do not change. These results are available upon request.
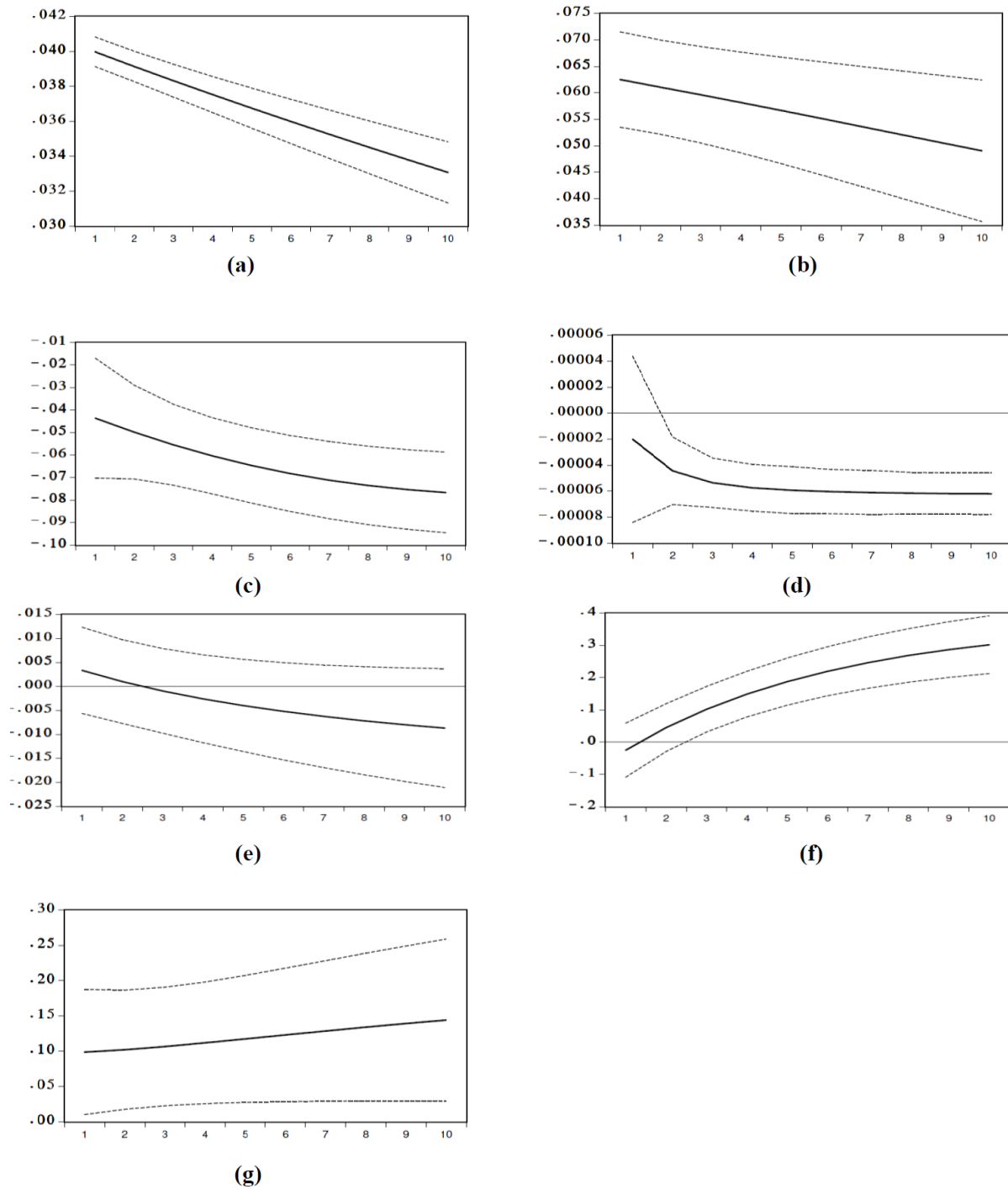
Fig. 1 Impulse response functions related to a one-standard-deviation positive shock in electoral democracy index. **a** Response of electoral democracy index. **b** Response of military in politics index. **c** Response of military expenditures (% of GDP). **d** Response of arms imports (% of GDP). **e** Response of armed forces personnel (% of total labor force). **f** Response of non-defense expenditure (% of GDP). **g** Response of government revenue (% of GDP).
Notes: The dotted lines represent ±1 standard deviation. The horizontal axis shows the periods (years) after the initial shock. The magnitude of the responses is presented on the vertical axis.

