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BRAZILIAN ARMS PRODUCTION: PARTIAL DEPENDENCE

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Rachel Schmidt

September 1988

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# BRAZILIAN ARMS PRODUCTION: PARTIAL DEPENDENCE

Rachel Schmidt

September 1988



The author, Rachel Schmidt, is a graduate fellow in the RAND Graduate School. This paper was prepared for the Winter 1988 Uses of History class led by Robert Perry.

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## I. INTRODUCTION

The emergence of such new arms producers into the world market as Brazil, Israel, South Korea, and the People's Republic of China has led to a resurgence of political and economic writings on arms trade. Numerous papers have been published that hypothesize the motives for establishing indigenous production and possible outcomes that may ensue.<sup>1</sup>

According to this arms trade literature, some of these motives include:

- 1) necessity, in the case of pariah states such as South Africa;
- 2) national prestige or regional dominance;
- 3) the role defense industrialization is expected to take in overall industrial modernization;
- 4) the desire to lessen dependency on superpowers or more traditional arms suppliers;
- 5) the need to develop defense equipment that better suits the operational requirements of third world environs; and, of course,
- 6) to make profits.

Similarly, scholars have postulated myriad outcomes that might result from the emergence of new suppliers such as: a growth in regional instabilities; reduced readiness for actual conflict because of the acquisition of less advanced, but indigenously produced equipment; and polarization of wealth or actual setbacks in economic development within countries that have elected to acquire "inappropriate" levels of technology.

This paper addresses the applicability of some of the above motives to the case of the Brazilian arms industry. The growth in Brazilian defense exports has been tremendous: from \$60 million in 1975 to \$500 million a decade later, ranking it as one of the top arms

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<sup>1</sup>Michael Moodie, for example, provides a fairly thorough discussion of motives for indigenous production and implications for regional security in "Defense Industries in the Third World: Problems and Promises," in Stephanie Neuman and Robert Harkavy (eds.), *Arms Transfers in the Modern World* (New York: Praeger, 1979), 294-312. See also Michael T. Klare, "The State of the Trade: Global Arms Transfer Patterns in the 1980s," *Journal of International Affairs* 4 n. 1 (Summer 1986), 1-21. And Gregory Copley, "The Road to Self-Sufficiency," *Defense & Foreign Affairs* (December 1987), 24-30.

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exporters among developing countries.<sup>2</sup> Table A.1 in the appendix shows Brazilian arms export and import data.

Brazil's oft-cited success in exporting armored personnel carriers (APCs) and light transport aircraft has prompted the theory that third world suppliers are developing a market niche in arms trade. But it is unclear whether Brazil's government has as yet achieved the goals for which they invested in indigenous production. In fact, although some aspects of Brazil's economic and military independence have been advanced by cultivation of its indigenous production capabilities, some aspects of dependency remain or have been exacerbated.

Section II provides some historical background on Brazil's defense industries. Section III describes its largest firms today. Section IV reviews some of the factors that have led to Brazil's arms production "success" and Section V analyzes the relevance of some common motives attributed to new arms producers such as those mentioned above.

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<sup>2</sup>World Military Expenditures and Arms Transfers 1986 (GPO: ACDA Publication 127, April 1987), 109.

## **II. SOME HISTORICAL BACKGROUND ON THE BRAZILIAN DEFENSE SECTOR**

The roots of Brazil's defense industries can be traced to naval hull construction under the Portuguese in the mid 1700s, production of ammunition since the late 1800s, and light aircraft production since the early 1900s. In fact, Brazilian Alberto Santos Dumont flew his aircraft in 1906, just three years after the flight of the Wright Brothers. However, the modern production and tremendous growth of Brazil's defense industries are largely attributable to government cultivation of indigenous production since the early 1960s.

