

**BRAZILIAN'S AEROSPACE INDUSTRY VIS A VIS COMPETITION:
FALLING-BEHIND? A LEAST PROBABLE CASE ANALYSIS OF
SECTORAL DEVELOPMENT.**

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Resumo: A indústria aeroespacial brasileira é considerada um caso de sucesso e adaptação a novos ambientes econômicos. No entanto, quando considerada em relação aos concorrentes, a indústria fica para trás. Há três principais motivos: i) a política macroeconômica das últimas décadas, que privilegiou a desvalorização da moeda, altas taxas de juros e, conseqüentemente, baixo investimento; ii) O Brasil possui, de acordo com os principais indicadores, um ambiente de inovação pobre, que não coevolui com as necessidades do mercado, nem com um bom desempenho das políticas públicas; iii) Por fim, os gastos militares e a estrutura de tomada de decisão no Brasil agem contra a formação de uma BID adequada, com a maioria dos recursos consumidos por pessoal e com pouca participação da sociedade civil. Índia e Turquia, apesar de problemas que serão abordados, adotaram uma estratégia diferente, com altas taxas de investimento e a priorização dos gastos militares em aquisições.

Palavras-chave: Economia da Defesa; Brasil; Índia; Turquia; Base Industrial de Defesa.

Abstract: Brazilian's Aerospace industry has always been considered a case of success and adaptation to new economic environments and technologies. However, when considered in relation to competitors, the industry is lagging behind. I argue that this has a threefold explanation: i) the perverse macroeconomic policy of the last decades, which privileged devaluation of the currency, high interest rates and, by consequence, low investment ii) Brazil has, according to main indicators, a poor innovative environment, which does not coevolve with market necessities, neither good public policy performance; iii) Finally, military expenditure and the structure of decision-making in Brazil acts against a formation of a proper Defense Industrial Base, with most resources consumed by personnel and with little participation from civil society. India and Turkey, despite problems that will be addressed, adopted a different strategy, with high rates of investment and the prioritization of military expenditure in acquisitions.

Key Words: Defense Economics; Brazil; India; Turkey; Defense Industrial Base.

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INTRODUCTION

Is Brazilian Aerospace industry falling behind or catching up? Albeit most authors hold that Brazilian's aerospace sector is a case of success, I argue that while compared to others sectors of the Brazilian economy it has shown remarkable results, it is still structurally tied to economic and political factors which compromise Brazil's industry. The sector must not be considered an exception to the phenomena of deindustrialization², *reprimarização*³, export-oriented currency depreciated strategy and poor levels of investment. In an international system, distribution of capabilities is *relative*. Brazil is losing important assets and the control of strategic components to other countries which have gathered ways of mobilizing resources effectively. Evaluating strategic sectors can provide important clues for explaining this phenomenon. Here, I argue that the first reason is the macroeconomic recent history of the country, which is "trapped" in a vicious cycle. There is a poor innovation environment as well. Thirdly, political elites, and in the case of aerospace industry, military elites, do not reach a sufficiently stable consensus to invest in the long run. Large projects demand state policy and not only government policy. This is the main "independent variable" which makes a successful case and prospects of promising new projects fail. Choosing the *least probable case* is methodologically valid to demonstrate that most sectors are embedded in this scenario. In order to establish proper parameters and evaluate the sector in relative terms, I will use the comparative method. Indian and Turkish aerospace industries are analyzed vis a vis the Brazilian aerospace industry. The first part is dedicated to the macroeconomic vicious cycle I argue Brazil is following and its lack of an innovative system. Then I briefly expose the Brazilian aerospace sector in order to compare it, in the final section, to India and Turkey. If Brazil has ambitions of becoming a regional leader or a global player, the aerospace industry can work as a solid path.

MACROECONOMIC AND INNOVATION FOUNDATIONS

Innovation is a highly risky endeavor. Failed attempts are very common and will result in major losses in R&D and other costs. There is no way, as an investor, for example, to accurately predict the cost and market performance of a new artifact, and the demand for it. Experimentation and understanding are, thus, inherent to the attempt to innovate. Products may turn out to be technically difficult to manufacture

² Ver: Bacha, Bolle (orgs.); Barbosa, Marconi, Pinheiro, Carvalho (orgs.)

³ The return of the economy to the production of low value-added commodities.

or fail to consider often elementary user requirements (Forrest 1991). Commercially unsuccessful projects often account for a disproportionate share of corporate R&D spending (Griliches 1991).

