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## *Occasional Paper*

### **How Brazil Competes in the Global Defense Industry**

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## Introduction

This paper examines the growth and development of Brazil's most dynamic high-tech industry—defense. Section I discusses the matrix of motivations for the establishment of the Brazilian defense industry (BDI). Section II reviews the growth and strategic directions of the industry. Section III elaborates on the industry's export drive, especially its major markets and products. Section IV discusses the catalytic role of the Brazilian government in the defense industry. Section V analyzes the defense industry's tripod strategy. Section VI discusses major barriers to the industry's further growth and development.

### Section I Matrix of Motivations

A perceived external threat to national security is the driving force behind establishing an industrial military complex in most countries.<sup>1</sup> However, Brazil developed a strong defense industry without external impetus. Furthermore, Brazil has not increased its domestic military expenditures—in fact it has experienced a real decline in total military expenditures since the early 1970s. At constant 1982 prices, real military expenditures decreased from US \$2,456 million in 1973 to US \$1,698 million in 1983.<sup>2</sup> As mentioned by Stepan, "This makes Brazil the democracy with the lowest level of military expenditures as a percentage of gross domestic product (GDP) in the world, and the nation with the second-lowest level of all major nations in the world."<sup>3</sup>

How is it possible, then, for Brazil to have one of the most dynamic defense industries among the newly industrialized countries (NICs)? The answer to this question may be found by examining the political and economic factors that have interacted to determine the BDI's technologically deepening growth, development, and overall strategy.

#### *Political Factors*

Three political factors induced Brazil to create a viable indigenous defense industry. First, there was a drive to become self-sufficient and free from reliance on military imports from industrialized countries. During 1946-1970, Brazil imported much of its military hardware from the US.<sup>4</sup> This dependency gradually fueled a growing sense of uneasiness in the Brazilian Armed Forces and among geopolitical strategists.

Second, it was believed that the development of a strong defense industry would enhance Brazil's influence among less developed countries (LDCs) throughout Latin America, Africa, and Asia, and potentially produce political and economic benefits. Strategically, the defense industry could provide Brazil with foreign policy instruments to fulfill its long-term aspirations for the

international arena. Arms exports would give Brazil political and economic clout over its customers and prevent other countries from exercising a similar role.<sup>5</sup>

Third, a sound defense industry would function as a highly visible manifestation of a competent military ruling elite. Indeed, the development of a defense industry created an opening, or *raison d'être* for the Armed Forces to assume an active role in Brazil's domestic and foreign political and economic spheres. Interestingly, Stepan argued that the presence of a strong arms industry would lessen, not increase, the role of the military in Brazilian politics. The presence of a massive arms-producing and exporting capacity means that some of the ideological and industrial infrastructure arguments the military could conceivably utilize as a reason for seizing control of the government are lessened.<sup>6</sup>

### *Economic Factors*

On the economic side a number of factors also favored the establishment of an indigenous industry. First, a strategy of import substitution was selectively re-implemented in the mid-1970s,<sup>7</sup> which helped dissolve bottlenecks in those sectors that were essential to the upgrading of the Brazilian defense industry. Import substitution industrialization (ISI) continued into the 1980s, with the BDI requiring from suppliers components with high technological content. (This ISI has also given rise to the development of the Brazilian computer industry<sup>8</sup> and has provided initiatives in microelectronics and laser technology.) Such a strategy necessitates strong forward and backward linkages in the domestic economy. The BDI has developed strong backward linkages in core sectors such as steel, metallurgy, transport equipment, machinery, and electrical and electronic industries.

Second, the export promotion strategy implemented in the late 1960s and early 1970s was in need of new products.<sup>9</sup> In the late 1970s Brazil relied on defense hardware exports to increase foreign exchange earnings and to further diversify its export structure. The export of defense hardware also had a multiplier effect on the country's overall exports, in that it encouraged additional exports of related and non-related goods and services.

Third, an increasing emphasis on the development of indigenous technologies by the Brazilian government in the 1970s also favored the erection of an indigenous defense industry. Further, by requiring a high technological base, the industry affected the economy's overall capital intensity, the rates of technical change and diffusion, and skill intensity. A relevant variant of these developments was the strengthening of Brazil's manpower base.<sup>10</sup>

It is possible to argue that Brazilian policy makers believed a strategy of dual-use technology would not force a trade-off between butter and guns, as mentioned by Edward Kolodziej for France's defense industry. The traditional choice between guns and butter was transformed into an opportunity to acquire both in larger quantities at reduced prices. A choice was not necessary since more guns sent abroad meant more butter at home.<sup>11</sup> But Brazilian policy makers rationalized the defense industry by noting its synergistic impact—merging national security ideals, geopolitical goals, economic growth, and technological innovation.

## Section II Growth and Strategy

Established after the ISI strategy in the mid-1950s, the defense industry benefitted from Brazil's highly diversified industrial structure by utilizing off-the-shelf components from existing industries such as transport equipment and machinery. The existence of a mature and developed industrial base supported the adoption of a dual-use technology strategy for the first phase of the arms industry by dramatically reducing the costs of indigenous defense technology development. Within a relatively short period, Brazilian defense hardware exports were becoming increasingly competitive. The BDI also benefitted from a skilled labor force. Since the late 1940s, many engineers and scientists had been trained in military schools to rapidly develop indigenous technology for the defense industry.<sup>12</sup>

Prior to the late 1950s and early 1960s, Brazil's status as a world producer of defense hardware was negligible. Military agreements with the US provided Brazil with most of its military hardware and limited the country to refurbishing WWII tanks and to producing only powder, cartridges, and light weaponry.<sup>13</sup>

Between 1964-67, the government established an industrial mobilization plan (GIPM) to expand local production of defense hardware and to create incentives for State and private sector cooperation in the defense industry. The GIPM was reinforced by US reluctance to transfer defense technology to Brazil, owing to US involvement in Vietnam at the time.<sup>14</sup>

From 1967-75, a significant move toward local production of defense hardware took place. Brazilian companies eagerly looked for new partners, and European firms responded enthusiastically. Consequently, numerous licensing agreements and joint ventures were undertaken, leading to large numbers of new Brazilian entrants into the defense industry. This rapidly and profoundly diversified the BDI.<sup>15</sup> In 1969, the State established Embraer, an aircraft manufacturer, which later would become the darling of the industry. Likewise, already established firms such as Engesa and Avibras were taking first steps toward manufacturing defense hardware.<sup>16</sup>

