DEFENSE ECONOMICS AS A GENERAL CATEGORY OF ANALYSIS IN ECONOMIC SCIENCES

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ABSTRACT

This study evaluates the field of Defense Economics, arguing that it should be considered a general category of analysis in Economic Science. More than an aggregate of isolated themes in different research subfields (national security, industrial economics, and/or government spending) and of analysis tools (game theory, statistics, growth theory, and econometrics), the field should assume its eminently interdisciplinary nature, incorporating contributions from other disciplines. In this way, the work investigates the particularities of the field, highlighting the main theoretical limitations of the mainstream economic literature. In addition, it stresses the scarcity of works on the subject in the area of Economic Science, presenting interpretations from different economic theories. Finally, there is an evaluation of the impact of the defense field on technology, industry and innovation, particularly considering the case of developing countries.

Keywords: Defense Economics. Defense Industry. Military Expenditures. Technology Innovation. Developing Countries.

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INTRODUCTION

The defense field is inherently interdisciplinary, with contributions, for example, from the Economics of International Relations, Strategic Studies, Social Sciences and Engineering, but it has never been considered a central theme in Economic Science. Despite this, with the development of new economic theories, such as the game theory and new data analysis techniques, the interest and the number of works on defense in Economics (MESA, 2012) has been growing, inaugurating a new line of research best known as "Defense economics."

Heavily influenced by the mainstream approach of Microeconomics, Defense Economics needs to be evaluated differently due to its particularities. Unlike most neoclassic models, it is not based on assumptions such as (i) pure and perfect competition (PPC); (ii) homo economicus; (iii) free entry; and (iv) complete and symmetrical information. In this sense, a significant revaluation of the theoretical and methodological bases is required for a better understanding of the defense field.

In addition, the defense field suffered significant changes after the end of the Cold War, which demanded new perspectives and approaches to deal with the topic. More and more, Defense Economics is studied beyond the management of the government's budget during the war, which opens up space for understanding its reason, effects and relevance also during times of peace.

The Defense Industry ends up being influenced by the theoretical and analytical bases of Defense Economics. In this way, discussions about market structure, technology transfer and innovation are weakened, which leads not only to the need to adopt more holistic perspectives, but, above all, to identify the different actors involved in the field, in addition to the influence of extra-economic variables in decision-making.

Thus, the present study presents as hypotheses the fact that defense is considered a public good influenced by (geo)political decisions. As main justifications, we highlight (i) the small participation of the defense field in economic studies; (ii) its correlations with other sectors of the economy; (iii) its relevance in the regional context; and (iv) the opportunity cost with other social investments (guns versus butter model), particularly when dealing with developing countries.

The structure of the article is divided as follows: after this brief introduction, the second section discusses the particularities of the defense industry, highlighting the main theoretical limitations in the field of Defense

Economics. Based on the classical contributions of Wohlstetter (1959), Hitch and McKean (1960), Schelling (1960) and Benoit (1973), it is identified that the mainstream theoretical framework of Economic Science has limitations to deal adequately with the defense field.

Next, the third section highlights the representation of the field of Defense Economics in the classification system of the Journal of Economic Literature (JEL), since the field is not even considered a general (and independent) category of analysis, but a subfield of research in different areas. In addition, the section highlights the scarcity of works on the subject in the area of Economic Science, focusing on the perception of the defense field by the different economic theories, as well as on the relationship between military expenditures and economic growth.

The fourth section discusses the impact of the defense field on technology, industry and innovation. In this way, it evaluates how the theoretical limitations to deal with the theme affect politics and practice, as well as the management of science, technology and innovation (CT&I) in the defense field, particularly when dealing with developing countries.

Finally, the final considerations are presented, followed by the appropriate bibliographical references that served as basis for the research. It is concluded that Defense Economics, although relatively recent as a field of research, should be considered a specific field of knowledge in Economic Science, not a subfield of different macro-areas, such as national security, international relations, industrial economics and/or government spending.