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The results of Fig.1 show that the increases in the quality of electoral democracy have a statistically significant impact on the military in politics index (recall that higher values of this index mean less involvement of the military in politics). Improvement in political conditions has a negative and statistically significant impact on the ratios of military expenditures to GDP and arms imports to GDP (after one year). The responses of the ratio of armed forces personnel to total labor force (after one year) to the positive shocks in democracy are negative but not significant. Improvement in electoral democracy has a positive and statistically significant impact on the ratios of non-defense expenditures to GDP (after one year) and government revenues to GDP. This indicates that a better quality of electoral democracy affects the government budget by creating a negative impact on the military sector and positive impacts on the non-defense sector and government revenues.

Fig. 2 presents the AR graph reporting the inverse roots of the characteristic AR polynomial (Lütkepohl, 1991). According to this figure, all roots in the PVAR model are located inside the unit circle and have a modulus of less than one. Thus, the estimated PVAR model is stable.
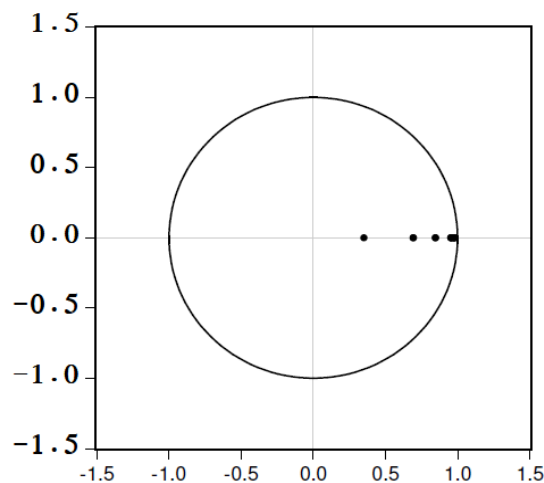
Fig. 2 Inverse roots of AR characteristic polynomial

4.2. Impulse responses to other components of democracy

The electoral element is an essential part of the V-Dem conceptual scheme. A democratic regime obviously has an electoral component. However, merely holding elections is not adequate. Countries may pretend to have "democratic features" without being electorally democratic

(Coppedge et al., 2015). Thus, as a robustness check, we consider the indexes of other components of democracy—liberal, participatory, deliberative, and egalitarian—that propose different approaches to defining democracy. All of these democracy indices range between 0 and 1, with higher values indicating a higher quality of democracy. Coppedge et al. (2015) describe these components as follows:

> • The *liberal* component of democracy embodies the intrinsic value of protecting individual and minority rights against a potential 'tyranny of the majority'. This is achieved through constitutionally protected civil liberties, strong rule of law, and effective checks and balances that limit the use of executive power.

> • The *participatory* component embodies the values of direct rule and active participation by citizens in all political processes; it emphasizes non-electoral forms of political participation, such as through civil society organizations and mechanisms of direct democracy.

> • The *deliberative* component enshrines the core value that political decisions in pursuit of the public good should be informed by respectful and reasonable dialogue at all levels rather than by emotional appeals, solidary attachments, parochial interests, or coercion.

> • The *egalitarian* component holds that material and immaterial inequalities inhibit the actual exercise of formal rights and liberties; hence, a more equal distribution of resources, education, and health across various groups should enhance political equality.

We use these components of democracy one by one in our panel VAR model to investigate the responses of our variable to the shocks in components of democracy. The overall results are largely consistent, indicating that positive shocks to other aspects of democracy (liberal, participatory, deliberative, and egalitarian) reduce military involvement in politics, military spending (as % of GDP), and arms imports (as % of GDP). This creates an opportunity for developing countries to expand their non-defense expenditures (as % of GDP) and increases government revenues (as % of GDP).[5]

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[5] These results are available upon request.

4.3. Impulse responses of variables in per capita form to Polity2 index

Fig. 3 shows the impact of the Polity2 index of democratization on the military in politics index, military expenditures (per capita), arms imports (per capita), armed forces personnel (% of total labor force), nonmilitary expenditures (per capita), and government revenues (per capita). In this model, considering the different lag criteria, we use two lags as the optimum number. The VAR stability condition test (roots of characteristic polynomial) indicates that the VAR satisfies the stability condition.[6]