In 1974, the Army Minister suggested to Brazilian President General Ernesto Geisel that the defense production policy be revised. He suggested establishing a state-owned enterprise (SOE) that would be subordinated to the Army Ministry and would be capable of creating, promoting, and rationalizing a modern defense complex. Early on the State had protected firms from competition by establishing specific niches, which helped them to avoid overlapping functions.<sup>17</sup> The State started to intervene more consistently in the industry after the creation of the Industria de Material Belico do Exercito (IMBEL). IMBEL, created by Law No 6227 of July 1975 and subordinated to the Army Ministry, performs a number of key functions in the industry, it collaborates in the planning and manufacture of defense materials, it promotes technology transfer, and it provides technical and financial incentives for the establishment of new firms. IMBEL, thus, may be characterized as a composite of producer, arms exporter, R&D promoter, and planning agency.<sup>18</sup>

Given its wide scope of functions and influence over the development of the defense industry, IMBEL is closely integrated with other areas of the government. For instance, its administrative council membership includes the President, Ministers of the Armed Forces, Industry and Commerce, and Planning and Finance, and the president and directors of IMBEL. The president of IMBEL is appointed by the president of Brazil.<sup>19</sup>

The catalytic role of the Armed Forces in the BDI is emphasized in the Brazilian Third National Development Plan (III PND)

- To support and stimulate the adoption of advanced technologies which are in the interest of Brazil and to promote the adaptation of civil technology to military purposes by developing projects, materials and processes
- To provide incentives for the production and development of military technology
- To acquire from the private sector the needed material to equip the Armed Forces

These initiatives are justified by national security reasons and by the need to reduce external procurement of defense hardware

Since IMBEL's creation the BDI has grown rapidly. The suspension of several military agreements with the United States in 1977 served to hasten indigenous technology build-up and dramatically increased the number of firms in the industry.<sup>20</sup> In 1987 the industry included more than 600 firms employing approximately 150,000 people.<sup>21</sup> Table 1 shows a sample of these firms and their respective products. The abundance and sophistication of the firms indicate the depth and capability of the BDI. In the second half of the 1980s, as a result of indigenous efforts, the self-sufficiency of the Brazilian Army was estimated to be around 80 percent. Brazil was the only Latin American country in the 1980s

capable of sustaining military conflict without the need to import defense hardware <sup>22</sup>

**Table 1 Brazilian Defense Industry Major Firms and Products**

<i>Firms</i>	<i>Products</i>
ABC	electronic components and systems
Aeromoto	avionics
Amadeu Rossi SA Metalurgica e Municoes	shotguns rifles ammunition
AME	motorbikes for police and armed forces
Arsenal da Marinha do Rio de Janeiro (AMRJ)	shipbuilder and offshore
Avibras Aeroespacial	sounding rockets artillery saturation rocket
Bernardini	tanks modernization of military equipment
Companhia Brasileira de Cartuchos (CBC)	military ammunition
Companhia Comercio e Navegacao Estaleiro Maua	shipbuilders
Companhia de Explosivos Valparaiba	hand grenades fuses etc
Datanav Engenharia	radar systems
DF Vasconcellos SA	optronics
Embraer Empresa Brasileira de Aeronautica SA	aircraft
Ede	avionics
Engesa Engenheiros Especializados	armored vehicles electronic systems guns ammunition explosives suspension
Engetronica	avionics
ENARM	sub-machine guns etc
Equitel	radar systems
Ericsoon	radar systems
Ferranti do Brasil	naval systems
Ford do Brasil SA	military vehicles
FI Industria e Comercio Ltda	naval ammunition
Helibras Helicopteros do Brasil SA	helicopters
Hydroar Industria Metalurgica SA	recoilless guns etc
IMBEL Industria de Material Belico do Brasil	light weapons ammunition
Industrias Reunidas Caneco SA	shipbuilder
Ishibras Isshikawajima do Brasil	shipbuilder
MacLaren	shipbuilder
Microlab	avionics
Moto Pecas SA	modernization of military equipment
MWM Motores Diesel	motors
Novatracao Artefactores de Borracha SA	rubber pads for tank tracks etc
Orbita	missiles aerospace systems
Pirelli	avionics
Prologo	electronics
Quimica Tupan SA	military/civil pyrotechnics ammunition
Saturnia SA	electronic products and batteries
Siteltra SA	multichannel equipment radios etc
SFB Informatica	electronic systems
Taurus SA	firearms
Tecnasa	radar systems
Verolme Estaleiros Reunidos SA	shipbuilder

Source *Military Technology* 10/85 pp 92 119 *INFOSTRAT* 1 1986 *Seguranca & Defesa* Janeiro/Feveiro 1985 No 3 *Jane s Defense Weekly* 16 August 1986 p 256 and *INFO* April 1987 pp 28 33



### *Internationalization of Activities*

BDI development was fueled in part by the expansion of Brazilian defense firms into Europe, Africa, and Asia. By transferring its technology to developed and developing countries, Brazil's defense industry was replicating the pattern set by Western multi-national corporations (MNCs). This is a logical and expected step for an industry that has achieved international status and technological sophistication. In addition, the BDI has been able, by moving overseas, to further exploit its firm specific advantages (FSA) and better serve its customers. Moreover, this strategy allows access to newer and more sophisticated technology via branches in developed countries (DCs) <sup>23</sup>

Brazilian defense firms actively engage in licensing agreements, joint ventures, and foreign direct investment in both LDCs and DCs. A good example is provided by the SOE, Embraer, which established a subsidiary in the US in April 1981, and another in France in 1983. These subsidiaries promote foreign sales and provide after-sales service <sup>24</sup>. Embraer has recently engaged in joint ventures and licensing agreements. In 1985 the Royal Air Force selected the EMB-312 *Tucano* turboprop for its new basic trainer aircraft. Embraer will develop the aircraft jointly with Short Brothers and will manufacture it in Belfast, Ireland. Both companies plan to research a new generation of commuter planes, executive turboprop, and missiles for space explorations <sup>25</sup>. In Egypt, Embraer will export structural components for assembly by the Arab Organization for Industrialization under a joint-venture agreement.

In a recent development Brazil and Argentina, through an agreement between Embraer and Argentina's Fabrica Militar de Aviones (FAMA), began negotiations to develop a two-engine passenger plane, the CBA-123. Co-production of the aircraft and aerospace research are important items in the countries' current economic integration processes. Argentina's share of the joint venture is 33 percent, while Brazil owns the remaining 67 percent <sup>26</sup>. In 1986 Brazil began sourcing Argentine parts for its EMB-120 *Brasilia*. Deliveries of the CBA-123 are scheduled for 1991 <sup>27</sup>. Argentina is thought to be an important future partner for the BDI <sup>28</sup>.

Avibras, the largest exporter of defense hardware, created a joint venture (Inscor) in 1989 with China's Great Wall Industry Corporation. Inscor will manufacture satellites, launch vehicles, earth stations, and antennas <sup>29</sup>.