PARTICULARITIES OF THE FIELD

Defense should be considered a public good, which distinguishes it from other goods and/or services (VARGAS PULIDO; GODOY ESTRELLA, 2013; FRANKO, 2014). Thus, it is a non-exclusive and non-rival good, which consequently leads to two central (and interconnected) issues of the field: (i) free-rider behavior of the actors; and (ii) guns vs. butter dilemma. Both issues make it necessary to provide transparent information[2] about the relevance of an efficient national defense (FRANKO, 2000), highlighting its spillover and spin-off effects so as to bestow legitimacy upon investments in the sector[3].

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[2] Although it is often confidential information.

[3] Because it is an area almost exclusively associated with military affairs, the dilemma between social investment and investment in the defense field is even greater in developing countries – particularly in South America, where past experiences with military governments still impose a negative relationship between society and the prioritization of

Due to the free-rider behavior of the actors, there will be demands for investment in other fields (health, education and leisure, for example), leading to the trade-off between investment in the defense field and in the social field (guns vs. butter dilemma). Said dilemma prompted the attempt to (i) measure the amount to be allocated to the defense field; (ii) measure its relationship with the countries' growth/development; (iii) evaluate the different industrial policies to promote it; and (iv) estimate its impacts on science, technology and innovation (CT&I) in other sectors.

In this scenario, particularly after World War II (WWII) and in the context of the Cold War (CW), there is an increase in the relevance and efforts of economists, who become interested in the field, developing a new "line of research" in Economic Science known as "Defense Economics", with contributions from, among others, Wohlstetter (1959), Hitch and McKean (1960), Schelling (1960) and Benoit (1973). It should be mentioned, however, that the field has never ranked among the most analyzed within Economic Science (MESA, 2012), which is also reflected in its (inter)national curricula.

Unlike the mainstream approach of Economics, the defense field could not be analyzed from the perspective of conventional economic theory (SANDLER; HARTLEY, 1995), due to its agents (State and Armed Forces), its basis of institutional arrangements (contracts and alliances) and its pertinent issues (LESKE, 2013). In view of this limitation, McGuire (2010, p. 231) points out that "the need for economists to think well beyond 'utility-maximization-plus-equilibrium' as a framework for defense, peace and security has never been greater".

Firstly, the main actor of the field is the State, i.e., it is a field that is not necessarily understood from the perspective of markets. Thus, the famous market structure in pure and perfect competition (PPC) does not apply, also because it constitutes a clear case of monopsony (or, sometimes, oligopsony). This market structure draws attention to the limitations of decision-making processes in the field (MOREIRA; MEDEIROS, 2016), highlighting the relevance of institutionalist approaches that consider path dependence and institutional change (NORTH, 1990), as well as bounded rationality (SIMON, 1955; JONES, 1999).

The fact that monopsony is the market structure most commonly associated with the defense field is even more relevant when dealing with developing countries, a focus of the present work. In these cases, the

this type of public spending.

performance of the state is essential "for the aim of strengthening the indigenous defense industry complex, to reduce the technological gap and gain self-reliance in arms production" (MOREIRA; MEDEIROS, 2016, p. 6). In the words of Mendonça et al. (2008, p. 582):

> [The] State can act as an agent playing a dual role in the science, technology and innovation system (CT&I): it sometimes acts as a facilitator of cooperation (between academia, government agencies and the productive sector), sometimes as a claimant of processes and products.

Nevertheless, there are several studies based on the principles of neoclassic microeconomics. In this sense, Scheetz (2011) points out that defense as a public good corresponds to a combination of different production factors, such as manpower (military and civilian), fixed capital (plants and equipment), variable capital (operations and maintenance) and knowledge (know-how and technologies).

