JIECEM

Journal of Islamic Economy and Community Engagement

ISSN: 2809-5685 (Online)

Vol. 6. No. 1, 2025, pp. 14 - 36
Doi: https://doi.org/10.14421/jiecem.2025.6.1.2317

Military Expenditure and Sustainable Economic Growth in Latin America

Maria Gabriel Acueva-Jiménez[1]
[1] UCJC

gabrielacuevaj@gmail.com[1]

Abstract

This research seeks to thoroughly examine the interconnectedness and directional influence between military spending and sustainable economic growth while considering the role of gross fixed capital formation (investment) as a controlling factor. Drawing on a comprehensive dataset from 13 distinct Latin American economies, spanning the extensive time frame of 1990 to 2019, the study investigates the patterns of cointegration and causal relationships within the variables. The results of the cointegration analysis do not provide substantial support for the existence of a strong and enduring relationship between all the examined variables over the long term. Notably, the research identifies a unidirectional causality running from (i) economic growth to military expenditure, (ii) economic growth to investment, and (iii) investment to military expenditure. This suggests a complex interplay between economic dynamics, investment patterns, and military spending behaviors in the context of Latin American economies, highlighting the need for a nuanced understanding of the underlying causal mechanisms at play. Moreover, it is necessary to consider national and international policies to promote sustainable development in countries, given it produces benefits for investment, safety, and security. As nations strive for sustained development, the research underscores the need for policymakers to grapple with the intricate implications of military expenditure on economic and investment landscapes. This holistic perspective advocates for a balanced and inclusive approach, cognizant of the multifaceted challenges and opportunities that characterize the evolving socio-economic and geopolitical landscape of the region.

Keywords: Military Expenditure, Economic Growth, Latin America, Cointegration, Causality.

INTRODUCTION

Military expenditure or military budget comprises the number of financial resources of total spending on all three-armed forces (army, navy, and air force) and peacekeeping provided by the central government in a country. The (Stockholm International Peace Research Institute (SIPRI), 2023) established that the military expenditure includes current and capital spending for the armed and peacekeeping forces, military space activities, defense ministries, and other government agencies that are focused on defense projects. Moreover, it should comprise expenditures on current military and civil personnel, retirement pensions of military personnel, social services for personnel and their families, operations and maintenance, procurement, military research and development, military construction, and military aid. (Smith, 2000) defined the defense of society as one of the primary functions of

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government and there is the reason for reasonable taxation; therefore, the military budget is recognized as one area where there is no private solution.

The primary challenge of the analysis of military expenditure in a country is how much security is required by a nation and how much security can be afforded by that country. These questions are also related to military capability, which does not necessarily only depend on the military budget associated with the Gross Domestic Product (GDP) but is also related to the economic, political, geographic, cultural, and strategic factors in a country. Therefore, the importance of military spending is aligned with the constant efforts to make a well-built and efficient defense system, which also involves internal and external security. Generally, the measure of military burden and the importance of the military sector in a country is defined by military expenditure as a share of GDP or as a share of government spending (Kumar, 2017). However, these metrics suffer problems of reliability, validity, and comparability.

Each country dedicates financial resources to defense purposes. As mentioned by (P. Dunne & Tian, 2013), these resources are needed to handle any internal or external security threads. However, even when there are opportunities, such as the generation of jobs, there is also an associated cost, known as opportunity cost, as these resources could be also used in more productive sectors. Several studies analyzed the impact of military spending on economic growth, but there is not a clear consensus about their effects. Literature in defense economics warns that resources allocated to the defense sector can have adverse effects on economic growth, as it can reduce the availability of resources for other more productive sectors of the economy, as well as displace or substitute research and development in the civilian sector. However, it has also been argued that it can produce positive economic effects, as it can create security and thereby promote trade, development, and investment, increase aggregate demand through the multiplier effect of spending, and generate spillover effects from military research and development (Desli et al., 2017; Sempere, 2018). As shown by (Safdari et al., 2011), developing economies in Asia (Iran and Saudi Arabia) did not show a clear relationship between military expenditure and economic growth. However, this relationship is evidenced in industrial countries such as South Korea and Malaysia. Nevertheless, this situation is like larger economies. For instance, (Das et al., 2015) demonstrated in their study that Italy and Australia showed a bidirectional causality between military spending and economic growth, while other countries such as the USA, Canada, France, Germany, China, and India did not identify any causality.

In this context, the objective of the present research is to analyze the relationship between military spending and economic growth in 13 Latin American countries (namely Argentina, Bolivia, Brazil, Chile, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Mexico, Paraguay, Peru, and Uruguay) from 1990 to 2019, using econometric techniques of cointegration and causality for panel data. The results are in line with previous investigations and the case of cointegration, most of the different tests implemented did not reject the null

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hypothesis of the absence of a long-term relationship. In the case of causality, three unidirectional relationships were found economic growth to military spending and investment and from investment to military spending.

The rest of this investigation is organized as follows. The theoretical framework is presented in Section 2, where the theoretical and empirical aspects related to the link between military spending and economic growth are developed. The third section details the methodology, the variables of interest, sources of information, and different econometric procedures to verify cointegration and causality in panel data. The results are shown in Section four. Finally, in Section fifth, the study concludes by describing the most relevant findings and offering recommendations and research directions for future researchers.

