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DEFENSE AND DEVELOPMENT INDUSTRY: THEORETICAL CONTROVERSIES AND IMPLICATIONS IN INDUSTRIAL POLICY

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Introduction

Two main discussions permeate the relationship between defense and development: i) whether there is a relationship between military spending and economic growth; and ii) whether military spending generates technological development in society as a whole. These two discussions are fundamental both for the motivations and justifications used by political actors for military expenditures and for public policies (including industrial policies) for the defense sector.

Hartley and Sandler (1995, 201-2015) make an important review of specialized literature in the debate between defense and development in several schools of economic thought. For the authors, the main studies that find positive correlations between military spending and economic development have five main points: 1) economic stimulus effect of military spending during periods of unemployment, caused by both underconsumption and underinvestment; 2) spin-offs and technological effects of the defense sector that, when applied to the civil sector, cause economic growth; 3) military spending can increase (economic) growth if some of these expenditures are used to provide social infrastructure (such as dams, highways, airports, communication networks) and other forms of public goods; 4) military spending can promote growth by providing nutrition, training and education to a segment of the population, and this improved human capital can positively impact the civil

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sector; and 5) military spending may indirectly support a safe environment for the promotion of an export market and for attracting foreign investment.

For the authors (Ibid., 202), those who consider that defense activities may have an inhibitory influence on growth argue that: (1) defense can divert resources from public and private investment that would be more growth-promoting than Defense, since if the defense competes for resources intended for private investment, then any crowding-out effect will have negative impacts on long-term economic growth; 2) if a country imports a large part of its armaments, military expenditures may have adverse impacts on the balance of payments; 3) economic growth can be inhibited when defense activities divert private sector research and development (R&D) resources, because although there may be technological spin-offs, private sector technology applications are generally faster and more targeted when they originate by the private sector itself; 4) Military expenditures can inhibit growth by diverting resources originally destined for the export sector, so that goods that would bring foreign exchange into the country are not sold abroad; and 5) the defense sector limits growth through inefficient bureaucracies created by taxes used to finance military spending, as well as the public sector in general.

In this reflection exercise, we will discuss contributions that use Classic, Marxist, Neoclassical and Keynesian approaches to development to expose the debates in relation to military spending and economic growth, and, on the other hand, we will focus on the Defense Industry's contextualization as a driving factor for Technological development and innovation using the Cepaline and Schumpeterian theories, as well as systemic approaches on the historical technical-economic transitions of the international system. As we will argue, the Defense Industry's contribution to development goes beyond the concept of a causal relationship between military spending and economic growth, being a sector capable of endogenizing certain technologies and productive processes that structure a country's capacity to guide its development trajectory in new technical-economic paradigms. For the State to pursue the strategy of nationalization of critical technologies of these new paradigms, institutional arrangements and instruments are needed, with a coherent and robust industrial policy.

Military Expenditures and Economic Growth

Generally, for economic theory there is no clear distinction between general public spending and military spending. These are just another form of government spending. Briefly and superficially, we can say that, for Neo-

classical theory, security may even be necessary for trade, but there will be a trade-off between "weapons and butter"[2], while for Keynesians, security, since it constitutes public spending, can have positive effects on demand (Dunne and Haines 2000). For Marxists, in parts the two views are combined, but scholars of the Underconsumption current see a clear and positive role in military spending, although they have not found empirical evidence to support such view (Smith and Dunne 1994). According to Dunne and Nikolaidou (2011), economic analysis of military spending is extremely difficult insofar as it is not a purely economic matter but a mixture of economic, political, strategic, psychological, cultural, and even moral factors.

Adam Smith (1723-1790) was the first great economist to defend the free market as an essential rule for the proper functioning of the economy and to postulate that the state should interfere as little as possible in the relationship between power and the market. However, Smith posits about the special character of the defense and the importance of the monopoly of force being exclusively in the hands of the sovereign. Matthews and Maharani (2009, 91) argue that Smith had a view of defense as the public good by definition, which was too important to be left to the market. According to the authors,

> Smith's insistence on defense by the public sector has two justifications: first, defense is one of the best examples of Pareto's optimum, that is, where all citizens benefit from the provision of a good without the danger of free-riding; And secondly, policy must be oriented so that defense product initiatives are public, since only public ownership will ensure the sovereignty of supply remains with stakeholders. (Matthews and Maharani 2009, 91).