To achieve the technological frontier and benefit from the advantages of high aggregated value in global chains, however, demands innovation. Innovation, when successful, is highly lucrative. Innovation gives extraordinary profits in turn of appropriability, as demonstrated by a neo-Schumpeterian perspective. Brazil does not have, however, a proper environment for innovation. Innovation is costly, systemic, adaptive and contingent. Innovation processes are contingent because they differ in many forms according to the country, field of knowledge, economic sector, type of innovation, many firm-level variables, and corporate and institutional strategies (Pavitt 1984). Links among different sectors are formed due to specialization and the growing knowledge-based economy, which reshapes the innovation process, and creates networks between different sectors and institutions (Nelson 1993; Dosi 1982; Metcalfe 1998; Lundvall, 1993; Lundvall and Johnson, 1994). In this sense, Brazilian's aerospace industry managed to adapt, forming a innovative cluster and reaching a duopoly with Bombardier in regional jet lines. However, evolution is an ongoing process and the variables that dampen innovation in Brazil can have a huge impact on its aerospace industry.

In this paper I work with the Aerospace industry, a highly innovative R&D intensive industry, which players have to adapt and innovative constantly to maintain themselves in the market. The only other option is selling obsolete products to their own government. The aerospace sector is a military and economic strategic industry. As argued by Hartley (2014), in the military-strategic sphere it provides vital equipment to defense, such as jets, helicopters and bombers. The question arises if it is domestically supplied or bought *off-the-shelf*. It is viewed as an economically strategic industry which is regarded as more important than others to national economic development. They are high technology and R&D intensive industries with technical spill-overs (external economies) to the rest of the economy; they are cost decreasing industry reflecting scale and learning economies. Furthermore, they are associated as dominant in international trade. States will be involved in strategic rivalry supporting their national champions (e.g., Embraer; Avibras⁴). Long-term funding is also an aspect of a strategic industry (e.g., Finep, BNDS, PAC).

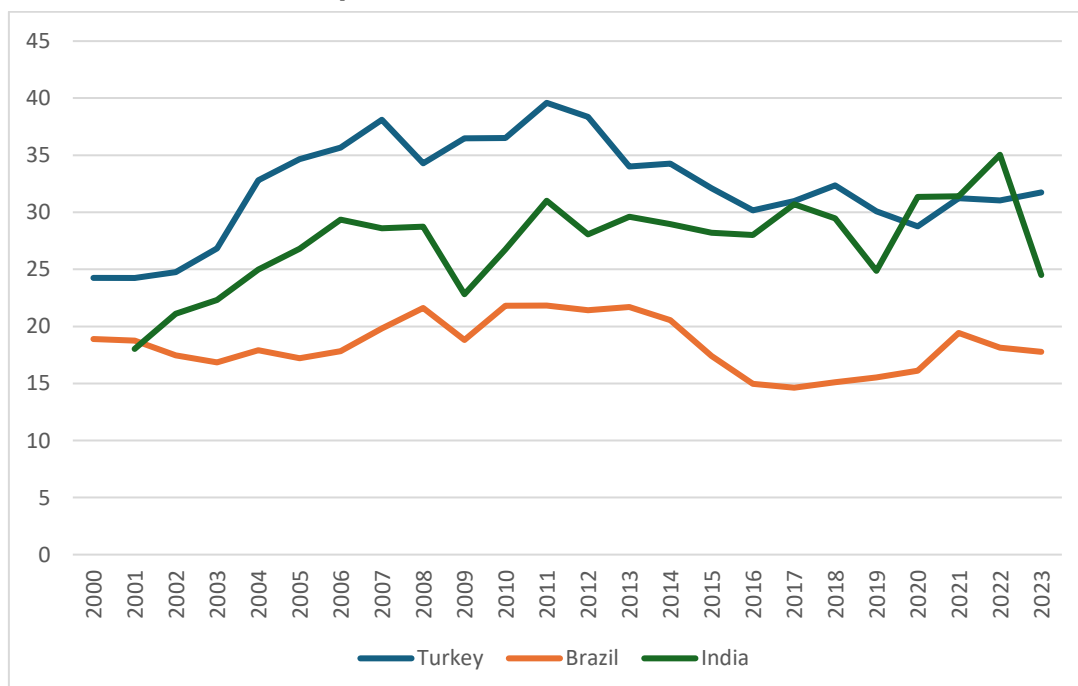
The "market shock" which followed the Brazilian dept crises of the 1980's resulted in a major failure of many industrial segments. Industry participation in GDP fell greatly (Graph 2). Few firms adapted to the new neoliberal order. This was the

⁴ Avibras was recently sold to an Austrian firm.

case with Embraer and other sectors such as Cellulose, since they were built in solid foundations and prepared to adapt to the new environment. Considered a case of success and adaptation, mainly through its anchor company, Embraer, Brazil is seen as an example of pushing the technological frontier in terms of competitiveness and integration into the global production chain of the sector (Amman, Cantwell, 2012). With regards to national defense, the cluster of São José dos Campos and the development of projects such as the KC-390 are considered strategic for the formation of the Brazilian Defense Industrial Base (Brazil, 2012; 2020). However, it is argued that the sector may also be threatened by the loss of competitiveness in the Brazilian industry, a fact that can be observed in the analysis of other countries that are excelling in the sector such as South Korea, India, Turkey, Japan, among others.