LITERATURE REVIEW

In the extensive study of the determinants of long-term economic growth, fundamental variables have been identified, for instance, investment (Manuelito & Jiménez, 2013; Serebrisky et al., 2015). However, the economic importance of defense spending is not similarly emphasized (J. P. Dunne et al., 2005). Empirically, (Barro, 1989) presented evidence that defense spending is not significant for economic growth. Similarly, (Sala-i-Martin et al., 2004) investigated the determinants of economic growth with a significant number of variables, including defense spending. The results indicated that out of 67 variables, 18 were significant, but none were related to the defense sector, suggesting its irrelevance.

On the other hand, the literature on defense economics has generated a variety of theoretical and especially empirical discussions about the effect of defense spending on economic growth, but without a solid consensus. Theoretically, it has been argued that there are several channels through which military spending can impact economic growth. In this regard, (Sempere, 2018) mentioned that defense spending can have a favorable economic effect through security, as it encourages trade and investment, through infrastructure and human capital that can be accessible to other sectors, and through the multiplier effect of spending that boosts aggregate demand. Similarly, (Desli et al., 2017) stated that military spending can create spillover effects due to military research and development, and stimulate aggregate demand (through Keynesian militarism), contributing to economic growth.

According to (J. P. Dunne et al., 2005), the defense sector affects economic growth through demand, supply, and security. On the demand side, the essential elements are the level and composition of spending (the multiplier effect of spending). On the supply side, the availability of production factors is highlighted, and through the security effect, which promotes investment and innovation and, consequently, production. The transmission channel of the economic effects of defense spending can be indirect, through investment or employment (Heo & Ye, 2016). In this regard, (Barro, 1989, 1991) pointed out that military spending can influence private sector productivity or property rights and, consequently,

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private investment. (Heo & Ye, 2016) mentioned that defense spending can generate employment through the hiring of active-duty soldiers, civilian personnel, external firms, and subcontractors that provide goods and services to the military.

On the other hand, the expenditure allocated to the defense sector reflects high opportunity costs, as it can displace more productive expenditures and public needs. Additionally, military research and development can disturb, substitute, or diminish its civilian counterpart (Cowan & Foray, 1995; Desli et al., 2017; Sempere, 2018). According to (Cowan & Foray, 1995), in the life cycle of technology, military research and development are only beneficial for civilian research and development during the experimentation stage, where new general knowledge about emerging technology arises. In the rationalization phase, where the use of technology is specialized in each sector, military research and development has little value for the civilian sector. In this sense, military research and development would no longer be as important for the civilian sector.

The first studies that analyzed the nexus between military spending and economic growth belong to (Benoit, 1973, 1978). The author found a positive association, mainly coming from defense spending. Subsequent research has raised questions regarding the validity of Benoit's hypothesis, as a substantial body of empirical evidence indicates that military expenditure yields not only positive but also negative and neutral effects. Consequently, there exists evidence suggesting that in certain instances, the causal relationship originates from economic growth, particularly prevalent in developing nations, rather than the conventional assumption of military spending driving economic growth. Moreover, this research highlights the existence of bidirectional causality in some cases, emphasizing the intricate and multifaceted nature of the relationship between military spending and economic dynamics. However, some subsequent studies that evaluated the same link confirmed Benoit's hypothesis, while others reached opposite conclusions, and there is even evidence suggesting a null economic effect. In terms of causality, there is evidence that the direction of causality originates from economic growth (mainly in developing countries) and not the other way around, as well as bidirectional causality. Overall, the various types of findings contribute to the lack of consensus on the economic effect of military spending. (Aizenman & Glick, 2006; Alptekin & Levine, 2012; Dakurah et al., 2001; Deger & Sen, 1983; Desli et al., 2017; Dritsakis, 2004; P. Dunne & Tian, 2013; P. Dunne & Vougas, 1999; Wijeweera & Webb, 2009; Yakovlev, 2007; Yesilyurt & Yesilyurt, 2019).

Regarding the null effect, (J. Dunne & Smith, 2020), through econometric techniques for panel data, argued that from 1960 to 2014, there is no evidence of a strong relationship between military spending, economic growth, and investment. A group of European Union countries, (J. Dunne & Nikolaidou, 2012) concluded that defense spending did not stimulate economic growth; on the contrary, it can have a negative or null effect. In the case of the

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U.S. economy, (Heo, 2000, 2010) mentioned that the resources allocated to the defense sector do not have significant economic effects.

Despite a plethora of empirical evidence on the military spending-economic growth nexus, there is no consensus, which can be explained for various technical reasons: i) sample composition, model specification, and estimation methods (Aziz & Asadullah, 2017; J. Dunne & Smith, 2020); ii) problems of endogeneity of the variable linked to the defense sector that have not been adequately addressed (D'Agostino et al., 2017), iii) sample heterogeneity and non-linearity (P. Dunne & Tian, 2013; Huang et al., 2017); and iv) weaknesses of theoretical models, such as the Feder-Ram model, which is prone to misinterpretations, and its econometric estimation contains simultaneous bias problems. Alternatively, augmented Barro and Solow models offer better results compared to the Feder-Ram model (J. P. Dunne et al., 2005). Therefore, it is necessary to analyze empirical evidence and the relationship findings between military spending and economic performance.

Empirical Evidence

The empirical evidence regarding the link between military spending and economic growth is extensive. (Yildirim & Öcal, 2016) studied the economic effect of military spending from a broad perspective (128 countries) through spatial econometrics methods and the augmented Solow growth model for the period of 2000-2010. The findings indicate a positive effect of military spending on economic growth with significant spatial dependence. (Kollias et al., 2017) analyzed the link between military spending, economic growth, and investment using the panel vector autoregressive methodology (PVAR) for 65 countries from 1971 to 2014. The authors also disaggregated the information into panel subgroups classified by income level. In the high-income group, they found that the economic effect of military spending is positive, which can be explained by effective demand and spillover effects generated in the defense industry sector. In medium- and low-income countries, the opposite occurs; economic growth has a positive effect on military spending, suggesting that as the economy grows, more resources are available for the defense sector.