International production is not restricted to the aerospace industry. Engesa is negotiating a US \$5 billion package with Saudi Arabia to co-produce 1,500 EE-TI *Osorio* main battle tanks (MBT) <sup>30</sup>. Engesa also signed an agreement allowing the US-based Ford Motor Company (FMC) Corporation to manufacture

the EE-9 *Cascavel* armored car and the EE-11 *Urutu* armored personnel carrier in the US<sup>31</sup>

Nor is the internationalization of activities restricted to the four sisters (Embraer, Avibras, Engesa, and Bernardini) Taurus, the leading exporter of firearms, exports to more than 60 countries and has followed the industry's leaders by setting up a subsidiary in the US. The American subsidiary assembles completely knocked down (CKD) kits imported from the Brazilian parent company. According to Taurus officials, the US subsidiary is fundamental for the company's upgrading of its own products<sup>32</sup>

### Section III Arms Trade

As indicated above, the BDI has a very aggressive export marketing strategy. The industry, on average, exports 80-95 percent of its total output. In ten years Brazil has become the fifth largest exporter of defense hardware worldwide. The domestic content of Brazilian-made hardware varies considerably. The domestic content of Embraer products is in the range of 50 to 60 percent. This has to do with the firm's marketing strategy of sourcing a number of parts and components from foreign companies, thereby facilitating maintenance of their planes abroad<sup>33</sup>. The domestic content of Avibras products, on the other hand, is in the range of 80 percent<sup>34</sup>. Engesa's products vary considerably, basic products such as the *Urutu* and *Cascavel* have a much larger domestic content than the EE-T1 *Osoio* MBT, which uses a number of imported parts such as the turret<sup>35</sup>. The following sections will elaborate on the country's export marketing strategy, its major products and markets.

#### *The Decision-Making Process*

The Brazilian government controls arms exports through a council that deliberates on the National Export Policy of Defense Material (PONAENEM). This policy is defined and coordinated by a select group of government officials: the President, the General Secretariat of National Security Council (SGCSN) and Ministers of each branch of the Armed Forces, Foreign Relations (Itamaraty), Finance and Planning. All exports must be approved by this council. For instance, the PONAENEM has established that no arms be exported to South Africa, Israel, or countries in Central America<sup>36</sup>.

#### *Export Marketing Strategy*

A major characteristic of the BDI has been its strong export orientation. The industry exports 80-95 percent of its domestic production. Though Brazil exports virtually all categories of hardware and a wide array of arms in the four

main weapons classifications, it does not compete in the top end of high-technology hardware. Brazilian exports of military hardware range from subsonic combat airplanes to firearms.<sup>37</sup>

The industry's international marketing strategy is a niche strategy designed (a) to avoid direct competition with superpower producers, (b) to provide tropicalized technology, (c) to customize products, (d) to offer on-site technical assistance, (e) to provide export credits, (f) to have flexibility in compensatory agreements, and (g) to have no strings attached. This strategy has substantially increased Brazil's share of the international arms market.<sup>38</sup>

However, this export policy occasionally conflicts with Brazil's foreign policy. For instance, the no strings attached element, which means that no end-user certificates are required, resulted in arms being sold to Libya for resale to Iran in the war against Iraq. The president of Engesa, Luiz Whitaker Ribeiro, has defended his position: "I sell to one country which resells to another—that's a sovereign act that can't be controlled. [this accusation is] a device invented by the big powers to limit sales by smaller countries."<sup>39</sup> As noted by Ohlson and Skons, Western countries regularly violate this principle, besides, the Brazilian arms export marketing strategy is considered quite flexible. Arms deals today are concluded with complex financing arrangements, technology transfer and offset agreements involved.<sup>40</sup>

Trade credits, barter, and subcontracting have been used to sell *Tucanos* to Egypt, warships to Paraguay, handguns to Canada, and armored vehicles to Gabon. Arms are frequently traded for oil from Iraq. Recently, Brazil bought German submarines through a US \$200 million barter agreement involving Brazilian iron ore.<sup>41</sup>

In addition to the know-why, the know-what to sell is a vital factor in any marketing strategy. Brazilian producers have achieved a high degree of flexibility in hardware design, accommodating their customers' needs as much as possible.<sup>42</sup> In addition, Brazilian producers offer on-site technical support and training. Design flexibility is frequently cited by purchasers of Brazilian hardware as an important feature and is a competitive advantage for Brazil. Another important aspect of export sales is a non-price advantage. In several of Brazil's major markets, cultural affinities and a mutual NIC status figure prominently in arms deals.<sup>43</sup>

### *Major Markets and Products*

As shown in Table 2, exports of arms by NICs are highly concentrated in Brazil and Israel. Together they produced almost half the exports in 1982-86. Brazil leads NIC producers with the highest export growth rates of military hardware. Brazilian hardware exports grew swiftly after improved designs were

successfully tested in combat in the Middle East during the 1970s. Brazil augmented its export of hardware in 1975, after the creation of IMBEL. Exports of arms are highly concentrated in four firms: Avibras, Embraer, Engesa, and Bernardini. In 1984 Avibras share was 40 percent of the total Brazilian arms sales, Engesa, 30 percent, Embraer, 20 percent, Bernardini, 5 percent, and other, 5 percent.<sup>44</sup> Brazilian exports of arms have increased dramatically. In 1975 total arm exports reached US \$46 million, and by 1986 totalled US \$3 billion.

**Table 2. The Top 10 Third World Suppliers of Major Weapons, 1982-86**

Supplier	Share in total TW exports of major weapons	Number of recipients		Region	Major recipient		Share
	1982-86	TW	IC		Share	Country	
Israel	23.9	15	2	F East	38.8	Taiwan	38.1
Brazil	23.3	24	4	M East	48.3	Iraq	36.7
Egypt	14.1	9	0	M East	89.2	Iraq	89.2
Jordan	7.3	2	1	M East	91.4	Iraq	88.1
Libya	7.3	8	0	M East	80.8	Syria	47.4
S Korea	7.2	6	0	F East	43.4	Malaysia	31.6
N Korea	5.5	5	0	M East	95.8	Iran	95.8
Syria	3.3	2	1	M East	98.9	Iran	88.5
Singapore	2.1	6	0	F East	50.9	Taiwan	40.7
Indonesia	1.6	3	0	M East	64.3	Saudi Arabia	64.3

Percentage shares are based on SIPRI trend indicator values as expressed in US \$millions at constant 1985 prices.