I argue here, however, that the trend in Brazilian economy will also eventually have a negative affect its aerospace industry and, since in strategic sectors what matters is relative material capabilities, Brazil will lose space to its competitors. With high interest rates and a depreciated currency, with a mandatory budget of large proportions and powerful bureaucracies, it is hard to maintain an investment rate. As Graph 1 shows, the other countries that I compare Brazil are far ahead in the time series in terms of investment. As it will be argued, certain kinds of investments have a multiplier effect that cannot be ignored.

Graph 1- Investment rate as % of GDP



Source: IMF. Author.

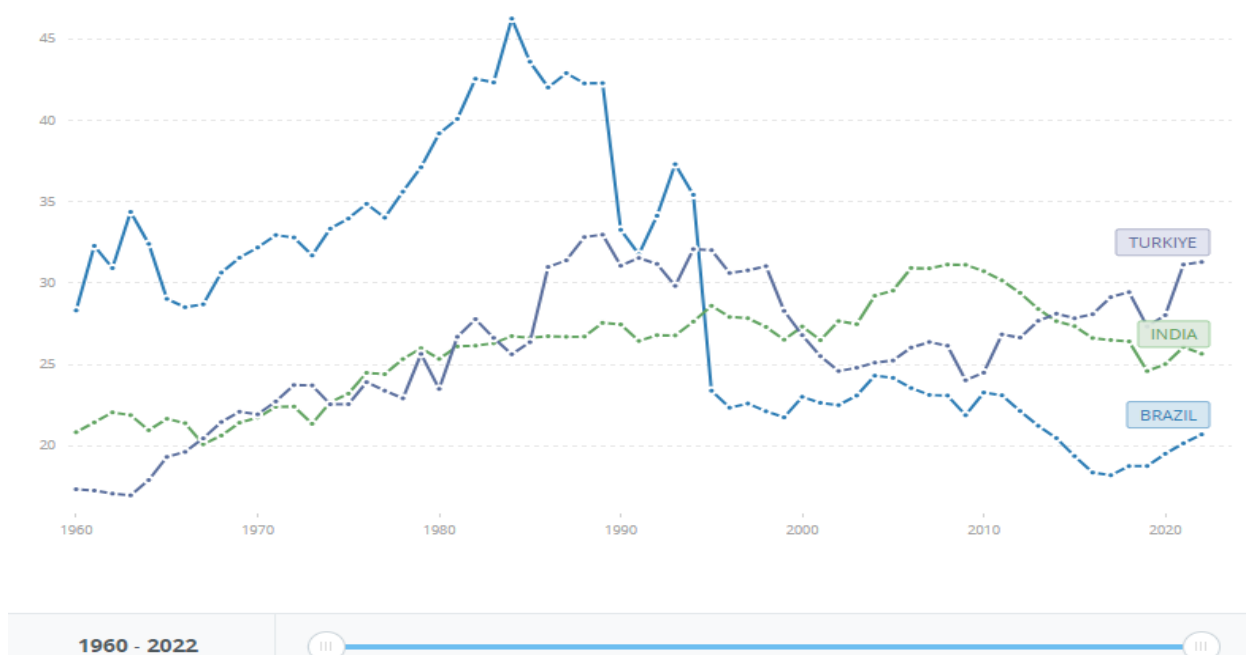
Not all investments have the same effect on the economy, and particularly on its industry. Multiplier effects diverge based on the type of investment. Investment, as argued here, must be channeled through a solid and interconnected National System of Innovation (NSI), since the case treated is in a highly innovative e technologically advanced industry. In a National System of Innovation (Freeman, 1987), actors interact and reinforce each other, such as firms, universities and government, creating thus, a successful innovative environment.

In the aerospace sector, research on innovation demands an analysis of sectoral idiosyncrasies (Malerba, 2006; Pavitt, 1984). Defence products are subject to the political-strategic imperative of the State. Elements such as the strategic direction of defence policy, the share of investment and R&D in the defence budget, funding mechanisms, and incentives for innovation in defence and industry in general (Fagerberg, Godingo, 2006) are crucial. It is argued that there is no synergistic, systemic, and long-term political environment and direction for the success of the sector as a whole in terms of national defense, except for specific projects. Other industrial vectors for success in terms of national defense and innovation, such as the development of fighter jets, VTOLs, aero mobility, and anti-aircraft defense, still require Brazil to make an autonomous catching-up effort that may already be compromised in the medium term. This argument is based on the reasons of the macroeconomic variables outlined below.