### **RELIANCE UPON WESTERN INDUSTRIALIZED NATIONS**

Before World War I and during the interwar period, Brazil relied upon Germany as its primary supplier of weaponry, particularly cannons, machine guns, antiaircraft guns, ammunition, and transport equipment.<sup>1</sup> France and the United States also participated in limited training of Brazilian soldiers in the period. After 1940, the United States became the predominant force in the training and equipping of the Brazilian military, supplying it with weapons for its incursion into Italy during World War II. In 1942 the Joint Brazil-United States Defense Commission was formed, formalizing military ties. A decade later Brazil was included in the U.S. Mutual Defense Assistance Program and throughout the 1950s and early 1960s received substantial military aid grants. Brazil acquired vintage World War II destroyers, armed trainers, and later C-130 transports, helicopters, armored personnel carriers, and tanks for its internal (counterinsurgency) and external defense.<sup>2</sup>

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<sup>1</sup>Information on the early 20th century history of Brazilian defense supplies is derived from Andrew L. Ross, Chapter 5, "Brazil: From Dependent to Rival," in **Security and Self-Reliance: Military Dependency and Conventional Arms Production in Developing Countries** (Columbia University Ph.D. thesis, 1985). Also Frank McCann, Jr., "The Brazilian Army and the Pursuit of Arms Independency 1899-1979," in Benjamin F. Cooling (ed.), **War, Business and World Military-Industrial Complexes** (Port Washington, NY: Kennikat Press, 1981): 171-193.

<sup>2</sup>Ross, p. 8.

The goal of nationalizing defense equipment sourcing began in the economic development era (1930-54) of Brazilian President Getulio Vargas.<sup>3</sup> Like many of its Latin American neighbors, before the Great Depression Brazil relied upon the export of primary commodities such as coffee, sugar and cocoa for its hard currency earnings.

After 1930, however, shortages of imported manufactured products prompted the Vargas government to initiate an import-substitution strategy to promote development. The country's industrialization benefited from its bountiful deposits of copper, lead, zinc, aluminum, and iron ore, which it exported to earn funds to, for example, develop its own steel industry. Manufacturing effectively replaced agriculture as the predominant economic sector, and increasingly in the 1960s, manufacturing production took on larger importance among Brazilian exports.<sup>4</sup> Industrial growth was strongly supported by the government, which actively created state enterprises such as *Banco do Brasil*, *Companhia Siderurgica Nacional* (the state-owned steel company), *Fabrica Nacional de Motores* (producer of tractors, automobiles, and refrigerators), and the nationalization of railroads, oil companies, and major shipping companies.<sup>5</sup>

## REDUCING DEPENDENCY

A series of events in the 1960s, however, accelerated the purposive Brazilian policy of reducing its dependency on U.S. supplies of weapons. A 1964 military coup and the subsequent administration of President Humberto Castelo Branco supported the notion that investment in defense industries was needed to insure the country's national security.<sup>6</sup> Plans were created in an alliance between the army's Department of War Materiel and a

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<sup>3</sup>Ronald D. Green, *Brazilian Government Support for the Aerospace Industry* (Washington, D.C.: U.S. Department of Commerce, International Trade Administration, March 1987), 1.

<sup>4</sup>Ross, p. 12.

<sup>5</sup>"Obsessed With Growth," *The Economist* (25 April 1987), 6-9. Also Ross, pp. 13-15.

<sup>6</sup>See Clovis Brigagão, "The Brazilian Arms Industry," *Journal of International Affairs* 4 n. 1 (Summer 1986), 101-114.

group of São Paulo manufacturing industries known as the *Grupo Permanente de Mobilização Industrial*. These plans led to the partial conversion to defense production of civilian industries such as automobile, heavy equipment and electronics that had been left idle from the country's 1962-67 economic recession.

In addition to the 1964 coup, U.S. military aid to Brazil had been sharply reduced during the 1960s, largely because of allocation of military resources toward Vietnam. This increased Brazil's impetus to seek out alternative European suppliers, such as in its 1970 purchase of Mirage III fighters from France, naval missiles and submarines from Great Britain, and minesweepers from West Germany. By the late 1970s, domestic procurement and weapon purchases from Europe were larger than Brazilian purchases of U.S. equipment. Then in March 1977, the Carter administration issued a highly critical report on the human rights situation in Brazil, attempted to intervene in Brazil's nuclear power plant agreement with West Germany, and introduced a more restrictive arms export policy. Brazil subsequently withdrew from its 1952 mutual defense agreement with the United States and reaffirmed its goal of increased independence in its supply of defense equipment.