> Contributions in defense economics have made fundamental advances to game theory [e.g., Thomas Schelling (1960), The Strategy of Conflict], procurement theory [Cummins (1977), Laffont and Tirole (1993), McAfee and McMillan (1986), Tirole (1986)], and the econometrics of military manpower [Ash, Udis and McNown (1983)] (HARTLEY; SANDLER, 1995, p. 3).

It is thus evident that the contributions of mainstream Economic Science are limited, which highlights the need for interdisciplinary analyses derived from the close relationship between the defense sector and either the civil sector (VIÑAS, 1984) or national policies, particularly Foreign Policy (MORAES, 2012; SOARES, 2015). In addition, it is essential to consider the structure of the defense market, as well as the behavior of its main actors to understand the challenges faced by the policies of promotion of the field.

Perhaps because it has so many characteristics that distance it from the markets theorized by great part of the mainstream literature of Economic Science, the field of Defense Economics remains marginalized. The lack (or even non-existence) of teaching, debates and research on the discipline

translates into its curriculum (at undergraduate and graduate levels), nationally and internationally, also requiring that the few existing studies use the theoretical and analytical framework of areas of Macroeconomics, Microeconomics and Industrial Economics. As a result, the "Defense Industry" is born, which should actually be understood as a sub-topic of the field of "Defense Economics".

This, however, leads to the inadequacy of a large part of these defense studies, either due to (i) the assumptions of the theories used; (ii) the indicators selected; or (iii) the inappropriate limitation of the field to a strict notion of Economy. Consequently, in an almost cyclical way, there are few studies in the field, which often lack projects and funding. As a consequence, studies in Defense Economics end up being limited to the different military schools of the Armed Forces (AFs) and/or the few civilian centers of study/research in the field[4].

ECONOMIC THEORY AND DEFENSE

According to Franko (2000), due to its nature (public good) and to market failures, it is difficult to estimate the d*emand for defense. It may be said that it depends on* preferences, budget, expectations, perceived threats, the price of other goods, the number of actors in the market, as well as the existence or not of conflict and/or war. From the point of view of the *supply of defense goods/services, it is known that it is affected by* technology, expectations, the price and availability of resources, the price of other goods, the cost of work and equipment, the rate of return in other sectors, taxation, previous military expenditures, the party in power, public opinion, and international restrictions such as arms control agreements.

Thus, it is clear that the defense field is directly or indirectly affected not only by non-economic variables, but also by variables that are microeconomic and macroeconomic in nature. In this sense, more than associating it solely with the industrial and technological field (as is often done in Economic Science), Defense Economics must be understood as a sub-area of Economic Science, that is, as an independent field of study.

For example, the classification system of the Journal of Economic Literature (JEL), which is an international standard method of classification

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[4] Again in a cyclical way, the discussion on Defense Economics is not reproduced (i) in the academic world of Economic Science, for the aforementioned reasons; nor (ii) in the civilian world, since the debate ends up being (de)limited to military institutions and/or those specialized in the field.

of academic literature in Economics, does not include any "general category" or "subcategory" for the Defense field. It is instead represented in distinct and isolated categories[5], as shown in Table 1.

Table 1. Categories considering "Defense Economics" and "Defense Industry", according to the JEL classification

Tabela 1. Categorias que consideram 'Economia de Defesa' e 'Indústria de Defesa', de acordo com classificação JEL

Categoria Geral		Subcategoria	
F5	International Relations, National Security, and International Political Economy	F52	National Security • Economic Nationalism
H5	National Government Expenditures and Related Policies	H56	National Security and War
L6	Industry Studies: Manufacturing	L64	Other Machinery • Business Equipment • Armaments
O2	Development Planning and Policy	O25	Industrial Policy
R5	Regional Government Analysis	R58	Regional Development Planning and Policy

Fonte: Elaboração própria.

As shown in **Table 1**, different areas of Economic Science consider, in some way, themes of the defense field – albeit in an isolated and independent manner. Its interconnection with the discussion on national security, even from the regional perspective, is a significant example[6]. Moreover, as will be seen below, the incorporation of the theme is frequent when dealing with public spending, and its potential impact on (inter)national development is worth noting.