Adam Smith argued that defense spending should be an obligation of the sovereign state, including the maintenance of a permanent and professional army, following its own logic of the division of labor in a society. Moreover, accepting the importance of material production for the sovereignty of the nation, Smith admitted that State interference in the economy, especially in relation to import restrictions, is admissible when it serves to protect industries essential to national defense. In that sense, Smith advocated maintaining the UK Shipping Acts, even though they were unfavorable to foreign

2 Skinner (1969) introduced a fundamental concept in the study of strategy and operations management: the trade-offs. A trade-off is defined as a situation where there is a conflict of choice, that is, the balancing of two opposite situations or qualities, which are desired concurrently. For example, a classic trade-off is between "guns and butter", the more we spend on national defense (arms) to protect our borders from foreign aggressors, the less we can spend on consumer goods (butter) to raise our standard of living internal.

trade from cost increases. Since the merchant navy was easily converted into a navy, it became a strategic requirement to sustain the British naval industry in times of peace to ensure its existence in times of war. So, Smith did not necessarily discuss the impact of military spending on economic growth, but saw the defense industry as strategic for the power of nations.

In the Marxist approach, the phenomenon of war is often seen as an instrument for the destruction of the stock of capital, which excessively undermines the rate of profit given the organic composition of capital. That is, war would be a way for the capitalist system to continue its continuous process of accumulation from the destruction of constant capital stock that is no longer sufficiently productive. Dunnes (2000, 6) points out that Baran and Sweezy (1966), theoretical Marxists of underconsumption, were one of the first authors to actually reflect on the mechanisms of military spending as a way of benefiting the growth of the capitalist profit rate when Economy is in imbalance. In general, Marxists tend to regard militarism and military spending as social phenomena within historical aspects and focus on the strategic and political aspects of military spending.

The Keynesian theory of economic growth reflects the delicate period of the international economy of the 1920s and 1930s, introducing for the first time in the debate macroeconomic concepts. Keynes's main concern regarding economic growth is the dynamics of the effective demand of the economy, since, given that supply tends to adjust to the effective demand in the long term, it ends up that consumption and investment determine the product and the employment in an economy. According to Porcile, Esteves and Scatolin (2006, 365), "the government, in order to reduce unemployment, can increase effective demand through increased public spending, leading to an increase in output". In Keynes's view of interventionist and proactive State, military spending could be used to increase output from multiplier effects when aggregate demand is inefficient. In addition, if aggregate demand is relatively low regarding potential supply, increases in spending may lead to increased productive capacity, increasing profits, and thus increasing investment and economic growth.

According to Dunne and Nikolaidou (2011), Keynesian models of demand are widely used to explain the relationship between military expenditures and economic growth, which, in general, tend to find a negative relation between military spending and economic growth, verifying the Displacement Effect (Crowding Out) of savings or investments. The direct relationship between increased military spending and economic growth in the Keynesian logic finds a basic challenge, which is to rely on a national defense industrial base so that military expenditures are not reversed in imports. Moreover, for

the authors, the basic disadvantage of this theory is the excessive focus on demand and the failures to consider defense supply issues (technological developments and positive externalities).

The Neoclassical School tends to perceive military expenditures as a pure public good and the economic effects of these expenditures will be determined by its opportunity costs, that is, the trade-off between military spending and some other expenditure. This approach perceives the State as a rational actor who seeks to balance the opportunity costs and security benefits of military expenditures to maximize a well-defined national interest and reflected in a social welfare function (Dunne 2000).

Thanks to the tendency to take a tragic choice between military spending and other expenditures, well exemplified in the classic "guns and butter" dilemma, Neoclassicists often argue that defense spending undermines economic growth. In this paper, we can see that Deger & Smith (1983), Heo (1999), Kwaben (1989), Lim (1983) and Shieh (2002). For Dunnes (2000), the most influential Neoclassical models in defense economics are those of Biswas and Ram (1986), developed from the Feder (1982) model. With Feder's model on the effects of exports on growth in developing countries, these authors have created a model for cross-country analysis of the effect of military spending on economic growth. ERDF models tend to suggest that the impacts of military spending on growth are positive, especially from the effects of export and technology transfer, or are insignificant (Dreze 2006).