Brazil is gradually undergoing a process of deindustrialization, with low investment rates and a lack of policies focused on ST&I and R&D. For sectors and projects with a long-life cycle, the opposite is necessary. The innovation fruits reaped by some products from Embraer and companies that partner with it (e.g., Ael Sistemas, Aerotron, Eleb, and LhLocus) date back to decades of intrafirm collaboration, funding channels, investment in R&D, and infrastructure. The sector is also affected by a cycle of macroeconomic stagnation.

It is argued that Brazil has been prioritizing the option of exporting with competitiveness based on price rather than value-added to the product. Currency devaluation and inflationary pressure lead to a restrictive monetary policy and reduced investments. This logic fuels deindustrialization. In Brazil, the manufacturing industry and construction sector have a multiplier effect close to 2 and are linked to periods of growth, whereas simple resource transfers, depending on the relationship with public debt, have a multiplier effect of less than 1.

Graph 2- Industry Participation in GDP%



Source: IRBD. The Author.

Fall of industry as % of GDP is a global phenomenon (excluding Asia). But there is a sharp difference between developed countries, which provide high value services and the commodity driven economies of the global south. In the Global Innovation Index (GII), Brazil ranks 62nd among the 131 countries analyzed. The index is composed by approximately 80 indicators (WIPO, 2020). The GI shows that Brazil ranks 106th in ease of starting a business; 108th in general infrastructure; 118th in gross capital formation as % of GDP; 103rd in weighted applied tariff rate; 93th in productivity growth (PPP\$ GDP/worker, %); 105th in credit and 94th in ease of getting credit. This clearly demonstrates an unfriendly environment for business and for competition (and therefore for competitiveness). Exchange rates have devalued steadily since 2015 with the R\$ (Real) accounting for 0,30 \$ in 2015 and 0,20 \$ in 2020 (IMF, 2020). This further increased deindustrialization, as industry participation in the GDP fell from 48% in 1985, to 25,6%, 22,5%, 20,4% in 1996, 2015 and 2020, respectively (CNI, 2022).

As argued, this is in no matter specific to the aerospace industry, as it is treated as the *least probable* case and still has success in projects like the cargo KC-390, medium size passenger jets, among others. The problem is structural and it derives from a public choice of priorities. Brazil's industry participation was

surpassed by Turkey and India in the 1990's neoliberal shock, and by 2021 were 31.1% and 25.9% respectively. Turkish industrial production advanced from 44% of Brazil's industry to 91% in 2019. As for India, it surpassed the total of Brazilian industrial production in 2006 and in 2010 grew to 124%, with a continuous relative growth reaching 217% by 2021 (IRBD, 2022).

BRAZIL'S AEROSPACE INDUSTRY

As it was stated, the aerospace industry is strategic, both militarily and economically. The immediate hypothesis derived from this fact is that the State will put his efforts to enhance his capabilities. Brazil's economic history is characterized by a period of import substitutions and internal efforts to develop an autonomous industry in diverse segments. Most of these industries did not survive the neoliberal shock of the 1990's. Engesa, which is a defense industry, for example, declared bankruptcy in 1995. Brazil's BID was left with few companies.

The aerospace sector, however, has a history that can be paralleled with what I defined as a systemic innovation system. Brazilian's aerospace industry had already been responsible, through its leading firms (especially Embraer and Avibras), governmental support for R&D through universities like ITA (*Instituto Técnico-Aeronáutico*), the DCTA (*Departamento de Ciência e Tecnologia Aeroespacial*⁵), and international collaboration, to be successful in developing important project's such as the the EMB-Bandeirante, EMB-312 Tucano, the EMB-314 Super Tucano, and the AMX-10, to cite some examples.

Recently, despite the Air Force cuts in procurement, Embraer has been extremely successful in exporting its KC-390, a cargo plane which had an estimated market of \$60 billion and was envisioned to replace the aging Hercules- 130 planes. Rivals would include the C-130J, the Airbus A-400M and the Antonov-178 (which for obvious reasons is not on international markets). The firm has done well in its sales around the world. The KC-390 represented the budget action 14XJ which is entitled "The acquisition of tactic cargo military aircraft of 10 to 20 tons (...) in order to "adjust FAB's operational resources and assure aerospace defense capacity"⁶ (DCTA, 2016, p. 50). It can carry 23 tons and is a multirole plane, with participation from industries from England, Germany, Israel and France. Compensations in the form of *offset* policy guided by Brazilian legislation were negotiated. Other Brazilian firms participated as subcontractors, some with important functions such as ballistic

⁵ Aerospace Science and Technology Department.