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[5] The categorization does not consider research/analysis methodologies, such as B (History of Economic Thought, Methodology, and Heterodox Approaches) or C (Mathematical and Quantitative Methods). See general categories and subcategories at: https://www.aeaweb.org/econlit/jelCodes.php.

[6] In Economic Science, the term "regional" is often associated with the micro-spaces of the national territory; on the other hand, in International Relations (IR), it is associated with macro-spaces, i.e., with the set of different nations. In the defense field, however, given the contributions of both disciplines, there are studies that perform "regional" analyses from both perspectives.

Consequently, the studies in the field of Defense Economics, also due to their interdisciplinary nature, end up having greater relevance in the field of International Relations and Strategic Studies. However, in the field of Economics, the few studies that exist on the subject focus on three main themes: (i) how the defense field is perceived by the different economic theories; (ii) the relationship between military expenditures and economic growth; and (iii) the impact of the defense field on technology, industry and innovation. The first two, also for being interconnected, will be analyzed in this section; the last one, in the next section.

Before analyzing each of the theories individually, it should be noted that it is necessary to understand the institutional bureaucracies responsible for spending – which vary widely from country to country – to estimate the amount spent on defense. Often, however, current expenditure is defined as that of the previous year plus a variation, which is not efficient from an economic point of view (FRANKO, 2000). Thus, the theoretical analysis of military expenditure is not a purely economic problem, but a mixture of economic, political, strategic, psychological, cultural and even moral aspects (VARGAS PULIDO; GODOY ESTRELLA, 2013).

In addition, the expenditures of the defense field are not always directly associated with the Ministry of Defense, the Ministry of Security and/ or the Ministry of Justice, but also with specific programs for the economic growth and/or development of the country, or sectoral and/or industrial policies. Thus, the measurement of military expenditures and investment in the defense field can change significantly, depending on the institution consolidating it, as well as the country analyzed.

Theoretically, it is possible to find references and analyses of the defense field as early as in the famous work of Adam Smith (1996 [1776]), "The Wealth of Nations". In book V, chapter 1, the author deals exclusively and specifically with the theme, highlighting that "[the] first duty of the sovereign, that of protecting the society from the violence and invasion of other independent societies, can be performed only by means of a military force" (Ibid. p. 173).

In a general and simplified manner, Marxist theory indicates that war would be a way for the capitalist system to continue its continuous accumulation process, by destroying the stock of constant capital. Thus, Baran and Sweezy (1966), Marxist theorists of underconsumption, see the impact of military expenditures on economic growth as positive and clear – especially when the economy is not balanced.

For Keynesian theory, security, as public spending, can positively affect aggregate demand (AD)[7] and reduce unemployment. In this way, the State would be an active and interventionist actor, increasing production when the AD is ineffective. Thus, some economists advocate a growth model based on defense spending (MORENO; JUNCA, 2007), better known as "military Keynesianism". However, in an aggregate manner, it can have a negative impact due to the crowding-out effect[8].

In Neoclassic theory, on the other hand, the relationship between military expenditures and growth depends on the modeling of each author (DUNNE; SMITH, 1990). Therefore, the effect depends on the cost of opportunity (tradeoff) between military expenditures and other expenses (guns vs. butter). Solow's economic model, for example, highlights that the main effect is the promotion of technology, to be discussed in the next section.

This would thus be a dilemma of allocation of resources (approach of rationality), often methodologically represented by game theory. Therefore, the relationship between defense spending and the gross domestic product (GDP) can be measured, for example, by the Granger causality test (econometrics), the real business-cycle model, the ordinary least squares model (MQO), the defense spending ratio and/or the Gini index.

Schumpeterian theory highlights that technological change is the central element of capitalist dynamics, and the micro-economic level (of the firm) would be at the center of this innovation process. Thus, unlike the neoclassic vision, the development driven by new technologies would create inequalities and a hierarchy of capacities; more than analyzing only the absolute impact of military and defense expenditures on growth and GDP, the theory focuses on the relational and comparative analysis of this expense.