The enhanced economic model of Solow[3], introduced by Mankiw in 1992, was used to measure the effects of military spending on growth by

3 The Solow Model is one of the major structuring studies of the Neoclassical school. In it, besides perfect competition, the factors of production are homogeneous, divisible and perfectly interchangeable (i.e. one of the main Neoclassical presuppositions). The model seeks to relate savings, capital accumulation, and population growth (which automatically becomes the labor market) to explain the long-run per capita product variation. The deepening of capital, that is, its accumulation (in a Marxist language), is financed by per capita savings, which must be sufficient to supply capital to the growing population at a certain rate and to depreciate existing capital. According to Souza (2011, 264), "the conclusion of the model is that the increase in the saving rate expands the K/L ratio and per capita income until the economy reaches a stable long-term equilibrium, when the rate growth per capita will remain constant and equal to the rate of population growth". However, once the equilibrium is reached, the increase in saving will no longer impact the growth rate of the product to the point of raising it above the rate of population growth. That is, the explanation of long-term growth is exogenous to the Solow model, which introduces technological progress as an exogenous variable explaining long-term sustainable growth, since it is the increase of the technique that will provide higher labor productivity and higher rates of capital deepening. Finally, Souza (ibid., 265) concludes that "the important conclusion of the Neoclassical model is that the pace of technical progress determines the growth of per capita income in the stable long-term equilibrium".

Knight et al. (1996). The key premise is that the portion of military spending affects the productivity factor through the level of effect on the efficiency parameter that controls the increase in labor given the technological change. That is, the main effect of military spending on the economy is the increase in technology.

Neoclassical models for the analysis of military expenditures and its impacts on economic growth have the advantage of allowing the development of consistent formal models for empirical analysis. However, in general, the school provides models of static allocative efficiency, which are visibly limited by not considering historical and dynamic aspects, as well as concentrating excessively on the supply side, "ignoring the internal role of the Armed Forces and their interests, supposing the existence of a national consensus and requiring extreme knowledge and unrealistic cognitive abilities of rational actors" (Dunnes 2000, 5).

In an important and provocative contribution, Emile Benoit (1973) pointed to a positive association between military spending and economic growth for forty-four developing countries during the period 1950-65. In these cases, higher defense spending as a proportion of the Gross Domestic Product (GDP) may have fostered economic growth (measured by the growth of civilian output) for these countries. According to Hartley and Sandler (1995), Emile Benoit's controversial studies have prompted research with the most different theoretical approaches to the economy in order to find flaws in its methodology or to apply other analytical models to study the same cases.

Briefly, these models were focused on the supply side[4], the demand side[5], or a combination of both. Hartley and Sandler (1995, 215) argue that most models focused on the demand side found negative impacts of military spending on economic growth given the competition of defense resources

4 See Hartley and Sandler (1995, 204-8) that supply-side explanations of the relationship between defense and economic growth derive from the aggregate production function. From the most macro level, national income or output, Y, can be expressed as a function of resources and technology Y = F (L, K, Tc), where L is aggregate labor, K is aggregate capital, and Tc is the technology index (Deger and Smith 1983). Based on this basic equation, models (Mueller and Atesoglu 1993) studied scenarios of military technology incorporated or not in available resources and focused on the study of differentiated productivities and externality networks between private sector, non-military public sector and military sector (Ferder 1983; Ram 1986; Biswas and Ram 1986).

5 Demand-side models are based on Keynes's representations of aggregate demand, where income, Y, or potential output at full employment, Q, is the sum of components of real demand for goods and services, i.e.: Y = QW = C + I + M + B, where W is the gap between current and potential output, C is aggregate consumption, I is public and private investment, M is real military expenditure, and B is the trade balance. Some models are applied by Deger (1986), Faini, Annez and Taylor (1984) and Lebovic and Ishaq (1987).

with other investments. The main studies corroborating these analyzes are Deger (1986), Deger and Smith (1983), Lebovic and Ishaq (1987) and Scheetz (1991). However, when the supply-side approach is employed, military spending can have a positive influence from spin-offs and positive externalities. More than that, in studies with developing countries, the effects on productivity were positive. Overall, supply-side studies find that military expenditures have a small positive effect or almost no externality effect of economic growth.

As Hartley and Sandler (1995, 2020) put it, while individual studies of the impact of military spending on economic growth have apparently controversial results, one can still see some strong consistencies. While demand-based models tend to verify the crowd out phenomenon and the negative impact on growth, supply-side models almost always have a positive or neutral impact. Thus, the positive or negative relationship between economic growth and military spending cannot be confirmed. However, it has been shown that technology involved in defense-related business processes can contribute to the development of a country. Therefore, in the next section we will focus on the debate on the relationship between military and civilian technologies in the dynamics of a country's technological development.

Military Expenditures and Technological Development

It is important to distinguish between types of military spending and their impacts. Dumas (2004) argues that military spending is a broad concept, which can be divided into Operations and Maintenance, which includes the payment and operational support of the military serving the Armed Forces; And Acquisition, which includes purchases of domestically or overseas weapons systems and R&D services. Both types of spending consume financial capital, but acquisition has a much greater effect on the allocation of key industrial and technological labor assets and physical capital (Dumas 2004, 23). It is from the designs designed for military acquisitions that the effects of spillover, spin-off and spin-on were supposed to occur.