#### **TECHNICAL AND MILITARY INSTITUTES**

Before the decision to form a defense industrial sector came the establishment of military-sponsored engineering and technical schools. In 1946, the Brazilian Air Ministry formed the country's Aeronautic (now Aerospace) Technical Center (*Centro Tecnico de Aeronautica* or CTA) and the *Instituto Tecnologica de Aeronautica* (ITA). The CTA conducts state-sponsored research to support the nation's aircraft manufacturing firms. It consists of five institutes with the following responsibilities: 1) aircraft electronics, propulsion, structural materials, and weaponry; 2) certification and testing of aircraft; 3) aerospace research, astrophysics, space flight, and technology; 4) aeronautical and aerospace standards development; and 5) coordination of firm production activities. The

ITA is the air force's technical university and graduates many of the nation's aeronautical, mechanical, and electronic engineers.<sup>7</sup> Many of its graduates receive postgraduate education or on-the-job training at defense firms and universities in the United States, Great Britain, France, and Italy.<sup>8</sup> Similarly, Brazil is cultivating its infant space industry through its *Instituto de Pesquisas Espaciais* (Institute for Space Research, INPE) under the Ministry of Science and Technology. Brazil hopes to advance its space launch program by conducting four satellite flights beginning in 1989.<sup>9</sup>

Central to its policy of limiting its external dependency on weapons imports is the degree to which economic and political factors are interrelated in Brazilian national security doctrine. The nation's *Escola Superior de Guerra* (ESG, or Superior War College), established in 1949 to formulate doctrine, has emphasized economic growth as a priority for assuring both internal and external national security. Brazilian governments since 1964 have followed the motto "*Seguranca e Desenvolvimento*" (security and development) by taking an active role in the industrial expansion of the economy.<sup>10</sup>

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<sup>7</sup>Ross, p. 25.

<sup>8</sup>Edward H. Kolcum, "Embraer Moves to Solidify Role as Leading Aircraft Manufacturer," *Aviation Week and Space Technology* (17 August 1987), 46.

<sup>9</sup>Edward H. Kolcum, "South American Aerospace Programs Press Ahead Despite Weak Economies," *Aviation Week and Space Technology* (15 June 1987), 190.

<sup>10</sup>Commander Robert J. Branco, USN, *The United States and Brazil: Opening a New Dialogue* (Washington, DC: National Defense University Press, 1984), 3.

### III. MODERN BRAZILIAN DEFENSE FIRMS

Modern Brazilian defense production is the output of a limited number of private and semi-private firms. Many of these companies originated as wholly government-owned entities, although private owners now have sizable holdings. Public-sponsored R&D programs at technology institutes such as the CTA are often conducted in conjunction with the design and development efforts of these firms. Like other industrial sectors, defense industries have had the benefit of a Brazilian government strategy of import substitution (high tariffs on foreign imports plus indigenous industry promotion) and an export orientation in production.<sup>1</sup>

Brazil's defense industries appear to be following a pattern observed in the cultivation of other nations' indigenous defense production.<sup>2</sup> According to this model, the acquisition of indigenous defense production know-how proceeds through the following steps:

- 1) the country develops repair and overhaul facilities to maintain imported arms;
- 2) the nation obtains agreements for licensed assembly of unassembled kits or component packages;
- 3) licensed production of simpler components begins while more complex components such as avionics, electronics, and engines continue to be imported;
- 4) the nation has an engineering ability to copy and/or modify imported components, and thereby reduces the volume of these imports;
- 5) indigenous designs of entire weapons systems are begun, using more sophisticated imported components that are beyond the design capability of the country; and
- 6) indigenous designs that use no imported components signify total self-sufficiency in defense production.