The positive shocks to the Polity2 index have a positive and statistically significant impact on the military in politics index and a negative and statistically significant impact on per capita military expenditures (after two years) and per capita arms imports (after three years). The negative responses of the armed forces (% of total labor force) are only marginally significant eight years after the initial shock. The responses of per capita nonmilitary expenditures to Polity2 shocks are positive and statistically significant after three years. We observe no significant responses of per capita government revenues to Polity2 shocks. These results confirm our previous findings regarding the negative impacts of political institutions on military expenditures and arms imports and their positive impacts on non-defense expenditures.
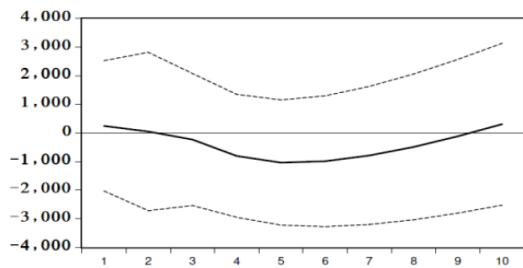
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[6] This is available upon request.
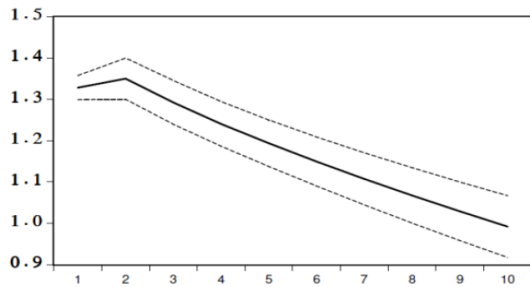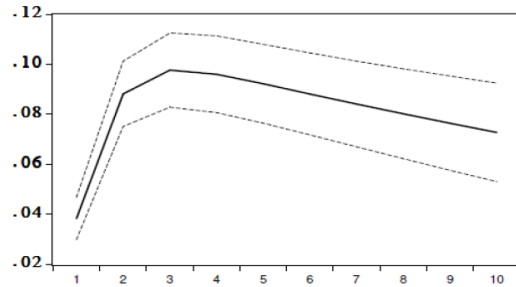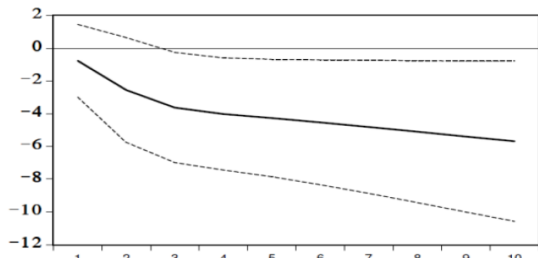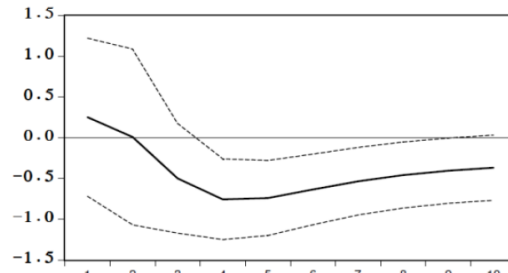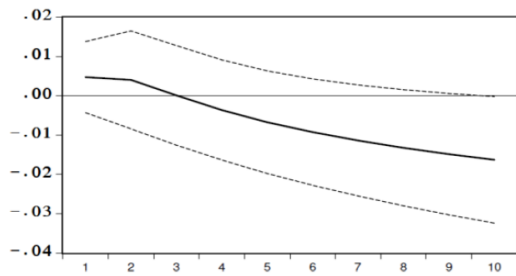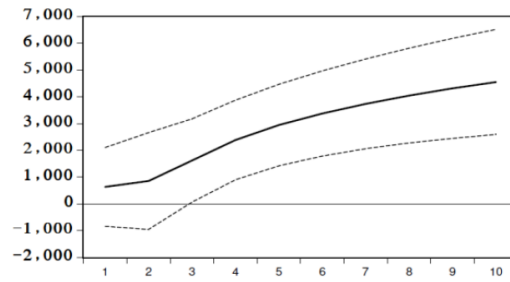
Fig.3 Impulse response functions related to a one-standard-deviation positive shock in Polity2 index. **a** Response of Polity2 index. **b** Response of military in politics index. **c** Response of military expenditures (per capita). **d** Response of arms imports (per capita). **e** Response of armed forces personnel (% of total labor force). **f** Response of non-defense expenditure (per capita). **g** Response of government revenue (per capita). *Notes*: The dotted lines represent ±1 standard deviation. The horizontal axis shows the time periods (years) after the initial shock. The magnitude of the responses is presented on the vertical axis.

4.4. Impulse responses of democracy to shocks in military expenditures

To examine our second hypothesis regarding the negative impact of military expenditures on democracy, we assume that significant shocks in military expenditures influence the other variables in the model simultaneously. Military factors (military expenditure [% of GDP], arms imports [% of GDP], and armed forces personnel [% of total labor force]) are followed by government budget (nonmilitary expenditures [% of GDP]), government revenue [% of GDP]), and the Polity2 index in our Cholesky ordering.

Changes in military budgets affect arms imports and armed forces personnel, and thus military involvement in politics. Changes in military factors may affect the government's budget and political behavior. We employ an unrestricted panel-VAR model comprising seven variables to analyze the impact of military shocks on government budgets and political institutions in developing countries. The vector of endogenous variables in our military shocks PVAR model is given by

$$Y_t = [milgdp,\ armimpgdp,\ armforc,\ militpolit,\ non\text{-}milgdp,\ govrevgdp,\ polity2]$$

Fig. 4 shows the panel impulse responses of the democracy indexes, military factors, and government budgets to a one-standard-deviation positive shock in military expenditures (% of GDP) for the 1990–2017 period among the 47 developing countries.