TW=Third World IC=Industrialized countries F East=Far East M East=Middle East

Source: Adapted from Ohlson T. and E. Skons (1987) p. 198

The accuracy of these figures, however, is compromised by the high level of secrecy surrounding arms sales and by counter trade deals. Table 3 illustrates the inconsistencies between published amounts of Brazilian arms exports. For instance, in 1984 the figures range from US \$750 million to US \$3 billion and may be inflated. In addition, CACEX (Foreign Trade Agency of the Banco do Brasil) trade statistics include records not for exports of heavy defense hardware as per CACEX's Chapter 93 of NBM (Classification of Brazilian Manufactures, index for classification of all goods), but rather for exports of firearms and ammunition. CACEX's statistics do not publicly acknowledge exports of defense hardware.<sup>45</sup>

While an exact figure on the volume of trade is extremely hard to obtain, the data do reveal a very dynamic industry that is rapidly shedding its infant-industry status. Table 4 provides further information on the exports of arms by the ten largest exporters. The figures show an upward trend in the period 1982-85, the peak of the Iran-Iraq conflict.

**Table 3 Brazilian Exports of Arms (estimated values in US \$ billions)<sup>†</sup>**

<i>News Media Sources</i>	1980	1981	1982	1983	1984	1985	1986
1 <i>Defense Journal of Latin America</i> Jun/Jul 1981 Aug/Sep 1981	1 00	•	•	•	3 00	3 00	•
2 <i>Jornal do Brasil</i> Sept 4 1984	1 00	1 00	1 00	1 00	1 00	•	•
3 <i>Jornal do Brasil</i> June 2 1984	•	•	•	•	0 80	•	•
4 <i>Jornal do Brasil</i> March 18 1984	•	•	•	•	0 75	1 00	1 00
5 <i>Jornal do Brasil</i> June 29 1984	•	•	•	•	1 00	•	•
6 <i>Veja</i> June 6 1984	•	•	•	•	2 00	•	•
7 <i>O Globo</i> July 1 1984	•	•	•	•	1 00	1 50	1 50
8 Brazilian Foreign Ministry in <i>O Globo</i> Nov 19 1984	•	•	•	•	1 40	•	•
9 US Department of State in <i>O Globo</i> Nov 19 1984	•	•	•	2 60	2 60	•	•
10 CEBRES	•	•	•	1 80	2 30	3 00	3 00

† nominal dollars

Source *Seguranca & Defesa* 3 January/February 1985 p 30

**Table 4 Brazilian Exports of Arms and Ammunitions (US \$ millions)**

<b>Firms</b>	1980	1981	1982	1983	1984	1985	1986
Engesa	54 00	18 90	128 20	179 40	194 10	159 80	53 90
Avibras	6 40	3 40	3 80	6 60	19 50	197 20	167 20
Embraer	•	3 10	0 90	17 80	4 70	0 50	0 30
FN do Brasil	1 80	4 80	8 60	3 10	1 80	1 50	1 90
Taurus	•	1 80	5 60	2 70	1 60	3 00	5 10
CBC	2 30	2 30	2 00	1 90	3 40	2 70	2 60
CBV	•	•	•	•	•	7 30	9 50
IMBEL	•	•	6 60	1 20	2 20	1 70	2 00
Britanite	0 40	•	•	4 10	•	•	•
Mercedes Benz	•	2 10	1 10	0 10	•	•	•
Others	1 50	1 40	0 10	1 20	2 10	4 40	1 70

Source *Associação Brasileira das Industrias de Materiais de Defesa* (ABIMDE) 1988

Some sources indicate that, in terms of volume, Brazil became the fifth largest exporter of arms in 1986, with sales to over 40 countries<sup>46</sup> In dollar terms, however, Brazil's exports in comparison with total US arms sales were only 10 percent

Brazil's 1986 exports were concentrated in two regions North Africa and the Middle East The concentration of arms exports in these regions is mainly due to the Iran-Iraq war and to Brazil's chronic commercial deficit with oil-exporting nations Brazil, therefore, has adopted an aggressive export marketing strategy towards these countries Table 5 illustrates the major destinations for Brazilian arms



**Table 5 Brazilian Arms Exports--Major Markets and Clients**


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Latin America	Argentina	Bolivia	Chile	Colombia	Costa Rica	Ecuador	DNF	Guiana
	Honduras	Panama	Paraguay	Peru	Suriname	Uruguay	Venezuela	
Africa	Angola	Algeria	Egypt	Gabon	Libya	Morocco	Mozambique	Nigeria
	Togo	Tunisia	Zimbabwe					
Middle East	Saudi Arabia	Cyprus	United Arab Emirates	Iran	Iraq	Kuwait	Qatar	
East and South Asia	India	China	Thailand					
Europe	France	Portugal	United Kingdom					

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Source *INFOSTRAT 1 ACE* 1986

In Latin America, Chile and Colombia are the major importers of Brazilian hardware. As shown in Table 6, Chile has imported approximately 500 armored wheeled vehicles from Engesa. Argentina in the second half of the 1980s is also rapidly becoming a major commercial and technological partner.

Brazilian hardware sales to Africa are largely destined for North Africa, where Algeria, Egypt, and Libya are the major importers. Other trade partners include Nigeria, Mozambique, and especially Angola. In 1986 Algeria was negotiating an arms package worth US \$400 million, which included the EE-11 *Urutu*, EE-9 *Cascavel*, and technology transfer. In 1988 Libya was considering the purchase of an arms package worth US \$2 billion, which included the EE-T1 *Osorio* MBTs and Leo and Piranha missiles.<sup>47</sup> Iraq became Brazil's best customer in the Middle East by acquiring thousands of Engesa's major export products, such as the EE-3, the EE-9, and the EE-11 *Urutus*. Additionally, Iraq makes large purchases from Avibras and from Embraer. Saudi Arabia, the Far East, Europe and China are becoming important clients for Brazilian hardware. The 1985 sale of 130 T-27 *Tucanos* to the Royal Air Force in Great Britain was the first sale of Brazilian-made military airplanes to a North Atlantic Treaty Organization (NATO) member. The transaction is likely to prompt first-time purchases by other NATO members, even the US is considering the purchase of 500 T-27 *Tucanos*.<sup>48</sup>