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<sup>1</sup>The previously cited Green report provides a complete synopsis of the government-directed import substitution strategy for the Brazilian aerospace industry.

<sup>2</sup>See Moodie, p. 199. Also David J. Louscher and Michael D. Szomone. **Technology Transfer and U.S. Security Assistance: The Impact of Licensed Production** (Boulder: Westview Press, 1987), 4-7.

Many of Brazil's modern-day exports are derivatives of designs originally produced under licensed production. For example, the Italian-designed trainer and light strike aircraft M-326 has been exported by Embraer, Brazil's predominant aerospace firm, under the name Xavante.<sup>3</sup> Currently, much Brazilian production is at stage five, designing its own weapons systems, but with a large percentage of imported components.<sup>4</sup> The government also participates in a number of defense coproduction agreements and joint ventures such as Helibras, a helicopter producer jointly owned by Aerospatiale of France, the Brazilian firm Engesa and the Brazilian state of Minas Gerais. Additionally, legislation passed in 1984 now requires offset concessions in all foreign aircraft purchases.<sup>5</sup>

In 1975, the state holding company *Industria do Material Belico do Brasil* (IMBEL) was formed to manage Brazil's war materiel production factories and to formulate arms marketing policy.<sup>6</sup> IMBEL was intended to help structure Brazil's defense industry and supply firms with technical and financial assistance, and posts representatives within firms to provide advice and guidance in weapons development.

## AIRCRAFT INDUSTRY

Brazil's premier producer of aerospace defense equipment is *Empresa Brasileira de Aeronautica S.A.*, or Embraer. It was established by public decree in 1969 and incorporated a Fiscal Incentive Program, allowing private investors to write off their

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<sup>3</sup>Michael Mihalka, "Supplier-Client Patterns in Arms Transfers: The Developing Countries, 1967-76," in Neuman and Harkavy (eds.), 58.

<sup>4</sup>For example, one of Brazil's most technologically advanced exports, the Osorio tank, is said to be composed of a vast percentage of foreign parts. David J. Lynch, "The Party's Over: Brazilians Scramble for Markets in Brave New World of High Tech," *Defense Week* 8 n. 12 (23 March 1987), 13.

<sup>5</sup>Offsets are barter-like concessions against the purchase price of foreign defense purchases. See *Assessment of the Effects of Barter and Countertrade Transaction on U.S. Industries* (Washington, DC: U.S. International Trade Commission Publication 1766, October 1985), 133.

<sup>6</sup>Branco, p. 84.

holdings from their taxes with the provision that a portion of stockholder earnings be reinvested in R&D. Today Embraer is one of the top ten general aviation firms in the West, with over 3500 aircraft deliveries since 1969, over 10,000 employees, and 1986 sales of \$378 million.<sup>7</sup>

Its product line includes the light turboprop transports Bandeirante and Brasilia, the armed trainer/striker Xavante, and its best sales item, the single-engine Tucano military trainer. The 19-seat Bandeirante and 30-seat Brasilia have been sold to regional and commuter airlines, over half of the sales to U.S. buyers.<sup>8</sup> Table 2 in the appendix shows some of the purchasing nations of these aircraft. Embraer's follow-on to these transports will be the 19-seat CBA 123, a joint development project with Argentina's *Fabrica Argentina de Material Aerospacial* (FAMA), with the first of an estimated 400-500 sales to be delivered in 1991.<sup>9</sup> The Tucano has been sold to seven other countries, including Peru, Argentina, Egypt, Iraq, Honduras, Venezuela, and Great Britain--over 586 unit orders and options in all.<sup>10</sup> Additionally, Embraer joined Aeromacchi and Aeritalia of Italy in the joint development of the subsonic ground attack AMX, a replacement for the F-104 with 79 orders thus far.<sup>11</sup> The AMX was scheduled to be introduced into the Italian air force by June 1988.<sup>12</sup> Additionally, plans are being made for the development of a supersonic military trainer, probably with the assistance of foreign firms as in the case of the AMX.<sup>13</sup>

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<sup>7</sup>Alan Riding, "Brazil's Burgeoning Arms Industry," *New York Times* (3 November 1985), 4F. Also "Brasilia Transport, Tucano Trainer Form Backbone of Embraer Product Line," *Aviation Week and Space Technology* (17 August 1987), 42-43.