Next, **Table 2** presents a synthesis of certain classical studies, starting with the original work of Emile Benoit (1973). Studies of this nature date back to the 1970s and were adapted to different countries and regions based on different methodologies, especially since the 1990s. In general, the regression equation is:

$$g_{i,t} = X_{i,t}.\beta + m_{i,t}.\gamma + \varepsilon_{i,t} \qquad \text{(Eq. 1)}$$

where: $g_{i,t}$ = growth rate of the GDP *per capita* (PIBpc) in country i and period t; $X_{i,t}$ = vector of conditioning variables (human capital, regional

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[7] Also due to the multiplier effect; if it was positive (+) and greater than 1 (> 1), it would be worth it.

[8] This effect causes the rise in aggregate public expenditure ($\uparrow$G) to increase the interest rate ($\uparrow$r), which, in turn, reduces private investment ($\uparrow$I) in sectors that are more sensitive to it.

dummies and the savings or investment rate); β = effect of these conditioning variables on gi,t; mi,t = military budget (in some cases, growth of the military budget) in country i and period t; γ = effect of military expenditures on economic growth (parameter of primary interest); and εi,t = error term.

Table 2. Synthesis of the comparison between classical studies on the military expenditures-growth relationship

Tabela 2. *Síntese comparativa dos estudos clássicos selecionados sobre relação gastos militares-crescimento*

Referência	Amostra	Período	Modelo	Conclusões
Benoit (1973, 1978)	44 LDC	1950-1965	Tradicional (ad hoc)	Efeito (+) significativo
Biswas (1993)	74 LDC	1981-1989	Tradicional - Feder 2 setores	Efeito (+) significativo
Atesoglu e Mueller (1990)	EUA	1949-1989	Feder 2 setores	Efeito (+) pequeno
Deger (1986a, b)	50 LDC	1965-1973	Tradicional com equações estruturais (3 eq.)	Efeito (+) direto, mas efeitos indiretos e totais (-)
Smith (1980)	14 países OCDE	1954-73	Keynesiano de investimento	Efeito (-)
Scheetz (1991)	AR, CL, PY, PE	1969-1987	Deger 3 eq.	Efeito (-)
Alexander (1990)	9 DC	1974-1985	Feder 4 setores	Sem relação
Landau (1993)	71 LDC	1969-1989	De crescimento tradicional (ad hoc)	Sem relação
Ram (1994)	71 LDC	1965-1973, 1973-1980 e 1980-1990	Tradicional - Feder 2 setores	Sem relação

Fonte: Adaptada de Ram (1995). LDC = *less development countries*; DC = *developing countries*; eq. = equação; OCDE = Organização para a Cooperação e Desenvolvimento Econômicos; AR = Argentina; CL = Chile; PY = Paraguai; PE = Peru; (+) = positivo; (-) = negativo.

The **traditional model** of Benoit (1973, 1978) sees a positive (+) relationship between military spending and growth, also due to (i) the spillover effect of research and development (R&D) on the civil sector, which occurs less intensely in developing countries; and (ii) the impact on human capital (KH). However, the model is criticized, since the statistical significance of certain variables is deducted from the regression to improve the determination coefficient (R2).

As previously shown, the **Keynesian model** focuses on demand and has uncertain results regarding the impact of military spending on GDP; initially, it evaluates that its increase would lead to a positive impact (+) on economic growth (growth of aggregate demand and reduction of excess idle capacity). Its critics, however, argue that (i) the increase in aggregate demand does not need to derive from military expenditures; (ii) the crowding-out effect leads to negative results (-) in the relationship between military spending and growth; and (iii) the model does not consider supply, so it does not see the possibility of spinoff (technological overflowing from the military to the civilian sector).