Negative effects have also been found. For instance, (Huang et al., 2017) studied the causality between military spending and economic growth in 77 countries from 1996 to 2014, considering the country's level of development through the Human Development Index (HDI). They found that causality is bidirectional, negative, non-linear, and varies over time and between countries. As the HDI becomes higher, the negative causality of the defense sector on economic growth and vice versa decreases. Similarly, (Chang et al., 2011), for different groups of countries from the causality approach from 1990 to 2006, found that there is no causal link between the variables of interest in the high-income and medium-

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income country groups. However, in low-income countries, military spending negatively affects economic growth.

(Heo & Ye, 2016) studied the direct and indirect economic effects of military spending on economic growth in 161 countries from 1990 to 2012. Using seemingly unrelated regressions (SUR), they found that the effect of the defense sector is negative and statistically significant; however, the magnitude of the coefficient is extremely small, suggesting an almost insignificant impact. (P. Dunne & Tian, 2013), using an exogenous growth model and methods for dynamic panel data in 106 countries from 1988 to 2010, identified that the effect of military spending on economic growth is negative and significant in the short and long term. The findings are consistent across different sample specifications and independent variables.

(Aziz & Asadullah, 2017), for a panel of countries from 1990 to 2013 and through econometric techniques such as ordinary least squares (OLS), fixed effects, random effects, and the generalized method of moments (GMM), concluded that the economic effect of military spending is negative and statistically significant. Similarly, (D'Agostino et al., 2017), using the pooled mean group (PMG) estimator and the dynamic fixed effects method for country panel data from 1970 to 2014, showed a long-term negative effect of military spending on economic growth. The results are robust to different study period specifications and countries.

(D'Agostino et al., 2019), employing the instrumental variables method to control for the endogeneity of defense spending, in a panel of 109 low-income countries from 1998 to 2012, found evidence in favor of a significant negative economic effect of military spending, which has been underestimated by the OLS method. The results are robust to heterogeneity and different time specifications. (D'Agostino et al., 2020), on their part, implemented the autoregressive distributed lag (ARDL) approach for panel data from 1984 to 2014. They found that both military spending and corruption have a significant long-term negative economic effect.

(Desli et al., 2017) constructed a panel of 138 countries from 1988 to 2013. Additionally, the authors disaggregated the information into subgroups according to the income level and applied econometric methods of cointegration and causality. The results confirmed a long-term relationship in the full sample formed by developed and developing countries, but in less developed countries, the tests tend to mostly reject the cointegration hypothesis. Regarding causality, in the long term, there is a bidirectional relationship between the general sample and developing countries, while in developed countries, it is unidirectional from economic growth to military spending. In the short term, there is no causality for the less developed country group, and in the rest of the groups, causality comes from economic growth to military spending.

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Specifically for the case of Latin America, (Kung & Min, 2013), using Granger causality, following the Bootstrap procedure, for 16 Latin American economies from 1988 to 2010, found that military spending causes economic growth in the case of Nicaragua and Belize. Conversely, growth causes military spending for Ecuador and Bolivia; while for the remaining countries (Argentina, Brazil, Chile, Colombia, Dominican Republic, El Salvador, Guatemala, Mexico, Paraguay, Peru, Uruguay, and Venezuela), there is no evidence of causality. (Kollias et al., 2017), The findings rely on the specification of various samples with varying country numbers: i) 46 countries in total with available information for the period of interest; ii) 25 OECD countries; and, iii) 17 OECD countries. Additionally, they disaggregate the entire period into two sub-periods, the first encompassing the Cold War era (1960-1985) and the second corresponding to the post-Cold War period (1986-2014); in addition to the variables of interest (military spending and economic growth), added investment and employed cointegration methods, linear causality, and non-linear causality for a time series analysis in 13 Latin American economies from 1961 to 2014. The results indicated that there is at least one cointegrating vector for each country; however, in terms of causality, not all countries showed a causality relationship in at least one direction; therefore, the authors concluded that, in general terms, the causality link is weak.

Understanding the relationship and causality between economic growth and military expenditure is especially important in developing economies, principally in those where the foreign exchange rate plays an important role (Paul Dunne, 1996) and where public financial resources are limited. Moreover, the share of military spending in the GDP of some Latin American countries is not insignificant, especially considering that they are developing economies with important public needs. During the last three decades (period of 1990-2019), the country with the highest military spending, on average, was Colombia, with a figure equal to 3.14% of the GDP, followed by Chile, Ecuador, and Uruguay, where the share of military spending exceeded 2% of their GDP. On the other hand, the country that has allocated the least resources to the defense sector is Mexico, distributing an average of 0.45% as a share of GDP. If we consider the last year of the study period (2019), the behavior of expenditure did not differ from the average observed over the three decades, as Colombia continues with the allocation of the highest resources for the defense sector (3.14% of GDP), followed by Ecuador (2.18%), and Uruguay (2.06%). About the other countries that are part of this study, in the last year, Chile, Bolivia, Brazil, Peru, and El Salvador allocated defense of figures less than 2%; while Paraguay, Argentina, the Dominican Republic, Mexico, and Guatemala, military spending is less than 1% as a percentage of GDP (World Bank, 2023) (Figure 1).