<sup>8</sup>Green, p. 16.

<sup>9</sup>Edward Kolcum, "Embraer Moves to Solidify Role as Leading Aircraft Manufacturer," *Aviation Week and Space Technology* (17 August 1987), 41-42.

<sup>10</sup>"Embraer Moves," p. 47.

<sup>11</sup>"Brasilia Transport," p. 42.

<sup>12</sup>"Industry Observer," *Aviation Week and Space Technology* (22 June 1987): 15.

<sup>13</sup>David Lynch, "Brazilian Firm Making Plans for Supersonic Training Jet," *Defense Week* 8 n. 11 (16 March 1987), 1,14.

The firm Helibras, jointly owned by France's Aerospatiale, Engesa, and the state of Minas Gerais, was established in 1977 and produces (under license) the Aerospatiale Lama, Ecureuil and Dauphin helicopters. Helibras most recently won a \$246 million contract to produce 52 antitank and assault helicopters for the Brazilian army's new airborne cavalry unit.<sup>14</sup> The French air force is reportedly considering the Tucano for its new trainer in order to fulfill offset commitments in Aerospatiale's helicopter contract.<sup>15</sup>

## AIRCRAFT ENGINES

Thus far Brazilian aerospace firms have relied upon foreign engine technology and imports to power their aircraft. For example, Embraer depends upon the Pratt & Whitney Canada PT6A engine for the Bandeirante, its PW115 engine for the Brasilia transport, and the Rolls Royce Spey Mk807 engine for the AMX. Embraer and FAMA are considering the Garret TPE 331-16, General Electric's CT9, and the Pratt & Whitney of Canada's PW400/1 for use in the new CBA123 commuter.<sup>16</sup>

Brazil does have limited engine repair and overhaul facilities, however, and the Brazilian Ministry of Aviation is attempting to upgrade its capabilities. The *Companhia Electromecanica* (CELMA) became part of Brazil's Aeronautics Ministry in 1972. Today the Brazilian government controls 80 percent of CELMA'S shares, while 15 percent is owned by United Technologies (Pratt & Whitney) and the rest by small shareholders.<sup>17</sup> Since 1980, CELMA has doubled its number of employees to 1600 and received a bolster of \$22 million from the Brazilian government and General Electric to upgrade its maintenance and repair facilities. GE holds the biggest proportion of Brazil's large jet engine market. CELMA now has facilities to repair GE CF6 and Pratt & Whitney

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<sup>14</sup>Rik Turner, "Aerospatiale, Brazilian Partners Win \$246 Million Copter Contract," *Defense News* (22 February 1988), 3, 36.

<sup>15</sup>Rik Turner, "French Ponder Purchase of Tucanos to Offset Brazilian Helicopter Deal," *Defense News* 3 n. 13 (28 March 1988), 18.

<sup>16</sup>Kolcum, "Embraer Moves," p. 42.

<sup>17</sup>Green, p. 25.

Canada PW115 engines and produce some components. It will also conduct the assembly of the Rolls Royce Spey Mk 807 turbofan for the AMX, as well as produce 12 of its engine components.<sup>18</sup>

## **ARMORED VEHICLES**

As is the case with the aircraft industry, one private firm--Engesa--dominates the field in Brazilian armored vehicle production. Engesa (or *Engenheiros Especializados S.A.*) was initially established in the 1960s as an oil equipment supplier, and it developed a suspension system for trucks that could withstand tough terrain. It consequently developed wheeled military vehicles such as its two largest export items, the 13-man Urutu armored personnel carrier, and the 3-man Cascavel armored car. Engesa made its first export sale to Libya in 1973 and has since sold over 5,000 Cascavels and Urutus.<sup>19</sup>