Bohn (2014) states that the terms spillover and spin-off are often used interchangeably in the wrong way. In a synthesized way, the term spillover deals with the general externalities of military projects, while spin-off would specifically be the overflow of technological results from the military to the civil sector of the economy, and spin- On would be the reverse, that is, civilian technologies being converted for military purposes.

As Walsh (2009) points out, the conception that spillover and spin-off processes would occur from public investments in the defense sector began in the US after World War II. Among the examples often referred to as

spin-off in general terms are the use of nuclear energy, space technology for communications, meteorology and cryptography, as well as products such as radar, transistor, microwave oven, Teflon, GPS, medical laser, internet and cell phone.

Although the spin-off, spill-over and dualization processes of technologies are defended as models of development and support of the defense industry of several countries (Walsh 2009), authors such as Dagnino (2010) point out that they are used as elements of an ideological construction to defend exacerbated military expenditures that find no support in academic studies. That is, the idea of spin-off which, according to the author (2010, 153), was a real and observable phenomenon in the post-Second World War soon became the spin-off paradigm, Ideology conceived and used by the US to justify and promote the expenditure of vast resources for the military R&D necessary for latent confrontation with the Soviet Union. According to Dagnino (2010, 103),

> disclosed by the establishment of the central countries, but criticized by eminent scientists and by sectors of society, the idea of the spin-off has been the subject of intense debate in the academic institutions, military and government decision-making bodies of these countries (...) studies conducted in advanced countries, even following different disciplinary approaches, have shown undesirable implications of military R&D for the civilian research system. With a macroeconomic and temporal approach, some of them have called attention, through empirical research comparing time series of expenditures in military R&D and public budget for research, that the former has not behaved as an additive variable, but as an expense that tends to be deducted from the total amount applied.

Thus, Dagnino (2010) points out that the idea that the spin-offs of the production of weapons systems would generate economic and social benefits, as well as the belief that the diffusion of the technologies produced in the military to the civil sector would be a natural flow and that it would be possible to adapt them with minimum effort for applications in the civil industry is very controversial. In view of this conception, justifying military expenditures based on economic and technological gains would be impracticable.

We consider that the processes of spillover, spinon and spin off are not automatic and do not follow a natural flow. They need to be stimulated by policies that take into account issues such as intellectual property, financing, technological absorption capacity and product marketing potential. Besides that, in general, the gains in technological development are not necessarily in the conversion of the final product of military R&D into civilian applications,

but in the whole process of basic and applied research and the training of a supply chain of components and subcomponents that was necessary to create the final product.

The separation between civil and military technologies is not so clear when we look at their process of design and development, and not just their application. It is common to imagine revolutions in military technologies as independent processes of society, somehow separable from human activity from non-military spheres. There is analytical value in assuming that there is a defined military sector in society, but much more can be harnessed if we think in terms of the fundamental and extensive links that connect this sector to the technology of the civil sector. Despite their distinctive features, frequent changes in military technologies need to be seen not as something separate, but as an integral element of a broad revolution in science, technology, and the human condition as a whole due to the emergence of the industrial age, and now of the age of information technology (Buzan and Herring 1998).

Buzan and Herring (1998, 21) state that in all eras, civilian and military technologies have been very close. The proximity of civil and military technologies during the nineteenth century is evident both in terms of the common body of knowledge that underlies them and the numerous overlaps between the civil and military applications of these technologies. During the nineteenth century, knowledge of metallurgy, engineering and design techniques that generated the revolution in firearms was the same knowledge that produced ever more efficient steam engines for mining, shipping, railway machinery, and the civil sector industry. Similarly, knowledge in chemistry that has developed more efficient explosives is also closely linked with the knowledge that underpinned the flourishing industry of civilian-bound chemicals ranging from fertilizers to pharmaceuticals. In both cases, as in many others, the knowledge and skills that produced revolutions in military technologies were almost indistinguishable from those that served civil purposes.

Nowadays, the advent of large-scale digitization[6] tends to further blur the frontier between military and civilian technologies. Generally, in the military area, the digitization is called Revolution in Military Affairs (RMA), addressing the incorporation of communication and information technologies and the advancement of situational awareness in the spheres of strategy, operation and tactics. However, Martins (2008, 7) criticizes the denomination of RMA by focusing too much on the confrontation between armies, not

6 According to Martins (2008, 7), "digitization is the process by which a certain data (image, sound, text) is converted to binary format to be processed by a computer. On a military level, digitization refers to the confluence between radar, infrared, laser and high-power microwaves".

between societies. That is, by clearly separating the military sector from the civilian. According to Martins (2008, 7-8),

> if we consider the definition of Clausewitz, for which war is a confrontation between societies and not just between armies, this usual terminology (RMA) becomes anachronistic. The idea of talking about a revolution only in "military matters" loses the dimension of the impacts of digitization on the civil economy, which is reflected in the technological convergence between the television, the telephone and the computer, which operate on the same network and on a common hardware basis. The change brought new standards for material production, for business management, and for leverage and business financing. Hence the use of the simpler and more precise digitization (instead of RMA) to account for the systemic character of the ongoing change.