Military expenditure (% of GDP) is the first variable in our PVAR model, followed by arms imports (% of GDP), armed forces personnel (% of total labor force), military in politics, nonmilitary expenditures (% of GDP), government revenues (% of GDP), and the Polity 2 index. We use military expenditures (% of GDP) to mimic the effects of military spending on government budgets and political institutions in developing countries. Increases in military expenditures lead to positive changes in arms imports and armed forces personnel. These positive changes in military factors increase military involvement in politics. A government with more military characteristics will spend more on the military and less in nonmilitary sectors. All of these factors have a negative impact on political institutions.
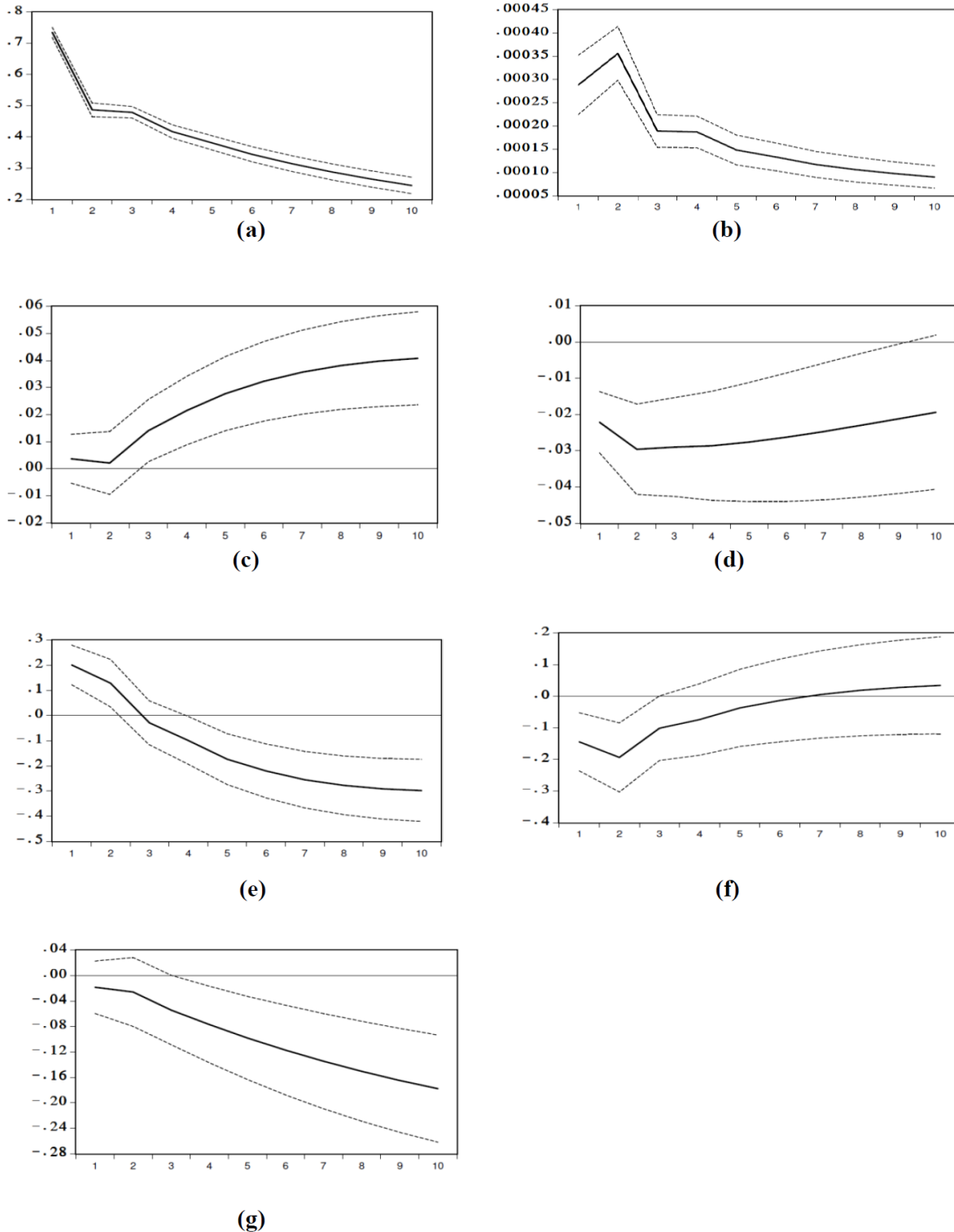
Fig.4 Impulse response functions related to a one-standard-deviation positive shock in military expenditures (% of GDP). **a** Response of military expenditures (% of GDP). **b** Response of arms imports (% of GDP). **c** Response of armed forces personnel (% of total labor force). **d** Response of military in politics index. **e** Response of non-defense expenditure (% of GDP). **f** Response of government revenue (% of GDP). **g** Response of Polity2 index. *Notes*: The dotted lines represent ±1 standard deviation. The horizontal axis shows the time periods (years) after the initial shock. The magnitude of the responses is presented on the vertical axis.