The firm attributes its success to the simple design of its vehicles, allowing easier maintainability, as well as the "no political strings attached" Brazilian stand on arms exports.<sup>20</sup> Engesa's first tracked vehicle, the 40-ton Osorio tank, was recently selected by Saudi Arabia from among West German, French, British and U.S. competition. Reports of the estimated \$3 billion deal suggest that Brazil will accept oil as partial payment and may coproduce the tank in Saudi Arabia.<sup>21</sup> However, Engesa has increasingly met financial difficulties, partly because of the cease-fire in the Iran-Iraq war and delays in its production schedule.<sup>22</sup>

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<sup>18</sup>Pierre Condom, "Brazil Moves to Make Engines," *Interavia* (7/86), 777-778.

<sup>19</sup>Riding.

<sup>20</sup>Bradley Graham, "Brazil Arms Industry Competes Worldwide," *Washington Post* (2 November 1986), D1-2. Also Lynch, p. 12.

<sup>21</sup>"Brazil Defies U.S. Over Proposed \$1-2 Billion Arms Sale to Libya," *International Defense Intelligence* 10 n. 6 (8 February 1988), 1. Also Rik Turner, "Brazil's Engesa Wins \$3 Billion Saudi Contract," *Defense News* 3 n. 6 (8 February 1988), 1, 36.

<sup>22</sup>"Military Manufacturer Faces Economic Problems," *Foreign Broadcast Information Service (FBIS)-Latin America Daily Report* (18 July 1988), 24.

*Bernardini S.A. Industria e Comercio*, Brazil's second largest armored vehicle producer, has met more limited success in its production of the X-1 series of tanks. Bernardino has also installed modification kits in the Brazilian army's M-41 tank, is a new entrant into Brazil's missile industry, and produces rocket launchers as well as a variety of wheeled military vehicles.<sup>23</sup> Three other firms, *Bisselli Viaturas e Equipamentos Industriais Ltda.*, *Gurgel S.A. Industria e Comercio de Veiculos*, and *Jamy*, also produce vehicles for the Brazilian military.

### MISSILES AND ROCKET SYSTEMS

Two firms produce the majority of Brazilian missile exports--*Avibras Industria Aeroespacial S.A.*, a private firm, and *Orbita Sistemas Aeroespaciais*, a new firm jointly owned by Engesa, Embraer, systems engineering groups, and an ammunition company. Both firms receive substantial engineering support from both Brazil's Army and Air Force Technical Centers, CTA and CTEX, respectively.

Avibras has gained stature as a major exporter primarily because of sales of its Astros 2 rocket artillery saturation system, with combined domestic and foreign sales totalling over \$1 billion.<sup>24</sup> The system consists of a universal mobile multiple launcher and a family of rockets designated the SS-30, SS-40, and SS-60 by their maximum surface-to-surface range. It has been alleged that Iraq has used the Astros 2 system in the war with Iran, but Avibras denies these charges.<sup>25</sup> The U.S. Congressional Research Service also recently released a study that alleges Libya has received some Astros 2 rockets and could

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<sup>23</sup>Ross, pp. 80-81.

<sup>24</sup>"Avibras Emerges as Major Exporter for Brazilian Aerospace Industry," *Aviation Week and Space Technology* (17 August 1987), 49.

<sup>25</sup>See Peter Adams, "Brazil Surveys Export Markets for Domestic Ballistic Missiles," *Defense News* 2 n. 34 (24 August 1987), 4.

conceivably acquire the SS-300 ballistic missile currently under development. Avibras has denied these allegations as well.<sup>26</sup>

Another Avibras product is the Fila point air defense system, an advanced design of the Swiss Contraves Skyguard developed for the Brazilian army. An antiaircraft missile, the Solar, is in the conceptual stages of development for use with the Fila system. Avibras hopes to provide French Exocet missiles with some competition in the world marketplace with new derivatives of their Barracada antiship missile, which has a 70 km range.