The conception that the processes of military and civilian technological development are closer than they appear is relevant to understanding the role of military spending in technological revolutions that influence economic development. The idea of evolutionary processes and technological revolutions is introduced in theoretical thinking on economic growth by Joseph Schumpeter (1961). In the Schumpeterian view, technological change is the central element of capitalist dynamics and the microeconomic level, that is, of the firm, would be at the center of this innovation process. The phenomenon of development is more revolutionary than incremental, as economic cycles are changed once and for all by the innovations and technologies introduced. Unlike the neoclassical view, Schumpeter argues that development driven by new technologies does not generate uniform impacts on operating results and nor are productive factors easily absorbed by all actors involved in the market. That is, technology creates inequalities and hierarchy of capabilities.

However, in his works, Schumpeter considers technological innovation as an exogenous variable to the explanatory model, as well as broader socio-institutional factors. Carlota Perez (2007) seeks to advance the understanding of the role of institutions and innovation as an endogenous variable to the model, arguing that the causal factor of the cyclical character of capitalism stems from the asymmetrical effect of technological revolutions on the economic (more changeable) and socio-institutional (more difficult to change) spheres. That is, there is opposition between the dynamism of technology and the conservative and stable character of institutions. Thus, in order to deal with the characteristics of long-term technological cycles, "she creates the concept of a 'technical-economic paradigm', which encompasses the two dimensions of change (technical-economic and socio-institutional) and

whose creation depends on institutional framework to the new technological reality" (Muller 2009, 43). In the table below, we can verify the five technical-economic paradigms of Perez and the countries that led the technological cycle.

Table 1 – Technical-economic Paradigms of Carlota Perez

The "Big Bangs" of the technical-economic waves of Carlota Perez (2002)				
Technological Revolution	Popular name of the period	Country or central countriestries	Big Bang	Year
First	The "Industrial Revolution"	Great Britain (GB)	Arkwright mill	1771
Second	Vapors and Railways Age	GB (spreading to the mainland and the USA)	Test of the "Rocket" locomotive	1829
Third	Steel, Electricity and Heavy engineering Age	USA and Germany surpassing GB	Bessemer Steel Plant of Carnegie	1875
Forth	Oil, Automobile and Mass production Age	USA, German competition, expanding around the world	Launch of the Ford-T model	1908
Fifth	Information and telecommunication Age	USA, expanding to Europe and Asia	Launch of Intel's first commercial microchip	1971
Source: Bueno (2009) based on Perez (2002).				

The ability to enforce decisions on technological innovation is a fundamental part of a country's development and international insertion. It is worth pointing out the Brazilian case, according to Muller (2009, 43):

> the paradigm of steel and electricity, which began in 1875, corresponds to the Brazilian enthronement of the steel industry. The petroleum and automobile industry, which began in 1908, corresponds to the enthronement of fine chemistry in Brazil from the 1950s. Since 1971, this strategic challenge of development has been embedded in the information and telecommunication paradigm, which includes chips, microelectronics, computers, softwares, fiber optics, semi and superconductors, etc. Such a context corresponds, therefore, to the field of digitization, since the digital computer is the "node" that serves as the nucleus of communication networks.

For a country not to be left out of the development of the technical-economic paradigms that dominate the international dynamics, it is necessary to create institutional mechanisms that take care of the economic challenges. It is in this sense that Celso Furtado's (1962) concept of the "Decision Center", one of the founders of the CELAC school, becomes fundamental

to understand the process of endogenization of economic and technological development. This idea is understood as the capacity of the State to manage, as it suits, its own economic development from the control of the productive technologies and techniques nucleating of a certain stage of the economic development. That is, it is related to the political-institutional and social mechanisms created to consolidate the capacity of a country to make decisions regarding its own development in a new technical-economic paradigm.

According to Oliveira (2012, 29), "the control of decision-making processes at the national level is in opposition to cases in which decisions regarding the economy and productive activities occur abroad, that is, decisions made by foreign actors who do not necessarily share development interests and objectives of the country". For a country to be able to plan and execute a national development project and thus achieve some degree of strategic autonomy that allows for a sovereign international insertion, it is necessary to nationalize the Decision Centers of the current technical-economic paradigm, which is, digitization.