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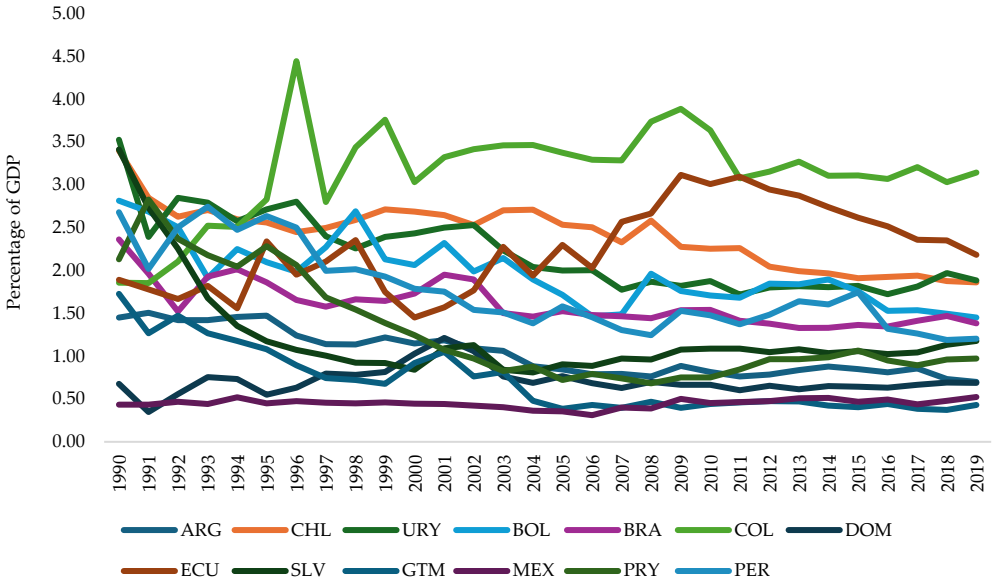

Figure 1. Military spending as a percentage of GDP

Note: Argentina (ARG), Bolivia (BOL), Brazil (BRA), Chile (CHL), Colombia (COL), Dominican Republic (DOM), Ecuador (ECU), El Salvador (SLV), Guatemala (GTM), Mexico (MEX), Paraguay (PRY), Peru (PER), and Uruguay (URY). Source: (World Bank, 2023).

By way of analysis, Peru, Colombia, and Ecuador share borders and, consequently, common security concerns such as drug trafficking, smuggling, and guerrilla activity. These threats have led to an increase in military spending in these countries, aiming to strengthen their defense and national security capabilities.

In the case of Peru, its military expenditure has historically been directed towards combating drug trafficking and controlling its extensive border with Colombia, where the activities of guerrilla groups and drug traffickers have posed a threat to internal security. Additionally, Peru has faced challenges related to organized crime and terrorism, especially in rural and border areas.

Colombia, on the other hand, has faced decades of internal conflicts with illegal armed groups such as the FARC and the ELN, as well as challenges related to drug trafficking. Military spending in Colombia has focused on combating these internal threats, as well as protecting its borders and ensuring stability in the region.

In the case of Ecuador, although it has not faced internal conflicts as intense as Peru and Colombia, it has experienced border tensions with Peru in the past and shares similar concerns regarding regional security. Ecuador's military spending has focused on strengthening its defense capabilities and border surveillance, as well as addressing threats such as drug trafficking and smuggling.

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Therefore, the hypothesis of the study is:

Hypothesis 1. There is a relationship between economic growth to military spending (unidirectional causality) in the short term. During a specific short-term period, an increase in economic growth directly leads to a corresponding rise in military spending, indicating a unidirectional causal relationship between these two variables.

IMPLEMENTATION METHOD

The study of the relationship between military spending and economic growth for some Latin American countries is conducted based on cointegration and causality methods for panel data; these methods allow for verifying whether there is a long-term equilibrium relationship between the variables of interest and identifying the direction of causality. The choice of cointegration and causality methods for panel data in the study of the relationship between military spending and economic growth in certain Latin American countries is justified by their suitability for examining dynamic and interdependent relationships over time across multiple entities. These methods are particularly appropriate as they enable the analysis of both long-term equilibrium relationships and short-term causal dynamics, allowing for a comprehensive understanding of the complex interactions between the variables under investigation. Additionally, panel data analysis facilitates the consideration of individual country-specific effects alongside overall trends, providing a more nuanced and robust assessment of the relationship within the context of the diverse Latin American economies. A balanced data panel was constructed for 13 Latin American economies (namely Argentina, Bolivia, Brazil, Chile, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Mexico, Paraguay, Peru, and Uruguay) from 1990 to 2019. The variables of interest are GDP per capita and military spending. Additionally, gross fixed capital formation (investment) is added as a control variable. GDP per capita and investment are obtained from the World Bank's World Development Indicators (World Bank, 2023), and military spending is collected from the (Stockholm International Peace Research Institute (SIPRI), 2023). All variables are measured at constant prices and transformed into logarithms. Table 1 summarizes the variables of interest, abbreviations, and sources of information (Most of the methodological procedures were conducted in Stata 16, except the (Pesaran, 2007) unit root test and the Johansen-Fisher cointegration test, which were performed in EViews 12, owing to the availability of the procedure).