Table 6 Brazilian Major Arms Exporters--Engesa Embraer Avibras

<i>Company</i>	<i>Country</i>	<i>Quantity Exported</i>	<i>Product</i>	<i>Year</i>
Engesa	<b>Latin America</b>			
	Argentina	10	EE 9 Cascavel	1982
	Bolivia		EE 9 Cascavel	
			EE 11 Urutu	
	Colombia	100	EE 9 Cascavel	1981
		100	EE 11 Urutu	1981
	Chile	200	EE 9 Cascavel	
		300	EE 11 Urutu	
	Guiana		EE 11 Urutu	1982
	Paraguay		EE 9 Cascavel	
			EE 11 Urutu	
	Suriname		products unknown	1983
	Uruguay		EE 9 Cascavel	
			EE 11 Urutu	
			Jararaca	
	Venezuela		EE 9 Cascavel	
			EE 11 Urutu	
	<b>Africa</b>			
	Angola	2000	trucks	1986
		200	jeeps	1986
	Algeria		EE 9 Cascavel	1981
			Osorio	1985
	Gabon		EE 9 Cascavel	
			EE 11 Urutu	
	Libya	1000	EE 9 Cascavel	1981/84
		1000	EE 11 Urutu	1981/84
			Osorio	1984
	Mozambique		trucks and jeeps	
	Morocco	60	EE 11 Urutu	
	Nigeria	100	EE 9 Cascavel	
	Togo		EE 9 Cascavel	
	Tunisia		EE 9 Cascavel	
			EE 11 Urutu	
	Zimbabwe		EE 9 Cascavel	
	<b>Middle East</b>			
	Saudi Arabia		EE 9 Cascavel	1981 85
			EE 11 Urutu	1981 85
			Osorio	1981 85
	Cyprus		EE 9 Cascavel	
			EE 11 Urutu	
			Jararaca	
	United Arab Emirates		EE 9 Cascavel	
		EE 11 Urutu		
Iran		EE 9 Cascavel		
Iraq	1300	EE-9 Cascavel	1979 86	
	1000	EE 11 Urutu	1979 84	
	500	Jararaca	1982 84	
	300	Osorio	1986	
	400	Ogum	1986	

	Kuwait		EE 9 <i>Cascavel</i>	
			EE 11 <i>Urutu</i>	
	Qatar		EE 9 <i>Cascavel</i>	
			EE 11 <i>Urutu</i>	
	<b>East and South Asia</b>			
	China		EE 9 <i>Cascavel</i>	
			EE 11 <i>Urutu</i>	
	India		EE 9 <i>Cascavel</i>	
			EE 11 <i>Urutu</i>	
	Thailand		EE 9 <i>Cascavel</i>	
	<b>Europe</b>			
	Portugal		EE 9 <i>Cascavel</i>	
			EE 11 <i>Urutu</i>	
Embraer	<b>Latin America</b>			
	Argentina	11	<i>Xavante</i>	1982
		2	<i>Bandeirante Patrulha B P</i>	1982
		30	<i>Tucano</i>	1986
	Chile	3	<i>Bandeirante</i>	1986
		6	B P	1977 79
	Honduras	12	<i>Tucano</i>	1984 86
	Panama	20	<i>Tucano</i>	1986
	Paraguay	10	<i>Xavante</i>	1979
			<i>Bandeirante</i>	1983
	Peru	25	<i>Tucano</i>	1986
	Venezuela	30	<i>Tucano</i>	1985
	<b>Africa</b>			
	Angola	2	B P	1986
		1	<i>Bandeirante Carga</i>	1986
	Egypt	120	<i>Tucano</i>	1984
	Gabon	3	<i>Bandeirante</i>	1980
		1	B P	1980
	Togo	6	<i>Xavante</i>	1982
	<b>Middle East</b>			
	Iraq	80	<i>Tucano</i>	
	<b>Europe</b>			
	France	41	<i>Xingu</i>	1982
	United Kingdom	135	<i>Tucano</i>	1985
Avibras	<b>Middle East</b>			
	Iraq	38	<i>Astros II SS 30</i>	1985 86
	Libya	15	<i>Astros II SS-40</i>	negotiating
			<i>Astros II 33-60</i>	1987 negotiating
	Saudi Arabia		<i>Astros II SS-40</i>	1986 unconfirmed

*Estimated Sale Cost* EE 9 *Cascavel* and EE 11 *Urutu* US \$500 000 800 000 EE T1 *Osorio*  
 US \$15 20 million *Tucano* US \$1 3 15 million, *Astros II System* US \$10 million

Source *Seguranca & Defesa* No 3 Janeiro/Fevereiro 1985 pp 31 35 *INFOSTRAT* 1 ACE  
 1986 Embraer 1985 *SIPRI Yearbook* 1986 1987 *E Jornal do Brasil* 18 10/87 p 22

## Section IV The Catalytic Role of the Government

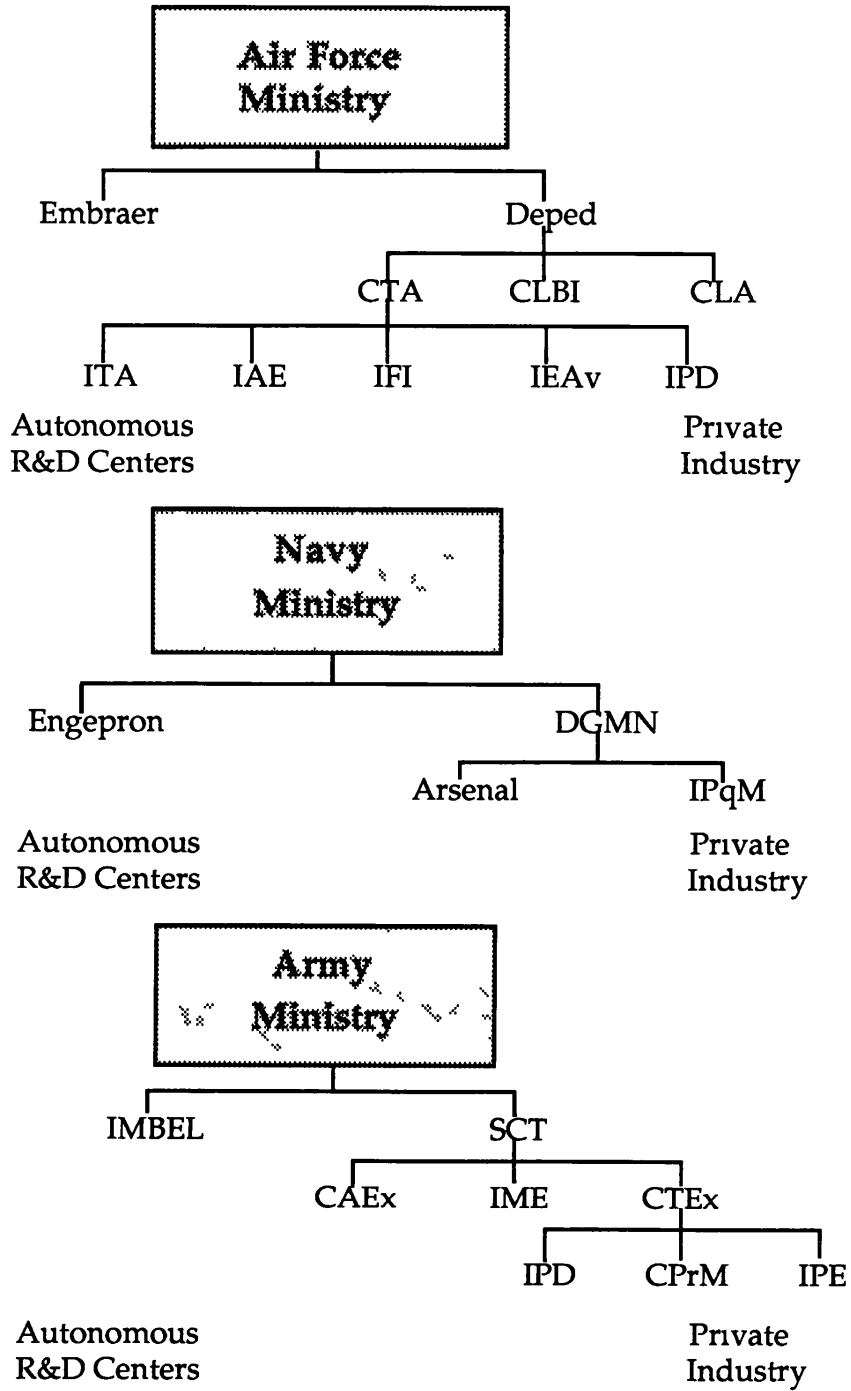
The Brazilian defense industry, unlike many in LDCs, is predominantly private<sup>49</sup> However, the State has played a very active role in the industry's development, production, organization, and industrial structure The State has developed and coordinated agencies that support and regulate the defense industry, including IMBEL, the Armed Forces Research Centers, the National Development Bank BNDEs, CACEX, and FINEP, a state funding agency for national development Proença Filho mentions that the degree of interaction and coordination in the arms industry surpasses all other public/private partnerships undertaken by the government<sup>50</sup>