⁶ Translated by the author.

protection (Aerotron), landing gear (Eleb), among others. The other major program of the air force is the acquisition *off-the-shelf* of SAAB's Gripen-x fighter, with a solid structure of *offsets*. The Air Force already ordered more Gripens, to a total of 36.

The military budget in Brazil, however, is tied to mandatory expenses with personnel and pensions, allowing little space for investment, O&M and procurement. PLO's⁷ typically "are likely to be the result of actions by various agents and interest groups in the political market, each acting in their own self-interest" (Hartley, 2011, p. 84).⁸ In the case of Brazil, the Armed Forces hold a disproportional share of the power concerning determining budget. Furthermore, the success of the aerospace industry can become volatile if the cited macroeconomic and innovation foundations of the country continue to degenerate. By 2024, air force capacities were very similar to those in 2010 (IISS, 2010; IISS, 2024). Although Gripen Squadrons are still in formation.

Brazil's President Luiz Inácio Lula da Silva, in August, announced a 'new growth acceleration plan' (Novo PAC) that calls for spending up to BRL1.7 trillion (USD340.5 billion) across all sectors of Brazil's economy, including BRL52.8bn (USD10.6bn) for defence. The money is expected to fund modernization and enhance the country's defence industry. His new funding reverses the decline in capital spending and reaffirms Brazil's commitment to its various strategic programs. Although the impact of this program has to be analyzed with cautiousness, since it will depend on bargaining with diverse sectors inside the Armed Forces. Data has to be constantly updated to investigate if these expenses are indeed going to priority discretionary programs.

PEER COMPETITORS?

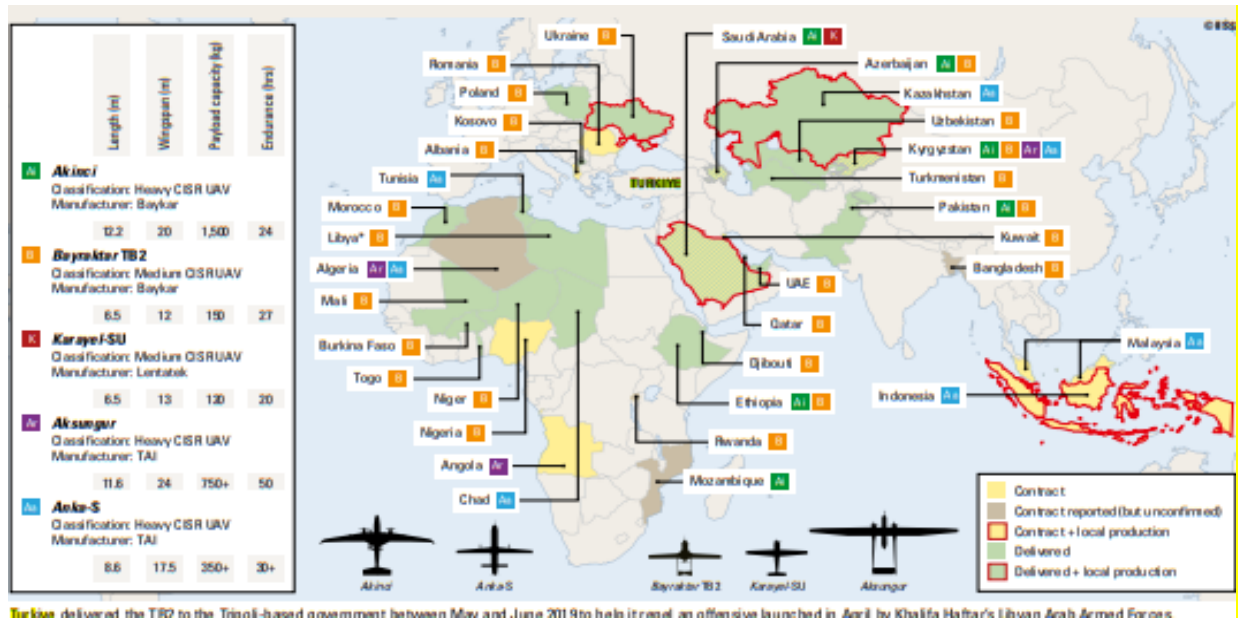
The defense budget of Turkey, India, and Brazil remained stable in proportion to GDP and government spending between 2010-2020. (SIPRI, 2022). It was their industrial strategy which made the difference. By 2009, Turkey did not have firms in SIPRI's top 100. By 2013, Brazil's Embraer ranked 63th, with \$2 billion (2014 constant prices) in sales and more than 2000 employees. By 2016, Embraer was no longer on the list. This scenario changed quickly. ASELSAN, Turkish Aerospace Industries and Roketsan, now figure in the, 54^o, 83^o and 100th positions. Its defense spending remained stable from 2010 to 2022, within a range of 10-15\$ billion (current prices), around 2-3% of the GDP. With a defense expenditure smaller than

⁷ *Projeto de Lei Orçamentária*. Annual budget enforcement law in Brazil.