Table 1. Variables

Variable	Abbreviation	Source
GDP per capita	lnpib_pc	(World Bank, 2023)
Military expenditure	lngm	(Stockholm International Peace Research Institute (SIPRI), 2023)

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Gross fixed capital formation (investment)	lnfbkf	(World Bank, 2023)

The cointegration analysis involves determining the order of integration of the series through non-stationarity tests. The choice of unit root tests is delimited by the assumption of cross-sectional dependence because in the presence of cross-sectional correlation of errors, unit root tests can exhibit significant size distortions (Baltagi et al., 2007). Therefore, the Lagrange multiplier (LM) spatial dependence tests of (Breusch & Pagan, 1980) are used, which are appropriate when the time dimension (T) is greater than the number of cross-sectional units (n) (T>n), and the cross-sectional dependence (CD) test of (Pesaran, 2004). In the presence of spatial correlation, three unit root tests are used: i) the cross-sectionally augmented panel unit root tests (CIPS test) of (Pesaran, 2007) that allows for spatial dependence; ii) the (Breitung, 2001) test, following the approach of (Breitung & Das, 2005) that provides robustness for cross-sectional correlation; and iii) the panel unit root test (IPS test) proposed by (Im et al., 2003) but subtracting cross-sectional averages to reduce the effect of spatial dependence, as suggested by (Levin et al., 2002). The null hypothesis indicates the existence of a unit root in the panels and is common for all tests.

To verify whether there is a long-run relationship between the series, non-cointegration tests by (Kao, 1999), (Pedroni, 1999, 2004), (Westerlund, 2005), and the Johansen-Fisher type by (Maddala & Wu, 1999) are implemented. (Kao, 1999) suggested various unit root tests based on Dickey-Fuller and augmented Dickey-Fuller. (Pedroni, 1999, 2004)'s tests allow for considerable heterogeneity and are organized into two groups, the first including four tests related to the within-dimension where the autoregressive parameter is common to all panels, and the second comprising three tests related to the between-dimension where the autoregressive term is specific to each panel. (Westerlund, 2005) proposed two non-parametric tests based on residuals, and (Maddala & Wu, 1999) developed a test that combines the cross-sectional p-values to construct a panel test statistic.

The tests are based on residuals (except the Johansen-Fisher type test); therefore, the analysis is complemented with the tests of (Westerlund, 2007) based on an error correction model, which has good properties in small samples and high power compared to tests based on residuals. The author proposed four non-cointegration tests, two corresponding to group-mean statistics (G_τ and G_α) and with the alternative hypothesis that there is cointegration in at least one cross-sectional unit, and the other two refer to panel statistics (P_τ and P_α) with the alternative hypothesis indicating cointegration for the entire panel. The tests relax the assumption of spatial independence using the bootstrap approach. In the tests based on residuals, the cross-sectional mean is subtracted to reduce the effect of spatial correlation (Levin et al., 2002).

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In addition to the cointegration approach, the causality test suggested by (Dumitrescu & Hurlin, 2012) is implemented, which will reveal the direction of causality in the variables of interest. According to the authors, the test is based on the cross-sectional average of individual Wald statistics of Granger non-causality. It has good properties in small sample sizes, and in the presence of cross-sectional dependence, the bootstrap approach can be used. The method requires the series to be stationary and the choice of the lag length, so the optimal lag length is based on the Akaike information criterion (AIC).

RESULT AND DISCUSSION

Table 2 shows the descriptive statistics of the variables. The data panel is balanced with 390 observations, containing 13 cross-sectional units (countries) and 30 annual frequency periods (1990-2019). In the three variables of interest, there is greater dispersion among countries than within a country over time (between dispersion is higher than within), although the difference is smaller in the case of economic growth.

Table 2 serves as a crucial gateway into the heart of our empirical exploration, presenting the descriptive statistics that encapsulate the essence of the variables under scrutiny. This statistical tableau unveils a balanced data panel, meticulously crafted with 390 observations. This comprehensive dataset spans a considerable temporal landscape, encompassing 13 cross-sectional units, representing distinct countries, and spanning 30 annual frequency periods from 1990 to 2019. Within this dataset, a trove of information awaits, shedding light on the distribution and variability of the key variables of interest—military spending, economic growth, and investment. These metrics stand as pillars, supporting the edifice of our investigation into the intricate dance between defense expenditures, economic prosperity, and investment patterns across the diverse tapestry of Latin American nations.

One notable characteristic that leaps from the statistical canvas is the discernible dispersion among countries relative to within a country over time. This divergence is particularly pronounced in the context of the between-country dispersion, where variations among the 13 distinct nations surpass those occurring within a specific country across the temporal spectrum. It's a revealing revelation, painting a vivid picture of the heterogeneity that exists among the nations comprising our study.

Now, let's delve into the specifics of the three variables—military spending, economic growth, and investment. These components, fundamental to our exploration, exhibit intriguing patterns that merit meticulous examination.

Military Spending: Unveiling Cross-Country Disparities

Our first protagonist, military spending, unfolds as a variable of substantial interest and intrigue. As we peruse Table 2, the dispersion among countries stands out prominently. Each nation, it seems, charts its unique trajectory in allocating resources to the defense sector. This

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cross-country variability paints a diverse panorama of strategic priorities, geopolitical considerations, and perhaps, economic capacities influencing the defense expenditure decisions of these Latin American nations.

However, a compelling nuance arises when we juxtapose this cross-country variability with the within-country variation over time. The between-country dispersion, while substantial, underscores that the variations in military spending within a specific nation across the years are not negligible. This duality sets the stage for a deeper inquiry—what factors contribute to the divergences in military spending policies among nations, and what internal dynamics drive fluctuations within a country over time?