Feder's model, on the other hand, focuses on supply and sees a positive (+) or neutral (+/-) relationship between military expenditures and GDP. It is mainly criticized for (i) ignoring the crowding-out effect; and (ii) having a concurrency bias (risk of double counting). Nevertheless, it is worth noting that the original model (FEDER, 1983) made sense and had none of these vices, because it focused on the effect of exports (X) on economic growth[9].

Among the positive effects (+), the following stand out: increase in employment level, in addition to physical and technical training, as well as educational investment, developing human capital (KH). In addition, the possibility of spin-off and improvement of social infrastructure is highlighted. It is also possible to highlight the increase in the aggregate demand (⊚AD) for national (and international) security, possibly contributing to the attraction of foreign direct investment (FDI). Franko (2000) states that some military expenditures may also have civil purposes, as is the case of former soldiers and combatants, as well as military production/service facilities and land, provided that there are some modifications such as organizational reinsertion, adaptation and restructuring.

On the other hand, among the negative effects (-), the pressure of imports (M) on the balance of payments (BOP) may be considered, especially in the case of developing countries. Consequently, there may be a reduction in international reserves and increase in debt.

As already shown by Keynesian theory, risks include (i) the crowding-out effect; (ii) the distortion effect (reduction in the efficiency of allocation of productive resources, distorting relative prices); and (iii) the negative spillover effect (use of civilian facilities for military purposes and environmental damage).

It is worth noting, however, that for didactic purposes, in **Table 2**, only texts of classical authors discussing Defense Economics are shown, more specifically, the relationship between military expenditures and economic growth. For this reason, these are publications from the 1970s, 1980s and 1990s, with study periods lasting up to 1990. However, it is important to consider that, especially after the Cold War, the dynamics of defense economics change, in geographic, technological, dimensional and environmental terms.

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[9] Even in Feder's model, a negative (-) or insignificant relationship has to be evaluated very carefully. For example, it may be related to the demanding nature of "significance tests" with low tolerance of type I errors.

INDUSTRY, TECHNOLOGY AND INNOVATION

Notwithstanding the changes that occur in the defense field after the Cold War, the defense industry continues to have a strong innovative role, despite the difficulties it faces (DAGNINO, 2008, 2010). In this way, the science, technology and innovation (CT&I) of the defense industry should be promoted so as to enhance the defense industrial base (DIB). Achieving this goal is the task of various actors such as the State, private companies, universities, research centers, servicemen and civilians, research and development agencies (R&D), politicians, the industry, and favorable normative and legal frameworks (SORENSON, 2009).

Nevertheless, it is important to highlight that innovation is not only technological progress, but also institutional development (MOREIRA; MEDEIROS, 2016) or a more productive/efficient use of resources (FRANKO, 2000). However, there are different analyses that insist on proposing an orthodox view of innovation in the defense field, such as the expansion of the production possibility frontier (PPF) and the hypotheses of general equilibrium.

Thus, faced with the difficulty of understanding Defense Economics and, consequently, proposing policies that consider its particularities, this section evaluates the barriers to the policy and management of CT&I in the defense field. To this end, the relationship between CT&I and the defense and civil sectors will be briefly presented.

It may be argued that innovation corresponds to one of the results, as well as the engine of the defense industry (SANTOS, 2017). Therefore, understanding how science, technology and innovation (CT&I) and research and development (P&D) are promoted is essential to ensure the dynamics of the defense field. Thus, it is necessary to understand the theoretical-methodological limits associated with Defense Economics in order to identify the barriers to the policy and management of CT&I in the field.

Previously, it was noted that monopsony is the market structure most commonly associated with the field of Defense Economics. This means that there is only one large buyer (demand), the State, which rules out the analyses of the models in pure and perfect competition (PPC). From the point of view of producers (supply), it should be noted that the non-diversity of potential purchasers leads to the need for contracts to ensure purchases by the State[10],

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[10] Economies of scale and the consumer market's growth are also made possible by external

so producers may produce under minimum guarantees. Otherwise, there may be no incentive to invest in the field.