It is within the domain of the digitization Decision Center that the modernization of the Armed Forces through parts of the national defense industry is strategic and structuring, both for the sovereignty of a country and for its economic development. Given that defense is a public good that the State has as its fundamental function to provide and, therefore finds sufficient legitimacy to act strategically from the promotion of robust policies, it can be used as a way of enthroning the digitization Decision Center. We agree with Martins (2008, 15) when the author states that

> digital military capabilities in the state-of-the-art (through the acquisition of systems, transfers and nationalization of technology) restructure the state physically and allow the recovery of the economic decision-making center. Digitization today is equivalent to the national strategy, which, in due course, was the acquisition of the decision-making center for steel, fine chemicals and nuclear energy. In short, the recovery of the operational capacity of the armed forces matters for all socioeconomic development. Digitization entails a growing instability in the international system which, by creating local war threats, engenders as a systemic response to military investments. If, instead of acquiring military equipment abroad, opting for native production, these investments can endow the regional powers with the decision center (semiconductors and superconductors) that are the nucleus of the contemporary economy.

The defense industry can be considered one of the pillars for the enthronement of the Decision Center of the digitization from three central

points. First, dual technologies dominate the digitization dynamics, given the presence of semiconductors and superconductors in most civilian equipment and weapons systems. The good synergy between dual-use technologies allows the dilution of research investments between civilian and military areas that bring the country closer to control of the productive processes of the nuclear technologies of the Decision Center.

Second, many critical scanning technologies are denied by those who master them, both for civilian and military purposes. Space technologies are a clear example, since it is common for subsystems and components that will compose a space project for civil purposes (eg, commercial communication, remote sensing and tracking) to have your sale banned with national security justifications. Thus, the technological restraint from the military perspective also impacts on the civilian sectors. Therefore, the measures that the State can take to overcome the technological constraint will impact on both dimensions. Once the state can manage the technological restriction from international partnerships, the specificities of defense make possible certain business arrangements that would not be possible in commercial sectors. As Brick (2016) puts it, "defense investments are immune to trade retaliation within the WTO (World Trade Organization), unlike other government R&D investments"[7].

Third, the State has the legitimacy to act as a promoter of the development of this industry. In historical cases, the State has played a strong role in the defense industry without much questioning about its economic intervention, especially regarding the establishment of the Science, Technology and Innovation (ST&I) infrastructure necessary for its development. Mariana Mazzucato (2014) argues that the US experience of technological development to win wars was only possible thanks to state initiatives. Moreover, according to Brick (2016), specific industrial and technological policies for defense

> do not burden the country's economy because the entire cost is 100% scaled and contained in the defense budget. The society does not pay for this as in past market reserve policies such as information technology and local content in the oil industry, which generate costs for consumers, cost increases and delays in investments, without developing and creating an industrial and technological capacity for the country[8].

7 cInterview of July 26, 2016, available at http://defesaeseguranca.com.br/entrevista-engine--de-de-esa-de-de-esa.

8 Interview of July 26, 2016, available at http://defesaeseguranca.com.br/entrevista-engine-de--de-esa-de-de-esa.

Thus, given that "the development of a strong national defense depends on a robust national scientific-technological structure, and the strengthening of this structure depends on state induction, the State has the greatest responsibility for the development of defense-related ST&I and consequently, for the strengthening of the IDB [Industrial Defense Base]" (Andrade and Franco 2016, 18).

Therefore, we consider that the Defense Industry's impacts on economic and technological development cannot be fully understood from conceptions that focus on the causal relation or correlation between military spending and economic growth strictly, but rather as a central variable in the control of Decision Centers referring to the technical-economic paradigms that govern the long-term technological transitions.

Defense Industry and Industrial Policy

For the defense industry to play its role in the endogenization efforts of economic decision-making centers in the country, the industrial and technological development of this sector must be coherently inserted in the Great Strategy[9] of the country. In addition to the application of power resources, the Great Strategy deals with the development and allocation of these resources (Layton 2012). In this sense, the ability to master critical technologies of the digitization era in the IDB is fundamental to guarantee the maintenance of military power and to aspire leadership positions in the international system.

The current international scenario did not keep up with the expectations of the end of the Cold War, where it was thought that a lasting model of peace promotion would have been achieved from the hegemony of a superpower. The increasing polarization of the international system (Huntington 1999; Amin 2006) has led to tension between the United States, Russia, China and some regional powers to new theaters and spheres of conflict, contesting strategic positions around the world and systematically making "use of its military power as an instrument of political pressure, now reinforced by new cybernetic and aerospace technologies" (Filho and Moraes 2012, 14).