The Military R&D institutes have played a vital role in the industry's development The Air Force and Army have provided undergraduate and graduate programs for scientists and engineers since the 1940s, enabling the country to produce indigenous technology<sup>51</sup> Military institutes have also been technology suppliers to the private sector, and a majority of indigenous defense hardware systems has benefitted from technical assistance from one of the three military institutes for research and development the CTA, the Air Force's Centro Tecnológico da Aeroespacial R&D Center, the CTE<sub>x</sub>, the Army's Centro Tecnológico de Exercito R&D Center, and the CPqM, the Navy's Centro Pesquisas da Maninha R&D Center

The Air Force's CTA was established in 1945 and today employs approximately 7,000 people Five institutes are subordinated to CTA see Figure 1 the ITA (Instituto de Tecnologia da Aeronautica), which trains aerospace engineers and does basic research, the IPD (Instituto de Pesquisa e Desenvolvimento), a R&D institute, the IAE (Instituto de Atividades Aeroespaciais), a space research institute, the IEAv, an advanced studies institute, and the IFI (Instituto de Fomentação e Coordenação), which promotes and coordinates the aerospace industry IAE is in charge of research and development of Air Force defense material, while IEAv does advanced studies in the laser and nuclear fields, and IFI acts as a bridge between the Air Force centers of R&D and the private aerospace industry ITA has had a strong impact on companies such as Embraer, and in fact, has trained the majority of the firm's engineers<sup>52</sup> CTA has also provided major stimulus for Air Force R&D efforts In 1988 CTA helped Orbita to develop the sophisticated *Piranha* MA-A1 air-to-air missile<sup>53</sup>

The Army's R&D center, CTE<sub>x</sub>, was established in 1977 Figure 1 shows that CTE<sub>x</sub> is under the umbrella of the Army's Secretariat of Science and Technology The Secretariat is comprised of the IME Military Engineering School, the IPD Research and Development Institute, the INIT Institute of Norms and Informatics, and the Institute of Incentives to the Private Sector CTE<sub>x</sub> does not charge for the technology it transfers to the private sector One of its top projects is the development of a microchip that will be used to control and

Figure 1 Organogram of R & D Center





guide missiles. The Army has followed the PGPDEX Army's General Plan for Research and Development, which is a guiding light of the Army's efforts in developing indigenous technology.<sup>54</sup>

Technological development in the Brazilian arms industry has not been evenly distributed across the branches of the Armed Forces. The Army and the Air Force have more sophisticated technology than the Navy, partly due to historical circumstances. Ferreira argues that since the Navy Insurgence in 1903, the Brazilian government has down-played the role of the Navy and has purposely relegated the group to a secondary position.<sup>55</sup> The Navy is fighting to change this by researching innovative defense projects such as the nuclear submarine. The discrepancy between the three branches has other roots as well. The Navy has been less willing to accept external input in its technological efforts than have the Air Force and the Army.<sup>56</sup> In addition, the Navy has been hardest hit by the country's external debt crisis of the 1980s, largely due to the magnitude of naval projects.

Following the BDI's general lead, the Navy Directorate of Naval Engineering DEN favors nationalization of defense hardware. The Navy's technological motto states that investments in defense should, to the extent possible, represent a stimulus to the nation's economy, development, and growth. DEN also has strict policies on foreign participation in Brazilian naval programs. MNCs must increasingly use local content and secure local logistical support to supply parts domestically. With technical assistance from the German firm IKL (Ingenieur Kantor Lubeck/Industrial), DEN has been developing two non-nuclear submarines, the NAC-1 and NAC-2. With the IPEN/USP (Universidade de São Paulo), the Navy is developing a nuclear reactor for installation in Brazilian nuclear submarines. The Navy has also transferred nuclear technology to the Argentine Navy for development of fast-breeder reactors.<sup>57</sup>

The finance and trade legs of the industry are mostly comprised of BNDEs, Banco do Brasil, FINEP, and CACEX. The BNDEs extends credit to firms in the industry. In 1987 Engesa borrowed US \$165 million from two governmental agencies: BNDEs and Banco do Brasil. Banco do Brasil lent US \$100 million to Engesa, while BNDEs provided Engesa with US \$65 million at subsidized interest rates.<sup>58</sup>

FINEP is the Brazilian financing agency for research and scientific development. It reports to the Ministry of Science and Technology and has financed more than 10,000 projects over the past twenty years. At present, FINEP is funding sectors that can alleviate supply bottlenecks to the defense industry, such as microelectronics. In the past, FINEP financed Embraer's EMB-312 *Tucano* and Avibras' *Astros II*. Table 7 lists a sample of defense firms receiving financial support for R&D from FINEP. Banco do Brasil, through its foreign

trade agency CACEX, allocates trade credits to foreign buyers of Brazilian-made weaponry