Economic Growth: Between Stability and Flux

Turning our gaze to economic growth, the second protagonist in our narrative, we encounter a nuanced tale. The descriptive statistics reveal a comparable pattern of greater dispersion among countries than within a country over time. However, a notable subtlety arises—the magnitude of this difference is somewhat less pronounced in the case of economic growth.

This finding prompts us to ponder the underlying factors that contribute to the relatively more stable trajectory of economic growth within a nation over the years. Is it indicative of resilient economic policies, structural stability, or perhaps, a convergence of developmental strategies among these Latin American nations? Conversely, the variability in economic growth among countries invites us to explore the diverse economic landscapes that shape the growth trajectories of these nations.

Investment: A Crucible of Economic Dynamism

Our third key player, investment, takes center stage, embodying the pulse of economic dynamism. The descriptive statistics spotlight a conspicuous trend—once again, the dispersion among countries eclipses the variations within a country over time. This accentuates the distinctive investment patterns that characterize each nation, reflecting diverse economic structures, policy frameworks, and perhaps, responses to global economic dynamics.

Synthesizing Insights: A Call for Deeper Exploration

In the symphony of descriptive statistics presented in Table 2, a harmonious yet complex melody emerges. Cross-country disparities resonate across military spending, economic growth, and investment, shaping a mosaic that reflects the diverse economic, political, and strategic realities of the Latin American region. The interplay between between-country and within-country variations beckons further investigation, inviting researchers to unravel the intricate threads that weave the fabric of these disparities.

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As we embark on the journey into the econometric intricacies that lie ahead, Table 2 serves not just as a numerical compendium but as a compass guiding us through the uncharted territories of military-economic dynamics in Latin America. The disparities unveiled within these statistics beckon us to explore the driving forces, the nuanced policies, and the intricate interdependencies that underlie the economic and defense landscapes of these nations. This statistical prelude, rich in insights, sets the stage for a deeper dive into causality, cointegration, and the underlying mechanisms that govern the symbiotic relationship between military spending and economic growth in the complex tapestry of Latin America.

Table 2. Descriptive statistics.

Variable	Group	Mean	Std. Dev.	Minimum	Maximum
lnpib_pc	overall	8.612	0.537	7.431	9.692
	between		0.516	7.722	9.344
	within		0.204	8.022	9.170
lngm	overall	20.991	1.422	18.001	24.002
	between		1.439	19.230	23.607
	within		0.327	19.560	21.822
lnfbkf	overall	23.625	1.431	21.133	26.689
	between		1.420	21.933	26.214
	within		0.428	22.363	24.565

Note: Number of observations for "overall group"=390, number of observations for "between group"=13 (countries), and number of observations for "within group"=30 (years of study).

The initial exploration preceding the selection of unit root tests delves into the realm of spatial dependence. The outcomes of the tests conducted, as elucidated by (Breusch & Pagan, 1980; Pesaran, 2004) are meticulously detailed in Table 3. Strikingly, the results from both tests align, unequivocally pointing towards the existence of spatial dependence across all three variables under scrutiny.

The spatial dependence, as unveiled by these tests, introduces a layer of complexity to our understanding of the relationships between the variables. This phenomenon implies that the values of the variables are not independent or randomly distributed across the geographical units, in this case, the various countries in our study. Instead, there is a discernible spatial pattern or interdependence that transcends mere temporal correlations.

Breusch and Pagan's (1980) test, a stalwart in spatial econometrics, and (Pesaran, 2004)'s test, a contemporary approach known for its robustness, converge in their verdict—each variable exhibits spatial dependence. This concordance fortifies the credibility of our findings and underscores the robustness of the spatial dependence observed in the dataset.

The presence of spatial dependence in all three variables—military spending, economic growth, and investment—holds profound implications for our understanding of the

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dynamics within the Latin American economies under study. It prompts a critical examination of the interconnectedness and spatial patterns that may underpin the observed variations in these key economic and defense indicators.

The spatial dimension introduces a geographical context to our analysis, suggesting that neighboring countries may influence each other's military spending, economic growth, and investment decisions. This spatial interdependence could stem from shared regional characteristics, geopolitical considerations, or even economic spillover effects that transcend national borders. As such, our investigation transcends a mere temporal examination and ventures into the spatial intricacies that shape the economic and defense landscapes of the Latin American region.

The acknowledgment of spatial dependence also opens avenues for further exploration. Researchers may delve into the specific mechanisms through which spatial interdependence operates in the context of military spending, economic growth, and investment. Are there clusters of countries exhibiting similar patterns, and if so, what factors contribute to this spatial homogeneity? Conversely, what divergent forces lead to spatial heterogeneity among nations?

Moreover, this spatial lens invites considerations of policy implications. If neighboring countries do indeed influence each other in terms of military spending, economic growth, and investment, policymakers may need to adopt a regional perspective. Collaborative efforts among neighboring nations could be essential for fostering stability, economic development, and security in the broader regional context.

Table 3. Spatial dependence tests

Test		**lnpib_pc**	**lngm**	**lnfbkf**
Breusch y Pagan	Test statistic	2038.857	817.875	1661.720
	Probability	0.000	0.000	0.000
Pesaran	Test statistic	45.095	17.968	40.414
	Probability	0.000	0.000	0.000

Due to spatial dependence, two tests are implemented: i)the CIPS test by (Pesaran, 2007), which relaxes the assumption of spatial independence, and ii) the Breitung (2000) and IPS tests by (Im et al., 2003) with control for cross-sectional dependence to mitigate their impact. The findings are presented in Table 4. The variable of GDP per capita, according to the CIPS test, is stationary only when specified with an intercept, while without a deterministic term, it is non-stationary. Breitung and IPS suggest non-stationarity. Regarding military expenditure, Breitung rejects the non-stationarity hypothesis when including trend or excluding trend and intercept, as does the IPS test with a constant. As for investment, when the constant is specified, there is stationarity according to the CIPS, however, when the trend

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is included or the deterministic term is excluded, it is non-stationarity. The remaining tests indicate non-stationarity. Upon obtaining the first difference of the variables, all tests converge towards the stationarity of the series, suggesting that the variables are integrated of order one (I(1)).