⁸ See Dall'Agnol for a detailed revision on domestic decision-making regarding defense.

Brazil, why is Turkey better positioned in the aerospace industrial production ? Public policy needs long-term direction. This is lacking in Brazil. To analyze global defense markets and seek opportunities where demand exists was what Turkey did with UAV's.

Figure 1- Turkish exports of UAV's



Source: IISS, 2024

To illustrate, by 2010, Turkey has a wide market for its different UAV's, which can give them resources to *buy of the shelf* other products alongside their military power projection and successful defence economics in this market. By 2010, Turkey did not, according to *The Military Balance* count on many aerospace capabilities. Exceptions are 37 AH-1P Cobra/AH-1W Cobra and AN/USD-501 Midge; Falcon 600/Firebee; CL-89; 19 Bayraktar reconnaissance UAV's. Its air defenses, however, were more developed, counting on the AN/TPQ-36 Firefinder Land Radar, SAM's PMADS octuple Slinger and Zipkin Inchr., for example (IISS, 2010). By 2024, however, the country has built further capabilities. In terms of fighter aircraft, Turkey now counts on 12 Gripen C, 2 Gripen D and 16 L-159 ALC, besides cargo and training planes. Turkey has 13 Viper attack helicopters; and 10 Mi-35 Hind E. In terms of Air Defence, Air-Launched Missiles (AIM-9m Sidewinder; ARH AIM-120C-5-7 Abraam) were acquired. Laser guided bombs GBU-12/-16 *Paveway II* are now part of the arsenal. SAM Short-range and Point-Defence complement Turkish air defense system. The main UAV's in Turkish arsenal are the Anka designed for reconnaissance, surveillance, and maritime patrol missions; the Bayraktar TB2 and the Karayel- Tactical UAV with medium altitude and long endurance, Designed for maritime and land surveillance, border patrol, and reconnaissance missions.

Table 1- Distribution of Defence Expenditure and Arms Trade in Turkey

Distribution of Turkish defence expenditure (%)				
	<i>Personnel</i>	<i>Equipment</i>	<i>Infrastructure</i>	<i>Other</i>
1990–1994	50.1	23.7	3.0	22.5
2000–2004	46.1	32.6	4.8	15.7
2005–2009	50.8	28.1	2.9	17.7
2014	56.8	25.0	2.8	15.2
2015	56.8	25.1	2.6	15.5
2016	57.6	25.5	2.4	14.4
2017	51.0	30.6	2.9	15.4

NATO, Information on Defence Expenditure.

Arms trade in Turkey				
<i>Years</i>	<i>Arms exports</i>	<i>Arms imports</i>	<i>World share (arms exports %)</i>	<i>World share (arms imports %)</i>
1999	131	3,798	0.14	4.32
2000	128	3,586	0.14	3.80
2005	114	2,402	0.10	2.25
2010	416	3,850	0.26	2.40
2013	393	4,619	0.21	2.54
2014	386	4,919	0.21	2.66
2015	382	3,245	0.21	1.77

Source: (Sezgin; Sezgin, 2019)

Turkish defense economics were marked from a large dependence on imports, which was reverted over the years. In 2003, 25% of the Turkish Armed Forces' needs were provided from domestic sources and this rate increased steadily over the years reaching 65% in 2017. The ratio of investment and personnel is a strong explanatory factor of this trend. In the beginning of the 1990's, only 20% were invested in equipment, compared with 30.6% in 2017. Turkey also reduced by 4 times its dependence on imports. According to Sezgin and Sezgin (2019, p. 5): The potential of the Turkish defense industry depends on the development of a long-term and robust industrial policy and technology management strategy. The sector has a stable growth trend in terms of both local market and export sales. Turkey will develop in the near future as a new force in the defense industry.

Over the years, India has created a large and diverse Defense Industrial Base. There arsenal, as can be seen below, ranges from fighters, missiles, submarines and defence electronics. However, as pointed out by Behera (2020), India's industry is still not innovative and that makes it dependent from imports. Defense expenditure in India is hard to disaggregate, since the publications made anually by the Ministry of Defense do not include Miscellaneous Expenditure and Defence Pensions, the Coast Guard, among others. According to Behera (2020, p. 507) total defense spending is 57% higher than official statistics present.