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The results of Fig. 4 show that increases in military expenditures (% of GDP) have significant and positive impacts on arms imports (% of GDP) and armed forces personnel (after two years). The responses of the military in the politics index to military expenditures shock are negative and significant, indicating that increasing military expenditures encourages military involvement in politics. The responses of the ratios of non-defense expenditures to GDP (after two years) and government revenues to GDP (before the third year) to positive changes in military expenditures (% of GDP) are negative and statistically significant. Finally, the response of the Polity2 index to increases in military expenditures (% of GDP) is negative and statistically significant (two years after the initial shock). This implies that militarization reduces the attention paid to non-defense sectors and increases dictatorship in developing countries.[7]

4.5. Generalized panel impulse responses of democracy indexes to military shocks

We seek to obtain more robust results regarding the impact of military shocks on aspects of democracy by defining a panel VAR model to capture the impacts of military expenditures (% of GDP) on the electoral, liberal, deliberative, egalitarian, and participatory components of the V-DEM democracy indexes. The ordering of these democracy indexes in the PVAR system is crucial, as different settings may result in different panel impulse response functions (Dizaji, 2019b). Ideally, the theory should help us choose the best ordering so that changes in some variables will follow the changes of other variables rather than lead them. Wherever the economic theory is not clear about the appropriate ordering of variables, we must use some other logical setting for sensitivity analysis. The panel generalized impulse response function (PGIRF) analysis, which is based on Koop et al. (1996) and Pesaran and Shin (1998), provides a useful solution when the theory is not clear regarding the possible linkages between the variables. The PGIRFs offer an orthogonal set of innovations that are independent of the ordering of the variables in the PVAR model. Therefore, we estimate the panel generalized impulse responses of the democracy indexes (electoral, liberal, participatory, deliberative, and egalitarian) to a one-standard-deviation shock to military expenditures (as % of GDP).