Table 4. Unit Root Tests

Variable	Deterministic term	CIPS	Breitung y Das	IPS
lnpib_pc (level)	Constant	-2.265 *	4.269	0.822
	Trend	-1.578	0.928	1.233
	Excludes deterministic term	-0.854	6.040	-
lngm (level)	Constant	-2.090	0.848	-2.489 ***
	Trend	-3.115 ***	-1.015	-0.842
	Excludes deterministic term	-2.112 ***	2.439	-
lnfbkf (level)	Constant	-2.602 ***	2.124	-1.021
	Trend	-2.477	-0.324	-0.697
	Excludes deterministic term	-1.302	3.698	-
dlnpib_pc (difference)	Constant	-3.202 ***	-4.960 ***	-10.145 ***
	Trend	-3.278 ***	-5.081 ***	-8.932 ***
	Excludes deterministic term	-3.080 ***	-5.333 ***	-
dlngm (difference)	Constant	-4.554 ***	-3.710 ***	-19.350 ***
	Trend	-4.440 ***	-5.207 ***	-18.638 ***
	Excludes deterministic term	-3.710 ***	-13.977 ***	-
dlnfbkf (difference)	Constant	-3.963 ***	-5.447 ***	-12.388 ***
	Trend	-4.240 ***	-7.042 ***	-10.033 ***
	Excludes deterministic term	-3.556 ***	-8.036 ***	-

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

Following the identification of the order of integration of the series, various cointegration tests are implemented to verify if there is a long-term equilibrium relationship. The results are shown in Table 5. Out of the five Kao tests, three indicate cointegration at the 10% significance level. (Pedroni, 1999, 2004) suggests in four out of seven tests that there is a long-term relationship at the 1% and 5% statistical significance levels, respectively. The non-parametric (Westerlund, 2005) tests do not reject the null hypothesis of no cointegration, while the Johansen-Fisher type test suggests the existence of at least one cointegrating vector at the 1% significance level. The (Westerlund, 2007) tests, which consider spatial dependence using the bootstrap procedure, do not reject the null hypothesis of no cointegration.

Table 5. Cointegration Tests

Cointegration tests	Statistic	Probability
Test Kao		
Modified Dickey-Fuller t	1.156	0.124
Dickey-Fuller t	1.265	0.103
Augmented Dickey-Fuller t	1.468	0.071*

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Unadjusted modified Dickey-Fuller t	1.457	0.073*
Unadjusted Dickey-Fuller t	1.586	0.056*
Test Pedroni		
Modified Phillips-Perron t	0.963	0.168
Phillips-Perron t	-0.596	0.276
Augmented Dickey-Fuller t	0.448	0.327
Modified variance ratio	-2.849	0.002***
Modified Phillips-Perron t	2.132	0.017**
Phillips-Perron t	1.908	0.028**
Augmented Dickey-Fuller t	2.143	0.016**
Test Westerlund (2005)		
Variance ratio (Alternative hypothesis: Some panels are cointegrated)	0.327	0.372
Variance ratio (Alternative hypothesis: All panels are cointegrated)	0.970	0.166
Test Johansen-Fisher		
Null hypothesis: No cointegrating equation		
Trace test	74.210	0.000***
Maximum Eigenvalue Test	62.500	0.000***
Null hypothesis: At least one		
Trace test	34.850	0.115
Maximum Eigenvalue Test	30.520	0.247
Westerlund (2007) (Bootstrap)		
G_τ	-1.516	0.881
G_α	-5.453	0.713
P_τ	-2.734	0.993
P_α	-1.507	0.994

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

Some cointegration tests do not reject the null hypothesis. Therefore, the evidence for a long-term equilibrium relationship is quite weak.

Regarding the causality approach, Table 6 shows the results of the (Dumitrescu & Hurlin, 2012) test. The statistical values are presented with their probability, and the probability values are calculated using the bootstrap procedure to control for spatial dependence. Additionally, the optimal lag length (AIC) is specified.

Table 6. Causality

Causality	Statistic Z-bar	Probability	Probability (Bootstrap)	AIC
dlngm does not cause the dlnpib_pc	1.114	0.265	0.281	1
dlnpib_pc does not cause the dlngm	4.706	0.000	0.005	1
dlngm does not cause the dlnfbkf	1.792	0.073	0.138	2
dlnfbkf does not cause the dlngm	5.511	0.000	0.003	1
dlnfbkf does not cause the dlnpib_pc	0.834	0.404	0.484	1
dlnpib_pc does not cause the dlnfbkf	2.410	0.016	0.093	1

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Note: Alternative hypothesis: There is causality in at least one cross-sectional unit.

The insights gleaned from Table 6 pave the way for a nuanced understanding of the causal relationships embedded within the economic and defense dynamics of Latin American nations. The unidirectional causality unveiled in the analysis serves as a key revelation, shedding light on the intricate interplay between economic growth, military expenditure, and investment.