Table 2- Procurement (National and International) in India

<i>Year</i>	<i>Domestic source (current \$ billion)</i>	<i>Import (current \$ billion)</i>	<i>Total (current \$ billion)</i>	<i>Share of domestic source (%)</i>	<i>Share of imports (%)</i>
2015–16	6.0	3.5	9.5	63	37
2016–17	6.2	4.1	10.3	61	39
2017–18	6.8	4.5	11.3	60	40

(Behera, 2019)

Procurement has grown steadily in India from the 1980's to the present. Apart from the dependence on imports, defence public initiatives have proven extremely successful as was the case with Hindustan Aeronautics Ltd (HAL), Bharat Eletronics ltd (BEL) and Mazagon Dock Shipbuilders Ltd. HAL is the biggest one, catering virtually for all aspects of India's military aircraft and associated avionics and accessories production, besides catering for some requirements of the space department. HAL has made indigenous designs of helicopters such as the HF-24. Other noticeable examples include the Hawk-Advanced Jet Trainer, the Light Combat Aircraft (LCA) and Dornier-228 Light Transport Aircraft. In many ways we can trace a parallel with Embraer's military branch. The private sector is a new entrant on India's defense market, with TATA as its most successful example so far. India counts on a institution called the DRDO which is dedicated to R&D in diverse sectors of defense. By the end of 2017, DRDO had a portfolio of 338 projects with a combined value of \$10.4 billion.

India has recently issued a "Make in India" initiative to stimulate its defense industry and a host of reform measures has "undoubtedly brought a fresh lease of life to the otherwise moribund Indian defence production sector which has been known for its inefficiency and lack of innovation" (Behera, 2019, p. 525). India created a dynamic and synergetic National System of Innovation. However, considering major platforms, lack of R&D and dependence on external sources, considering the lifecycle of modern fighters, submarines, long-range missile defence systems (30-50 years), India will continue to be dependent on imports.

Table 3- DRDO's Developed Systems (2017)

<i>Systems</i>	<i>Inducted* (current \$ billion)</i>	<i>Under induction # (current \$ billion)</i>
Missile Systems	3.6	11.2
Electronic and Radar Systems	2.0	3.2
Advanced Materials and Composites	0.7	0.3
Armament Systems	1.3	3.0
Aeronautical Systems	0.2	12.1
Combat Vehicles & Engineering Systems	0.8	1.8
Life Science Systems	0.1	0.0
Naval Systems	0.2	0.6
Micro Electronics Devices and Computational Systems	0.04	0.0
Total	8.9	32.2
Grand Total	41.1	

(Behera, 2020, p. 519)

India, a much larger country, already figured as a peer competitor in 2009, where its main aerospace company Hindustan Aeronautics, already ranked 36th in SIPRI's 100 largest list. Indian ordnance factories⁹ ranked 53th and Bharat Electronics 73th. By 2022, Hindustan Aeronautics went up to position 43th, Bharat Aeronautics to 62th and Mazagon Dock Shipbuilders entered the list. Our focus here, however, must be on the aerospace industry. India has developed a very successful space program over the years, including a successful landing on the dangerous south side of the moon. Brazil's aerospace program exists and has important goals, although it is still not demonstrated relevant results.

India is a nuclear state. Some comparisons are, therefore, poor for analysis. What I focus on is its evolution in industrial and defence investments in recent decades. India's main IRBM and SRBM were Agni-II; Agni-III, SS-150 Prithvi I and SS-250 Prithvi II. India could use the *Mirage 2000h* of Su-KMKI to enforce its strategic role. By 2010, India counted on Radar Land of a sort of varieties, such as the M-113 AIGE *Green Archer*, MUFAR, *Firefinder* and the *Stentor*. India had, already by 2010 an Aircraft Carrier, 11 Sea Harrier combat aircraft, 4 ASW Tu-Bear patrol aircraft, 54 attack helicopters and 12 UAVs: 8 Searcher MK II and 4 Heron. Three kinds of missiles complemented Indian's air power by 2010: ASM I (Sea Eagle and KH-35/ Sea Skua / Missile antibuque); ASCM (PJ-Brahmo /Antiship Cruiser Missiles) and AAM missiles air-air (R-550 Magic/ R 550 Magic tactical).

By 2024 India had enhanced greatly its capabilities. It continued to develop its nuclear program, which now consisted of ICBM's, IRBM's, MRBM's and SRBM's.