In this unstable scenario, the digitization of military technologies and the modernization of the world's Armed Forces bring challenges to countries that wish to maintain an autonomous capacity for maintaining sovereignty and that seek to enter strategically into the international order (Martins 2008). According to Filho and Moraes (2012, 15),

9 On Great Strategy, see Gray (2011); Brands (2011); Hoffman (2014).

> it is precisely in the technological field that the greatest transformations of the armies are perceived. Military power based on the number of means and personnel gives more and more space to smaller and more flexible defense structures, but with high operational capacity, due to the continuous improvement of the means of combat. These new configurations require, in turn, increasing investments in technology and the preparation of human resources capable of operating integrated defense systems. The process of combination and interoperability is also intensified, leading to the need for convergence of the plans and doctrines of the three forces (Army, Navy and Air Force). Finally, frequent cyberattacks, destabilizing civilian and military control systems across nations, as well as the risks posed by the "militarization of space" in the context of a world increasingly dependent on satellites, point not only to threats but also necessary paths for the future progress of military technology.

The development of military technology and the ability to industrialize it to the point of mobilizing sufficient material means to respond to an external threat in medium- and long-term conflicts is essential for the international strategic insertion of a country that intends to become a global player. Military Power only gains concreteness in its material base, which is built and/or maintained by the Industrial Defense Base. The strengthening of an Industrial Defense Base (IDB) is intrinsically linked to the autonomous defense capability of a State, since it has the industrial facilities and technological know-how capable of effectively producing and using the goods needed for National Defense, it ensures a key element for mobilization and response capacity. In this way, the IDB ends up being the central pillar guarantor of an active and sovereign diplomacy. According to Melo (2015, 26),

> an independent and universal foreign policy has as a necessary complement a robust defense policy ... and an essential element of a robust defense policy is an Industrial and Technological Defense Base capable of equipping the Armed Forces. Its structuring and strengthening is a strategic priority for a country such as Brazil, which, in addition to possessing a considerable amount of strategic natural resources that it needs to protect, is seeking an active insertion in the international political and economic scenario.

The creation of an IDB represents a major challenge for emerging countries, since Science, Technology and Development is an arena of power struggle in the international system, especially when it refers to military technologies, a reflection of a closed and competitive defense market, restricted to

transfer of technology (Moreira 2016). Given the sensitive nature of technology[10] that military technology inherently possesses, technological restraint[11] is a standard practice in international trade in military systems. Thus, the State must consider in its foreign policy, defense policy and development policy (especially industrial policy) ways of dealing with the challenges related to technological development and the industrialization of military solutions from a robust and consolidated national defense industry in order to reduce its external dependence on sensitive technologies. According to Brick (2009),

> [m]odern defense products are severely restricted for acquisition on the international market and, when available, never match what is most current and / or effective in dealing with contemporary threats. Thus, in order to guarantee its sovereignty and its interests, no country, wishing to be a relevant actor in the international system, could dispense with a technological-scientific-industrial complex capable of supplying its armed forces with the defense products needed to deal with threats that may be presented by any other countries.

Therefore, we consider that the Defense Industry is strategic for any country that wishes to maintain its sovereignty and its autonomy in the 21st century and is a key variable for the composition of National Power (Tellis et al. 2000). Thus, "State support to defense industries is strategically justified because a developed IDB enables the State to master its own technological capabilities, giving it additional power in the international system" (Mota and Rodrigues 2012, 3).

The IDB is also important in its aspects of economic and technological structuring, "which are related to the domain of sensitive technologies, many with a dual character, and to the generation of innovation, high-skilled

10 According to Longo (2011), sensitive technology refers to technologies of a civil or military nature whose particular group of countries or country perceives that it should not be passed over for an undetermined period, reportedly for reasons of national security.

11 According to Amarante (2013, 80-82), "the practice of technological restraint (...) is a set of judicial measures usually taken by developed states against developing or emerging states, in order to avoid access to sensitive technologies. (...) The policy of not obtaining, pure and simple, prevents access to sensitive knowledge, already dominated and exploited by a select group of countries. It is a blockade that removes the needy from the benefits of science, technology and innovation, provoking the widening of the technological gap between those who know and those who do not. Summarizing and emphasizing, the leading countries in scientific, technological and innovative development have practiced the explicit restriction of third parties to the access to technologies that, unilaterally, they consider sensitive. For example, the areas of study considered sensitive by the United States, listed in the Technology Alert List (TAL), issued by the US Department of State. When violated, the foreclosure may or may not be accompanied by retaliation, mainly of an economic nature".

jobs and exports with high added value" (Melo 2015, 26). As we have already pointed out, the IDB is a possible strategy for the endogenization of the Decision Center of the digitization era.