**Table 7 Defense Firms Financed by FINEP 1987**

<i>Firm</i>	<i>Project/Product Financed</i>
Elebra Microeletronica	Integrate project of pilot plant in microelectronics
Engesa	Development of the EE T1 <i>Osorio</i> MBT
Labo Electronica	Development of products
Metal Leve	Research center development of pilot plant in piston molds
Coester	Transport system
Tecnasa Eletronica	Development of new technology in radio navigation
Scopus Tecnologia	Local network development
Elebra Telecomunicacoes	Software integration laboratory
CBV Industria Mecanica	Development of products
Cobra Computadores	Operation system
Tecnasa	Development of VDR/DME system for radio navigation
Acesita	Training staff personnel at the graduate level
Ind Reunidas Caneco	CAD/CAM system
Fupresa Hitchiner	Import of a R&D center for high technology products

Source Compiled from FINEP *Relatorio Annual 1987* and *Brazilian Defense Directory 1987*

## Section V The Tripod Structure of the Industry The Role of SOEs, Private Sector, and Multinationals

The structure of the BDI combines SOEs, private domestic enterprises, and MNC subsidiaries, and spans over 650 firms<sup>59</sup> Defense firms permeate virtually all sectors of the Brazilian economy but are largely concentrated in four states São Paulo, Rio de Janeiro, Minas Gerais, and Rio Grande do Sul

### *SOE Enterprises*

State-owned enterprises are found in all three branches of the Brazilian Armed Forces SOEs as producers play a larger role in the aircraft industry Embraer, which is the largest SOE in the defense industry, originally specialized in the production of planes with low technological content However, in 1989 Embraer was designing and manufacturing a whole family of advanced aircraft ranging from agricultural planes to jet fighters Embraer also builds a wide range of single and twin engine piston planes under an industrial cooperation agreement with the American firm Piper<sup>60</sup>

Embraer's success is attributed to a number of joint ventures and licensing agreements throughout the 1970s that enabled the aircraft producer to acquire large scale assembling technology from the Italian firm Aermacchi, sales

techniques from Piper, and inputs such as landing gears for its airplanes from the French company Eran <sup>61</sup>

Embraer was the first producer from a NIC to develop a combat jet aircraft—the fighter/bomber and ground attack aircraft AMX. The jet fighter has no real competitors in its category, and the plane is arriving in the market at a time when competitive products are becoming obsolete <sup>62</sup>. In 1988 Embraer officials announced their plans to produce a supersonic light fighter, the MFT-LF <sup>63</sup>

Embraer exports to five continents, and in 1985 was ranked the six largest manufacturer of airplanes in the world <sup>64</sup>. This SOE was able within a relatively short time to successfully compete in a worldwide industry that has high barriers to entry. Embraer's success results from its flexibility in designing products that may be used for either military or civilian purposes. With 556 sold, the *Tucano* EMB-312, a fighter trainer, is the world's best-selling aircraft in its category, surpassing similar Swiss, British, and Australian aircraft <sup>65</sup>

### *Brazilian Private Sector*

In contrast to other LDC defense industries, such as Argentina's, <sup>66</sup> the private sector plays an important role in the Brazilian industry. The BDI has offered the private sector opportunities for higher degrees of capacity utilization, a way to offset downswings in the domestic market, and potentially new markets in which it can sell products for the civilian market via dual-use technology. For instance, Metal Leve, originally a supplier of engine pistons to Embraer, currently exports pistons to the US aircraft market.

Avibras and Engesa are Brazil's private sector leaders in the defense industry. Founded in 1961, Avibras developed a wide array of research in the aerospace field, an entire set of air-to-ground and surface-to-surface weapon systems, and a whole family of scientific rockets <sup>67</sup>. In the early 1970s the technology and skills amassed in the development of civilian rockets were diverted to military endeavors <sup>68</sup>. Through the years Avibras has vertically integrated its operations, creating subsidiaries in space research and in the electronic, chemical, spatial research, and communications sectors <sup>69</sup>

Avibras' line of products consists of space research systems, surface-to-surface defense systems, air-to-ground defense systems, electronics and communications, and satellite communication earth stations and radars. In addition, its subsidiaries Tectran and Tectronis produce special transport systems and electric vehicles <sup>70</sup>. One of the main global competitive advantages of Avibras is its on-site assistance and training. Like Engesa, the company also customizes its products according to customer specifications. In the mid-1980s eighty percent of Avibras' income came from international sales <sup>71</sup>

Engesa—Engenheiros Especializados—is the second largest exporter of wheeled armored fighting vehicles in the world<sup>72</sup> Originally a producer of oil-field pumps, the company developed a unique suspension for vehicles In 1968 the Army noticed the 6-wheel drive vehicles Engesa was manufacturing and contracted with the firm to convert 100 army trucks Since then Engesa has developed a full line of armored vehicles<sup>73</sup>

The company produces and exports a wide array of other products, including main battle tanks, utility military vehicles, tank transporters, weapons systems, ammunition, communication systems, and electronic warfare<sup>74</sup> Engesa products are renowned for their ruggedness, low cost, ease of operation, and adaptability to developing countries' terrain and climates characterizing developing countries Engesa's most popular products, the EE-9 *Cascavel* and EE-11 *Urutu*, are currently exported to 35 countries Engesa concentrates its sales in LDCs, exploiting market segments neglected by major arms exporters by tropicalizing its technology Today Engesa has 17 plants with 12,000 employees and a diversified production capability<sup>75</sup> The company has vertically and horizontally integrated its activities Most of its hardware is exported through Engexco, its trading company, which exports items ranging from orange juice to tanks<sup>76</sup>

As a protected firm, Engesa was the sole producer of wheeled armored vehicles, while Avibras monopolized the production of missiles In 1987 Engesa joined Embraer and IMBEL to form Orbita, a company geared toward producing an array of missiles<sup>77</sup>

### *Subsidiaries of Multinational Companies*

Brazilian subsidiaries of MNCs constitute another vital leg of the Brazilian defense industry's tripod Their role, which on the surface appears to be very restricted, is a vital one because they supply components and technology through sub-contracting and licensing agreements MNCs also invest heavily in Brazilian companies

In 1987, 159 MNCs were involved in the BDI US subsidiaries constituted the largest group, followed by the Europeans and the Japanese There is specialization among the MNCs operating in the defense industry French and Italian subsidiaries are concentrated in aerospace activities while West German Japanese, Swedish, and US subsidiaries undertake a wide scope of activities The British are primarily involved in shipbuilding<sup>78</sup>

In the majority of cases MNCs produce both civilian and military products This dual-use capability makes it difficult to delineate specific MNC supply functions<sup>79</sup> For instance, in the transport equipment industry MNCs

supply components Engesa buys locally produced parts from GM, Perkins, Mercedes-Benz, and Saab-Scania Volkswagen and Toyota subsidiaries supply engines and parts to local manufacturers of military vehicles<sup>80</sup>