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[7] Instead of using the Polity2 index of democratization in our panel VAR model, we also apply varieties of democracy indexes (i.e., electoral, liberal, deliberative, participatory, egalitarian democracy indexes) in separate panel VAR models one by one. The overall results confirm our earlier estimations, indicating that increased military expenditures have negative impacts on components of democracy in developing countries.
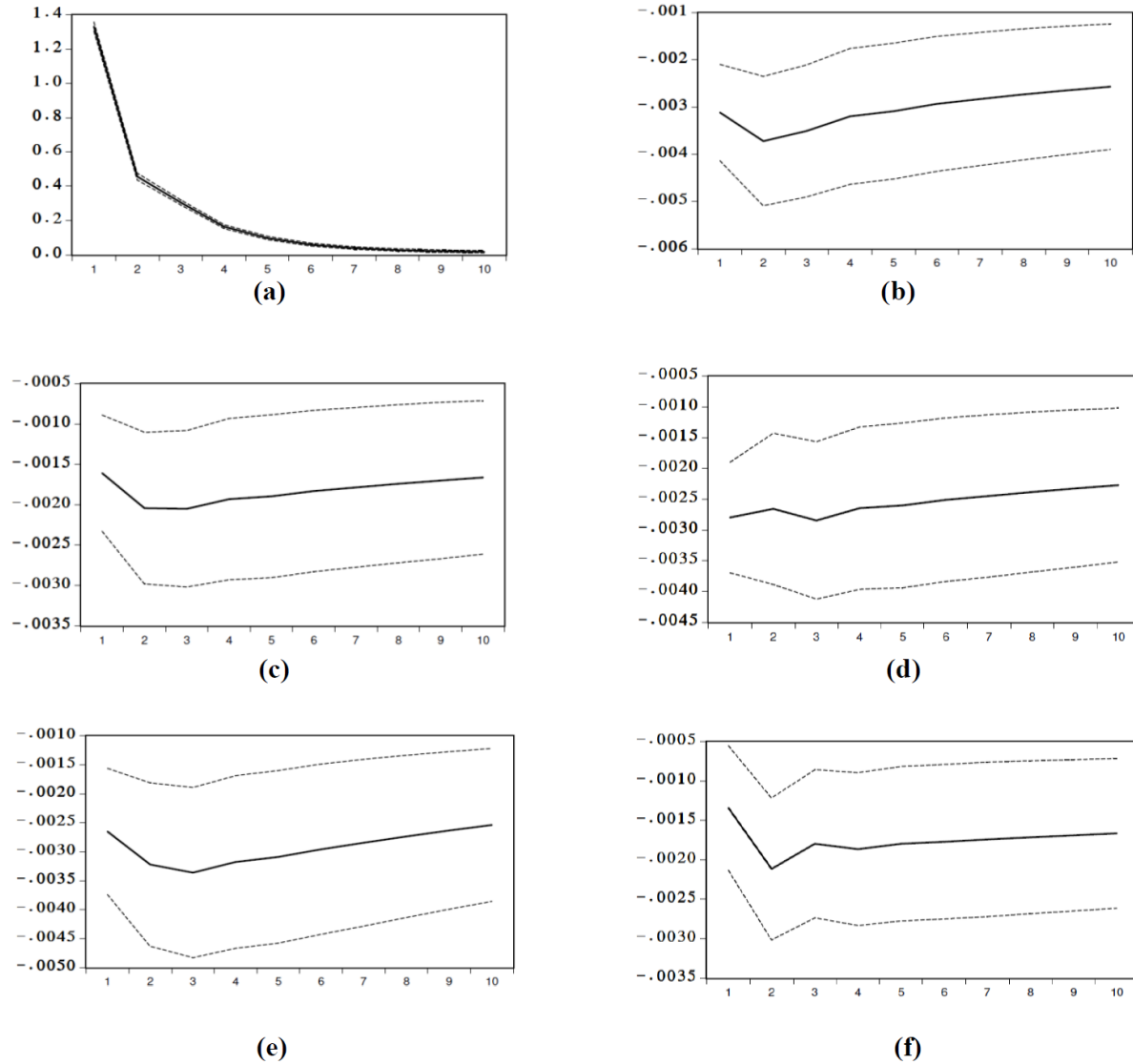
Fig. 5 Impulse response functions related to generalized positive shock in military expenditures (% of GDP). **a** Response of military expenditures (% of GDP). **b** Response of electoral democracy. **c** Response of egalitarian democracy. **d** Response of liberal democracy. **e** Response of deliberative democracy. **f** Response of participatory democracy. Notes: The dotted lines represent ±1 standard deviation. The horizontal axis shows the time periods (years) after the initial shock. The magnitude of the responses is presented on the vertical axis.

As Fig. 5 shows, the responses of the electoral democracy, egalitarian democracy, liberal democracy, deliberative democracy, and participatory democracy indexes during the period are negative and statistically significant to positive shocks in military expenditures (% of GDP).[8] The

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[8] We also examine the generalized impulse responses of the electoral, liberal, deliberative, egalitarian, and participatory indexes to positive shocks in per capita military expenditures. The results reveal negative and statistically significant responses of the democracy indexes to positive shocks in per capita military expenditures. These results are available upon request.

overall results indicate that militarization discourages electoral, liberal, deliberative, egalitarian, and participatory democracy in developing countries.

4.6. Panel impulse responses to shocks in non-defense expenditures

Fig. 6 shows the panel impulse responses of nonmilitary expenditures (% of GDP), military expenditures (% of GDP), government revenues (% of GDP), and electoral democracy to a one-standard-deviation positive shock in nonmilitary expenditures (% of GDP) for the 1990–2017 period among the 47 developing countries.

(a)

(b)

(c)