As a way to respond to this barrier that is innate to the market's structure, companies in the field try to diversify their production/market, participating in the civil market (LONGO, 2007). However, for different reasons, they end up finding different barriers (AZULAY et al., 2001), possibly preventing the innovations that occur in the military sector from overflowing to the civil sector (LESKE, 2013) – concept of spin-off. This occurs because the spin-off is not always successful, like the Internet, the Global Positioning System (GPS) and unmanned aerial vehicles (UAVS), better known as drones.

For Dagnino (2008), the spin-off was initially a "natural phenomenon", which became an "idea", and then, a "paradigm" (a governmental policy). It ends up diluting itself in the concept of "dual-use technologies", "the focus of which is not the promotion of a technology transfer between the military and civil sectors, but a convergence between its technological-productive dynamics" (Ibid., p. 115).

Dagnino (2010) states that the concepts of spin-off, spillover and dualization end up representing elements of an ideological construction to defend exacerbated military expenditures on the part of the United States (USA). It should be noted, however, that in addition to diversifying potential trading partners, the goal of promoting dual technologies is generating economies of scale to reduce costs (BRICK, 2011; NEUMAN, 2006; GANSLER, 1995).

In addition to the need for scale and technological costs, there is also difficulty in marketing. This difficulty relates to technical and, above all, (geo)political and (geo)strategic issues, hindering the transfer of technologies. Different regions, such as the USA and Europe, impose legal constraints that limit the transfer of knowledge to developing countries (FRANKO, 2014), delimiting different "roles" in the global defense industry chain.

The difficulty in transferring technology (and training) takes place not only between developed and developing countries, but, as already shown, between the military and the civil sector (MOREIRA, 2011). Therefore, to deal with this barrier, countries create different programs and industrial policies to stimulate this movement, seeing as it is not automatic and/or natural (AMBROS, 2017). Between countries, the means used to ensure access are international trade (ANDERTON, 1995) or purchase incentives in the

demand (international trade), although the commercial relations of these goods/services follow another logic.

defense field (MOWERY, 2012; ROGERSON, 1995), and sometimes offsets, international collaboration and/or standardization[11].

In the case of transfers, it is essential to highlight also the portion of the public budget dedicated to the defense field. For many, this amount is understood as a transfer of the allocation of resources from the social to the defense field, being interpreted as a "trade-off", better known as guns vs. butter[12]. Given this reality, there is another barrier to the policy and management of CT&I in the defense field: the fact that governments impose budgetary constraints.

As shown in the previous section, there is a long discussion in the literature about theoretical models for military expenditures, with often contradictory results. These expenditures are even more delicate when dealing with developing countries, which have other demands and emergencies in terms of social spending. It should also be noted that there is no standard in terms of (i) the areas considered in the defense budget (personnel, pensions, subsidies, debts, equipment, investments, internal security, defrayal and/or R&D); (ii) the macroeconomic variables affecting it (foreign exchange and/or inflation); (iii) the basis of analysis, whether in nominal or real terms, or in relation to public spending, social spending or the gross domestic product (GDP); (iv) the actors responsible for the budget (different ministries and/or specific programs); and (v) the relationship between defense spending and economic growth.

Particularly in developing countries, it is important to note that most expenditures are used to meet the consumption needs of military families and to build infrastructure for the country (FRANKO, 2000). However, these expenditures may negatively contribute to the balance of payments (BOP) and to the external debt, given the considerable volume of foreign currency reserves related to imports (M).

This debate on military expenditures necessarily leads to another particularly important barrier when it comes to developing countries: the funding issue. Funding can be obtained, for example, via (i) taxes, which may affect the country's income distribution; (ii) the issuance of public bonds, which would lead to the public debt's expansion (VARGAS PULIDO; GODOY ESTRELLA, 2013); (iii) the increase in the monetary supply, which would

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[11] However, it is necessary for countries to be prepared to absorb the knowledge transferred.