According to the findings, a unidirectional causal link exists between economic growth to both military expenditure and investment. This implies that as the economic prosperity of Latin American countries advances, there is a subsequent positive impact on both military spending and investment. This unidirectional causality underscores the pivotal role that economic growth plays in shaping resource allocation decisions within these nations.

Equally noteworthy is the identified unidirectional causality from investment to military spending. This suggests that increased investment levels contribute to a subsequent rise in military expenditure. The implications of this finding are manifold, hinting at the symbiotic relationship between economic investment and the defense sector. It beckons further exploration into the factors that drive this causality—whether it is driven by security concerns, geopolitical considerations, or a combination of various economic and strategic factors.

Contrastingly, the hypothesis of non-causality from military spending to economic growth cannot be rejected based on the results. This implies that at least in the examined period and countries, military spending does not appear to be a driving force behind economic growth. This challenges conventional wisdom in certain economic theories that posit military spending as a potential catalyst for economic development. The nuanced findings here suggest that, in the Latin American context, economic growth shapes the trajectory of military spending and investment, rather than the reverse.

The crux of these results suggests that the defense sector's dynamics are intricately tied to the performance of the broader economy. In essence, the resources available for military spending can expand if Latin American economic growth improves. This aligns with the broader narrative in the economic literature that emphasizes the importance of a robust and growing economy in supporting other sectors, including defense.

These findings echo the work of (Kung & Min, 2013) in the case of Ecuador and Bolivia, as well as the research conducted by (Kollias et al., 2017) for middle- and low-income countries. The argument that as the economy expands, more resources can be allocated to the defense sector resonates across various contexts, substantiating the idea that economic prosperity acts as a catalyst for bolstering military capabilities.

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In contemplating the policy implications of these results, a critical consideration emerges for Latin American policymakers. The prioritization of strategies that foster economic growth may not only enhance overall national prosperity but also fortify the resources available for defense and strategic investment. It underscores the need for a comprehensive and integrated approach to policymaking that recognizes the symbiotic relationship between economic development and the capacity to address security and defense concerns. Similar findings are presented in the study by (Desli et al., 2017), which stated that in developing countries from 1988 to 2013, the direction of causality in the short term is from economic growth to military spending and not the other way around. Similarly, (Kollias & Paleologou, 2019) for middle- and low-income countries concluded that there is a positive effect from economic growth to military spending, while the reverse only occurs in high-income countries.

CONCLUSION

In the quest to unravel the intricate relationship between military spending and economic growth in Latin American economies, this comprehensive research employed advanced econometric tech-niques, specifically cointegration and causality analysis, using panel data spanning the period from 1990 to 2019 across 13 distinct nations in the region. The multifaceted analysis yielded nuanced in-sights that challenge conventional wisdom and carry substantial implications for both economic and defense policy in the region.

The cointegration analysis, a fundamental aspect of this study, aimed to discern the existence of a long-term relationship between military spending and economic growth. The various tests conducted did not unequivocally reject the null hypothesis, indicating an absence of a robust and enduring rela-tionship between these variables over the extended time frame. While the results did not conclusively establish a causal link, they refrained from affirming a sustained connection. This challenges prevailing assumptions in the literature and warrants a reevaluation of the perceived long-term impact of military spending on economic growth in Latin America.

In delving into the causal relationships, the study identified three unidirectional causal links. First, a causal relationship was observed between economic growth to military spending, suggesting that a thriving economy contributes to increased allocation of resources to the defense sector. Second, a unidi-rectional causality emerged from economic growth to investment, indicating that economic expansion precedes and fosters higher levels of investment. Third, a unidirectional link from investment to mili-tary spending was established, implying that increased investment may lead to higher military ex-penditures.

These findings challenge the conventional narrative that military spending is a catalyst for eco-nomic growth. Instead, they suggest that economic growth plays a pivotal role in determining the re-sources allocated to the defense sector. This nuanced understanding

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reshapes the discourse surround-ing military spending policies, cautioning against strategies that prioritize defense expenditure as a means to stimulate aggregate demand.

The implications of these findings for public policy are profound. The traditional notion of increas-ing defense resources to stimulate economic growth is challenged, as the study suggests that such a strategy may be ill-advised. Policymakers need to carefully consider the economic dynamics at play and avoid overlooking the importance of fostering a robust and growing economy to sustain the defense sector.

The research also emphasizes that the efficacy of the defense sector extends beyond financial re-sources. Military capability is shaped by a myriad of factors, including economic, non-economic, polit-ical, geographical, geopolitical, and geostrategic considerations. The study underscores the importance of adopting a holistic approach to understanding military capability, moving beyond simplistic metrics such as the share of GDP allocated to defense.

In light of contemporary geopolitical tensions, the study notes a global trend of increased military spending across nations. This observation aligns with the notion that rapidly growing countries are likely to allocate higher proportions of their budgets to military protection. The implication is that as nations develop, they are likely to prioritize security measures, linking the development of a country to increased financial resources for both military spending and broader investments.

This research challenges preconceived notions about the relationship between military spending and economic growth in Latin America. The identified causal links highlight the intricate dynamics at play, emphasizing the need for nuanced development strategies that prioritize economic growth as a fundamental driver for both investment and military expenditures. Policymakers are urged to adopt a comprehensive understanding of the multifaceted factors shaping military capability, taking into ac-count economic, geopolitical, and strategic considerations. As Latin American nations navigate the complex interplay between defense and development, this research serves as a guide for formulating informed and effective policies that foster sustainable growth and security in the region.

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Doi: https://doi.org/10.14421/jiecem.2025.6.1.2317

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