(d)
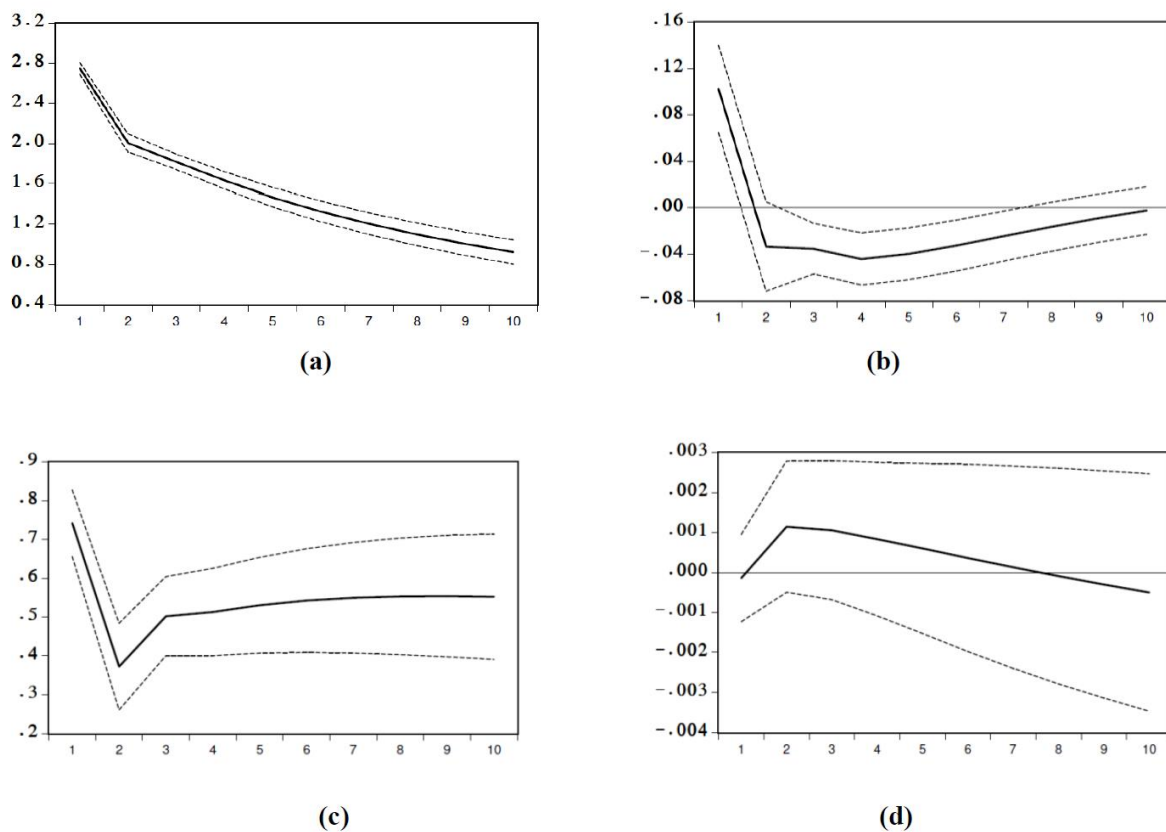
Fig.6 Impulse response functions related to a one-standard-deviation positive shock in non-military expenditures (% of GDP). **a** Response of non-military expenditures (% of GDP). **b** Response of military expenditures (% of GDP). **c** Response of government revenue (% of GDP). **d** Response of electoral democracy index. *Notes*: The dotted lines represent ±1 standard deviation. The horizontal axis shows the time periods (years) after the initial shock. The magnitude of the responses is presented on the vertical axis.

As Fig. 6 shows, the responses of military expenditures (% of GDP) to non-defense expenditures (% of GDP) are negative and statistically significant (two years after the initial shock), whereas those of government revenues (% of GDP) are positive and statistically significant for the entire

period. This suggests a substitution effect between military and nonmilitary expenditures as percentages of GDP. Governments in developing countries can shift their expenditures from the military toward nonmilitary sectors, which can increase government revenues (% of GDP). The responses of the electoral democracy index to positive shocks in nonmilitary expenditures (% of GDP) are not significant, suggesting that the political behavior of governments in developing countries is influenced more by their spending on the military sector than by their spending on the nonmilitary sector.[9]

4.7. Variance decomposition analysis

Variance decomposition is a helpful tool for associating the variation of each variable with the shocks in all variables in the model. This informs us about the relative importance of each variable in causing the changes in a particular variable for different years after the shock. As Table 3 shows, the largest part of the changes in each variable is explained by its own shocks during the period, implying that the historical trend of each variable is important in explaining a large portion of its changes. The results of the variance decomposition analysis are in line with the results of the IRFs. This shows that the role of military expenditures (% of GDP) is more important than the role of nonmilitary expenditures in determining the variations in the political variable. After its own changes, the largest part of the variations in the Polity2 index is explained by the changes in military expenditures (% of GDP) across all years. The role of military expenditures in explaining the changes in government revenues is negligible, while almost 11.85% of the variations in government revenues is explained by nonmilitary expenditures after 30 years. These results indicate that government revenues are most heavily influenced by non-defense expenditures, while the militarization process is more important in affecting political institutions.

The shocks to government revenues (% of GDP) explain 37.83 % of the variations in nonmilitary expenditures (% of GDP) and 11.77% of the variations in military expenditures (% of GDP) after 30 years.

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[9] We also apply other components of democracy (i.e., liberal, deliberative, egalitarian, participatory indexes) in separate panel VAR models. The results confirm our previous findings, showing that non-military spending (% of GDP) has a negative and significant impact on military spending (% of GDP) and a positive and statistically significant impact on government revenues (% of GDP). However, the responses of the democracy indexes to the shock in non-military expenditures (% of GDP) are not significant. These results are available upon request.