[12] "Every gun that is made, every warship launched, every rocket fired signifies, in the final sense, a theft from those who hunger and are not fed, those who are cold and are not clothed. This world in arms is not spending money alone" (EISENHOWER, 1953).

entail inflationary pressure (FRANKO, 2000); (iv) tax transfers (CEPAL, 2005); (v) a specific promotion agency for the defrayment of research, development and engineering projects (RD&E) (LONGO; MOREIRA, 2012, 2013); and/or (vi) external indebtedness. Regardless of how it is obtained, public funding is necessary to ensure the development of innovation systems, promoting interactions between the various agents responsible for the creation, dissemination and use of technological innovations.

It should be noted that the funding issue becomes even more critical after the Cold War, when the amount of investment allocated to the defense field falls significantly (MORAES, 2012). In addition to the quantitative reformulation of the capital allocated to the defense field, it is equally important to highlight the qualitative reorganization of the global map of defense industries, with increasing weight of South American (BÉLANGER et al., 2012) and Asian countries, particularly China and Russia (IISS, 2017[13]). Therefore, discussing defense issues from the perspective of developing countries is more and more necessary, not only due to the peculiarities of these countries, but above all, because of their growing relevance in the context of the economy and the global defense industry.

FINAL CONSIDERATIONS

The aim of the discussions developed in this article was showing that Defense Economics is marginalized in the teaching, research and curricula of Economic Science. Its mainstream theoretical approaches prove limited to deal with the field, the nature of which is distant from that of the economic models of Macroeconomics, Microeconomics and Industrial Economics.

Although relatively recent, studies on Defense Economics should be encouraged and developed, given its peculiarities, as well as its correlation with other fields, some even external to Economy. In this sense, more than just using theories and tools established in the discipline, such as game theory, statistics, growth theory and econometrics, the new field should embrace (also from an ontological, epistemological and methodological point of view) its eminently interdisciplinary nature. Thus, it must incorporate contributions from other disciplines, such as International Relations and Strategic Studies.

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[13] Based on IISS data (2017), the USA was the country with the highest defense budget in 2016 (US$ 604.5 billion), followed by China (US$ 145.0 billion) and Russia (US$ 58.9 billion). It should be noted, however, that the USA's budget is about 4.2x that of China, which, in turn, is about 2.5x that of Russia. Brazil is the South American country with the highest defense budget, ranking 12th (US$ 23.5 billion).

The current scenario is limited in relation to appropriate theories for understanding the field, and the lack (and often non-existence) of academic discussions on the subject causes these theoretical-methodological barriers in the studies of Defense Economics to entail political barriers in the management of Science, Technology and Innovation (CT&I) in the defense field. These "barriers", as shown, constitute particularly relevant obstacles when dealing with developing countries, given the budgetary constraints and other priorities (or even emergencies) they are faced with.

For the promotion of CT&I in these countries, it is essential that (i) funding sources; and (ii) training, development and innovation programs are discussed. Both cases can be made possible by internal (national) sources, via public indebtedness, or external (international) sources, via offsets, international collaboration and/or standardization, for example.

In any case, it is important to emphasize that funding is required for the management of CT&I to become feasible, allowing the innovation of products, services and/or processes, while avoiding the conversion of the amount allocated into sunk cost. Thus, it is evident that a collective and integrated planning of a set of (economic, social, educational, industrial, scientific-technological, environmental, defense, funding, and knowledge-management, for example) policies is necessary to promote the defense field.

According to data from The Military Balance 2017, the annual evaluation of the International Institute of Strategic Studies (IISS), developing countries have grown in terms of relevance in the global chain of the economy and the defense industry. Therefore, it is essential that Defense Economics considers the specificities of these regions, so that public policies that incorporate these characteristics, and not the generic, inadequate and decontextualized ones seen in the specialized literature, may be implemented.

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