Multinational subsidiaries are also involved in joint ventures in the BDI Embraer's AMX, a sophisticated combat airplane, is being developed with two Italian firms, Aeritalia and Aermacchi, 48 percent of the work goes to Aeritalia, 30 percent to Embraer, and 22 percent to Aermacchi<sup>81</sup> In early 1987 Embraer started negotiations with McDonnell-Douglas to produce a commercial jet plane that will compete directly with Airbus and Boeing aircraft

MNCs are also active investors in Brazilian defense companies For instance, Volkswagen is the largest single private investor in Embraer,<sup>82</sup> Phillips has a joint production with Engesa in the company's branch Engetronica 30 percent, and Aerospatiale from France has a stake in the Brazilian helicopter firm Helibras<sup>83</sup>

Future European MNC participation is likely to increase because, unlike their American counterparts, European MNCs do not seek much control over end users<sup>84</sup> Future involvement by American MNCs in the Brazilian industry will continue to be restricted by embargoes that prevent sales to one of Brazil's best markets—Libya

## Section VI Future Developments

In 1987 the Brazilian defense industry entered a new phase The BDI's highly specialized market-niche strategies were the impetus for change

First, Brazil initiated a new industrial strategy that forces final producers to become more competitive by reducing protection The recently established Orbita is a good example of increasing competitiveness in the industry For the first time final producers within Brazil, such as Orbita and Avibras, are directly competing in the same range of products—missiles, for example

Second, MNCs are becoming more involved than previously, deepening the international linkages of the industry The BDI is moving towards a closer cooperation with European countries in order to technologically upgrade its defense hardware This has been the first sign of exhaustion of the 'dual-use technology' approach In 1987 the Groupement des Industries Francaises Aeronautiques et Spatiales GIFAS, representing 36 supplier firms, promoted the first ever aerospace event in Brazil<sup>85</sup>

Third, the growth strategy based on readily available parts and technology is evolving to a more sophisticated and more elaborate weaponry, which will gradually avoid the dual-use technology approach and thereby reduce the spill-



over effects in the economy. Also indicative of technological deepening are the Navy's project for a nuclear submarine, Engesa's *Osorio*, along with Avibras SS-300 and CTA SS-1000 ballistic missiles.<sup>86</sup>

Fourth, the Brazilian government has decided to increase the Armed Forces budget, a measure that has important implications for the development of indigenous technology by the military. These trends are related to the Armed Forces modernization plan for the 1990s, which was initiated during the second half of the 1980s. Referred to as the FT-90, the plan calls for a number of investments in key technological areas. The goals of the FT-90 are twofold: modernization and professionalization of the Brazilian Armed Forces. The plan also intends to take advantage of Brazil's indigenous arms industry, which has already resulted in increased R&D expenditures in nuclear technology.<sup>87</sup> In the 1980s Brazil took serious steps toward further utilization of the atom for defense. There are indications that the Navy is running a parallel nuclear program, and it is well known that the Navy has plans to initiate its project for a nuclear submarine in the 1990s.<sup>88</sup>

The Air Force, through Avibras, is also developing a new family of missiles—in particular, the SS-300 missile, cosponsored by the Army General Plan for R&D—capable of reaching ranges beyond 300 kilometers. The CTA has already started research to build the SS-1000, a medium-range ballistic missile capable of carrying a one-ton payload to distances up to 1,200 kilometers and capable of spanning the whole Latin American continent.<sup>89</sup>

Further involvement and interactions of the BDI with the Brazilian computer industry are also expected. As was mentioned earlier, military projects were the driving force behind the creation of the computer industry.<sup>90</sup> It is believed in Brazil that a strong and relatively self-sufficient computer industry is a *sine qua non* for the future of the BDI. Already, there are several informatics firms doing military-related research: Scopus, Cobra, etc. The major firms in the defense industry—Engesa, Bernardini, and Avibras—have their own research laboratories pursuing the development of indigenous software. Bernardini, for instance, recently inaugurated two computer-related units to further develop hardware and software. These endeavors have already achieved some degree of success. For instance, the integration software for Avibras *Astros II* is being made in Brazil.<sup>91</sup>

However, Brazil lacks substantial research in inertial navigation systems, which is fundamental to the further development and upgrade of missiles and solid microelectronics technology.<sup>92</sup> Brazil also lacks the technology to integrate the electronic systems of a supersonic jet fighter.

The future development of the BDI also faces external restrictions. In the 1980s the defense industry had to contend with a number of technological barriers to expansion, including export restrictions by DCs on sophisticated

computers and military technology. For instance, the US has restricted supercomputer sales to Brazil and has pressured Japan and West Germany to adopt similar strategies. In April 1988, Canada, England, France, Italy, Japan, the US, and West Germany signed an agreement imposing embargoes on military rocket technology to NICs, including Brazil.<sup>93</sup> These practices impose serious constraints on the Brazilian space program.

### Conclusion

The rapid development of the Brazilian arms industry was the result of political and economic motivations. The catalytic roles of the government and SOEs were vital for the establishment of the industry and for the promotion of indigenous technology development. In addition, the tripod strategy was vital for the maturity and viability of the industry. The strategy of using dual-use technology reduced costs substantially and offered a competitive advantage internationally. Finally, the simultaneous import substitution and export promotion strategies provided the needed exposure and financial support for further investments.

This paper has also presented evidence showing that, in many instances, the private sector has benefitted from the externalities provided by SOEs, indicating that the State and private domestic enterprises can enhance each other's performance and competitiveness in the international trade scene.

Future development of the industry is likely to be conditioned by three factors. First, it will be vital to the industry's technological upgrading that the country have access to more sophisticated technologies. However, barriers from developed countries have limited Brazil's access to computer technology related to defense hardware development and to missile technologies. Second, conflicts between the arms industry export policy and Brazil's diplomatic policy are likely to increase in the future, possibly forcing Brazil to restrict exports.<sup>94</sup> Third, the high dependency on exports severely affected the industry in 1989. The lack of demand from Arab countries, specifically from Iraq, has had a negative impact on Brazilian defense hardware exports. Avibras alone saw a 50 percent decline in its exports.<sup>95</sup> This has resulted in massive unemployment in the industry. Avibras cut one-third of its labor force, and Engesa dismissed 1,200 people in 1989. Orbita has also reduced its labor force by half.<sup>96</sup>

Despite these setbacks, the Brazilian defense industry is likely to continue growing domestically and externally. Recent efforts such as the development of the AMX will provide a more attractive package of arms for Brazilian customers in the future.

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