The role of the Polity2 index is also more important in explaining the changes in military expenditures (% of GDP) in the long run. The contribution of Polity2 shocks to defense expenditure (as % of GDP) shocks was almost 1.9% in the tenth year, rising to about 8.8% in the thirtieth year, which is greater than its contribution to explaining nonmilitary expenditures. This indicates that government revenues are more important in determining nonmilitary spending, while the role of political institutions is more important in determining military expenditures.

Table 3: Variance decompositions of government expenditures/revenues and Polity2 index

Year	Non-military expenditure (% GDP)	Military expenditure (% GDP)	Government revenue (% GDP)	Polity2
Non-military expenditure (% GDP)				
1	100.00	0.00	0.00	0.00
10	78.43	1.20	19.73	0.64
20	64.42	1.45	32.49	1.64
30	58.40	1.39	37.83	2.37
Military expenditure (% GDP)				
1	0.32	99.68	0.00	0.00
10	0.93	91.62	5.49	1.96
20	1.08	83.03	9.99	5.89
30	1.03	78.38	11.77	8.83
Government revenue (% GDP)				
1	7.36	0.09	92.55	0.00
10	8.59	0.06	91.35	0.00
20	10.86	0.07	89.08	0.00
30	11.85	0.06	88.08	0.00
Polity2				
1	0.06	0.08	0.00	99.86
10	0.52	1.75	0.61	97.11
20	0.93	3.27	1.62	94.17
30	1.10	4.07	2.47	92.36

5. Summary and concluding remarks

This study examines the response of political institutions to a positive shock in military spending and investigates the response of military spending to a positive shock in the quality of political institutions, while controlling for other factors. We use a panel of annual data from 47 developing countries covering 1990 to 2017 and apply a PVAR model to estimate the possible interrelationships among the variables. Our main results show that increases in the quality of the

components of democracy have statistically significant impacts on the military in politics index. Moreover, improvements in political institutions have a statistically significant negative impact on the ratios of military expenditures and arms imports to GDP. Furthermore, improvements in the democracy indexes have positive and statistically significant impacts on the ratios of non-defense expenditures (e.g., education and health) and government revenues to GDP. This indicates that a better quality of democracy affects government budgets by exerting a negative impact on the military sector and positive impacts on the non-defense sector and government revenues.

We also investigate the response of democracy to positive shocks in military spending. Our results show that increases in military expenditures lead to positive changes in arms imports and armed forces personnel. These positive changes in military factors increase military involvement in politics. A government with more interactions with military interest groups will spend more on such fields and less in nonmilitary sectors. All of these factors create negative impacts on government revenues (as a percentage of GDP) and ultimately on political institutions.

We also investigate the response of our main variables of interest to positive shocks to government nonmilitary spending. We find a negative and significant response of military expenditures to nonmilitary expenditures, whereas the responses of government revenues (% of GDP) are positive and statistically significant. These results suggest a substitution effect between military and nonmilitary expenditures as percentages of GDP. This finding may imply that governments in developing countries can shift their expenditures from military to nonmilitary sectors, thus increasing government revenues (% of GDP). We also find that the responses of the democracy indexes to positive shocks in nonmilitary expenditures (% of GDP) are not significant. This result suggests that the political behavior of governments in developing countries is influenced more by their spending on the military sector than by their spending on the nonmilitary sector.

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Appendix

List of countries

Algeria, Angola, Argentina, Bahrain, Bangladesh, Bolivia, Brazil, Chile, China, Colombia, Ecuador, Egypt, Ghana, Hungary, India, Indonesia, Iran, Jordan, Kazakhstan, Kuwait, Latvia, Lebanon, Lithuania, Malaysia, Mexico, Morocco, Myanmar, Nigeria, Oman, Pakistan, Peru, Philippines, Poland, Qatar, Romania, Saudi Arabia, South Africa, Sri Lanka, Sudan, Thailand, Tunisia, Turkey, UAE, Uruguay, Venezuela, Vietnam, Yemen.

Table A: Summary statistics

Variable	Mean	Standard deviation	Minimum	Maximum
armimp (arms imports as % of GDP)	0.002	0.003	0.000	0.041
milex (military expenditures as % of GDP)	3.125	4.215	0.276	117.34
non-milex (non-military expenditures as % of GDP)	25.296	9.01	4.386	86.82
armforce (armed forces personnel as % of total labor force)	1.954	1.882	0.075	12.848
govreven (government revenues as % of GDP)	25.919	10.756	3.797	72.34
militpolit (military in politics index)	3.377	1.556	0	6
polity2	1.518	7.06	-10	10
elecdem (electoral democracy index)	0.447	0.274	0.014	0.929
libdem (liberal democracy index)	0.336	0.249	0.013	0.874
delibdem (deliberative democracy index)	0.353	0.243	0.016	0.879
egalitdem (egalitarian democracy index)	0.323	0.209	0.033	0.815
partibdem (participatory democracy index)	0.283	0.208	0.009	0.805