⁹ For further explanations of India's Defense Industrial Base, see:

Furthermore, India has now Strategic Submarines (SSBN) and nuclear Air Launched Missiles which can be deployed by *Mirage 2000h*, *Rafaele* or Su-30MKI. Its space program evolved greatly, with 26 satellites being deployed backed with a solid structure of Navigation, Positioning, Timing and Communications. Their capabilities regarding UAV's remained the same, as it is the case with Air Defence. Attack combat aircraft multiplied. They now count on 71 capable aircraft, including 42 MIG-29K.

In the 100 largest defense companies disclosed by SIPRI, Turkey and India have begun to stand out. The proportion of sales for defense is higher in the flagship companies of Turkey and India. However, Turkey, for example, has a defense budget smaller than Brazil's (SIPRI, 2022). India, on the other hand, spends many times more than Brazil in its *equipment* for the Air Force. The net revenue of the Brazilian aerospace sector did not achieve a significant real gain increase between 2010-2019 (IBGE, 2019). Brazilian aerospace industry is mainly civil-oriented, and that explains two things: i) spending too much on military products in a peaceful environment could be regarded as wasting money; ii) the diversity of products is lower. However, being Embraer and Brazil's aerospace industry the case that survived the 1990's and is regarded as a success, it cannot *fall-behind* its competitors. The international market is zero-sum.

The aforementioned macroeconomic scenario of the Brazilian economy, considered here a vicious cycle, results from a false trade-off between currency appreciation stemming from investment in innovation and a short-term strategy, anchored in the exportation of low-cost products, which generates currency devaluation, increased interest rates, and the need for inflation control. With a low investment rate, difficulty in accessing credit, lack of infrastructure, and low productivity, Brazil ranks 62nd in the Global Innovation Index (WIPO, 2020).

Besides the chronic problem of deindustrialization, the main explanation lies in Brazil's defense industrial policy. It is argued that the Brazilian problem does not lie in the amount allocated to the defense sector - considering that the country has urgent needs in areas such as health and education. There are political-institutional obstacles and budgetary limitations resulting from the *allocation of expenses* and of from the total value. It is not considered necessary to increase the total value of expenses. The problem lies in the allocation. Maintaining an average of 3.5% of government spending, Brazil's defense budget has dedicated over 80% of expenses to personnel-related obligations, while the amount invested in investments decreased from R\$ 11.23 billion in 2010 to R\$ 6.79 billion in 2019 (SIPRI, 2022; BRAZIL, 2020). This amount is insufficient in a monopsonistic market, given that the government has grand ambitions, projects with long life cycles, and high costs. The

gains of scale, scope, and learning, as well as eventual exportation, become even more important.

CONCLUDING REMARKS

Naturally, due to its immediate low external threat and potential medium-term threat, the Brazilian industry tends to be more oriented towards the civilian sector. India is positioned on a higher threat environment. But it chose to not be vassal. Furthermore, does not invalidate the significance of both the aforementioned factors and factors related to defense economics in general, such as the low proportion of investments made by the Brazilian Air Force (FAB) in its budget.

Moreover, the negative effects have not only a strategic character and implications for Brazil's relative positioning in the international system but also for the dynamism and prospects of its technological and economic framework. The argument put forward here applies to other sectors of the economy. Indeed, they tend to have a greater effect on them, being the aerospace industry the least probable case.

Brazilian macroeconomics work in the opposite way of investment, industry and growth. The devaluated exchange rate might work for exporters in the short-term, but for value-added industries it is detrimental. High level of interest rates to control inflation have to be carefully analyzed. Even so, Brazil has instruments for credit to strategic industries, like the BNDS and FINEP. There is no working National System of Innovation in Brazil. Firms adapt to primary commodities or retail, since high aggregated value investments are very difficult. The aerospace sector adapted and created a cluster. Even so, due to the country's business environment, it loses to its competitors. The *least probable case* is just a sample of the economy as a whole.

The second point, and maybe the most important, that I make, is the decision-making structure in defense. It is monopolized by the Armed Forces, with no real competitive incentive and no budgetary discussions. The money is tied in salaries and pensions. Congressional oversight and civilians in the Ministry of Defense are urgent. Independent studies such as from the CGU (*Controladoria Geral da União*) and the Treasury are also urgent. It is the government and not the military forces who hold monopsony.

India and Turkey have, thus, surpassed Brazil in its industrial participation of the GDP and in military technology. Leaving the external threat variable in a ceteris

paribus condition, what we observe is a *constant* investment in priority sectors and projects. State building is not government building. The relative distribution of material capabilities favors those who can balance *internally* and externally. If the Brazilian elites have any interest in becoming a medium power or regional leader the time is passing.

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