For the State to act in a transformative way in the industrial material of a country, it is necessary condition to develop a robust industrial policy. It is in this sense that the public policies focused on the development of the IDB must be aligned with the broad industrial policy of the State. Industrial policy is an instrument of economic intervention by the state, whose objective is to change the market status quo, conforming the behavior of economic actors from incentive mechanisms, conditionality, restrictions and prohibitions for the purpose desired by policy makers.

Shapiro (2014, 242) points out that there are two main approaches that inform the logic of the Development Policy and the regulatory action of industrial policies: i) the vision of market failures, whose main attributes are the hypothesis of market primacy and static evaluation of their competition process, and the type of intervention that the State can undertake is the correction of failures horizontally (without the choice of sectors) to level market conditions and allow economic agents to maximize existing efficiencies; and ii) the structuralist-evolutionist view, in which the State can institute and shape the economic environment and its instruments serve to "change the existing economic allocation towards another pattern of productive specialization, more inclined to incorporate innovation and technical progress" (Ibid., 243), that is, the structural-evolutionist industrial policy seeks to prioritize sectors capable of diffusing innovation, purposely creating an asymmetric economy between different sectors.

Cimoli et al. (2007, 68) point out that industrial (structural-evolutionary type) policies and the institutions developed to conduct them affect jointly

> i) the technological capabilities of individual and corporate organizations, and the pace at which they can learn; ii) the economic signals perceived by them (including, of course, the signs of profitability and perceived opportunity costs); (iii) how they interact with each other and with other non-market institutions (such as public agencies, development banks, training and research entities, etc.).

We agree with the authors when they say that

> It turns out that all major developed countries currently have relatively high degrees of intervention whether consciously conceived as industrial policies or not which affect all of the above variables. And this applies even more to the period when today's developed countries were seeking to

> match the international leader of the day. What primarily distinguishes the various countries are the instruments, the institutional arrangements and the philosophy of intervention (Cimoli et al. 2007, 68).

Thus, in order to induce a structural and innovation-oriented transformation, especially in such a strategic and competitive sector and requiring constant innovation as the defense industry, it is a necessary condition for a structural-evolutionary industrial policy to establish instruments and institutional arrangements that are aligned with this type of industrial policy. In order to implement and execute a robust defense industrial policy it is necessary to create the political and institutional conditions to coordinate and process the various actors and interests involved in the conduct of public policy (Evans 1995; Rodrik 2004). Therefore, the endogenization strategy of digitization through the defense industry requires an emphatic State action through industrial policies that establish guidelines, institutions and instruments aimed at the promotion of the sector.

Conclusion

This article had as its main objective to discuss the theoretical debate that involves the relation between defense and development. The implications of this debate are embodied in ideological positions and public policy choices that influence public spending on defense and the acquisition of new systems. In this way, we tried to emphasize the approach that points out that military spending is more related to technological development than to economic growth.

The promotion of the defense industry is a viable strategic choice for a country to be able to endogenize the technologies of digitization and thus nationalize the necessary means to be the protagonist of its own development. The State, as a legitimate monopolist of the use of force, has the legitimacy to establish robust policies that guarantee the material supply for its defense. Based on this premise, it may be through defense industry development policies that the state is enabled to intervene in the industrial and technological fabric of the country without being accused of excessive interventionism.

Therefore, the formulation and implementation of industrial policies aimed at strengthening the defense industry are instruments for the technological development of the country and with the potential to implement critical technologies for significant transformations in the industrial fabric. Therefore, it is fundamental for the advancement of studies on the defense industry, research that is dedicated to understanding the design of industrial

policies and the institutional arrangements structured to formulate and implement them.

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ABSTRACT

The main objective of this article is to expose the debate around the relationship between military spending and economic development, as well as between defense industry and technological development. With this in mind, we have explored literature from the classical school of economics through to Marxist, Skeletal, Schumpeterian and Neoclassical writers. We argue in this paper that the strengthening of the defense industry, through a robust and focused industrial policy, is a viable strategy for the endogenization of critical technologies central to the domain of the paradigm of development of the digitization. This strategy demands the construction of a robust industrial policy focused on the development and strengthening of the national defense industry. Therefore, it is necessary to advance the research agenda of institutional arrangements and governance focused on this sector.

KEYWORDS

Defense Industry; Development; Industrial Policy; Military Spending; Defense Economy.

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