Perhaps most notably, Avibras is developing the 300 km SS-300 ground-to-ground ballistic missile with antitank, antipersonnel and antifortification submunitions.<sup>27</sup> A prototype of the SS-300 was demonstrated to the Iraqi military in 1986. However, further development has proceeded at a slow pace.<sup>28</sup> Iraq expressed interest in procuring 50 to 60 missiles and launching systems following the USSR's cancellation of production of the Scud B missile, which both Iran and Iraq have used in their war.<sup>29</sup>

Orbita has three predominant missile programs: production of the MAF Leo laser-guided antitank missile with Italy's OTO Melara, production of the high velocity MSAAV missile with British Aerospace incorporating technology used in the Thunderbolt, and Brazil's version of the Sidewinder, the MAA-1 air-to-air missile, formerly known as the Piranha. The Brazilian government recently cut development fund for the Piranha program, the result of more general budget cuts in all government agencies.<sup>30</sup> The

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<sup>26</sup>Moises Rabinovici, "Avibras Denies Selling Weapons to Libya," **FBIS-Latin American Daily Report** (21 October 1987), 22.

<sup>27</sup>Agusto Calton, "Brazil's Growing Missile Industry," **Jane's Defence Weekly** (5 March 1988), 401.

<sup>28</sup>"Iraq Reportedly Interested in Brazilian Missiles," **DMS Intelligence Report** 9 n. 20 (25 May 1987), 2.

<sup>29</sup>Roberto Goday, "Iraq Interested in Brazilian-Made Missiles," **FBIS-Latin American Daily Report** (hereafter **FBIS-LADR**) (14 May 1987), D1.

<sup>30</sup>Roberto Lopes, "Ministry Cuts Money for Air-to-Air Missile," **FBIS-LADR** (5 July 1988), 26.

MSAAV land-to-air High Velocity Missile is a shoulder-launched missile with a 5-7 km range, firing at a speed of over Mach 4, and using a carbon dioxide laser guidance system.<sup>31</sup>

Additional Orbita programs have drawn as much if not more attention as the Avibras SS-300--for example, the Sonda IV rocket, which is being designed to carry a 500 kg payload 700 km or a 300 kg payload 1,000 km. Brazil claims the Sonda was designed for scientific purposes and commercial satellite launches, but military applications are being studied as well.<sup>32</sup> Jane's Defence Weekly also recently alleged that Libya has offered to provide \$400 million annually for at least five years to finance the development of the Orbita MB/EE series of tactical missiles.<sup>33</sup> Orbita is developing 150, 350, 600, and 1,000 km range versions of the MB/EE.

## **SUMMARY**

The Brazilian government has succeeded in cultivating an impressive aerospace and military production base. Its strongest industrial areas are those of civil and military airframe production, light armored vehicles, and missiles.

Embraer, Brazil's premier aerospace firm has met particular success exporting small regional transport aircraft such as the Bandeirante and Brasilia, as well as its single-engine military trainer, the Tucano. Embraer is enhancing its indigenous design and production capabilities through two codevelopment projects: the CBA regional transport being developed with Argentina, and the AMX, a subsonic ground attack aircraft developed jointly with Aermacchi and Aeritalia.

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<sup>31</sup>Roberto Godoy, "High Velocity Missile Being Developed for Army," FBIS-LADR (4 June 1987), M2-3. Also "New Brazilian Portable SAM," *Defense & Foreign Affairs Daily* XVI n. 109 (10 June 1987), 1.

<sup>32</sup>Eustaquio de Freitas, "Tactical Missile Development Reported," FBIS-LADR (5 January 1988), 22.

<sup>33</sup>"Libya Offers to Finance Brazilian Missile Project," *Jane's Defence Weekly* (6 February 1988), 201.

Indigenous production capabilities of helicopters and aircraft engines within Brazil are at a lower stage than that of airframes. Helibras, a Brazilian firm partly owned by France's Aerospatiale, still largely relies on the transfer of French designs and know-how through licensed production. Although enhancements are being made to the Brazilian firm CELMA's engine repair and overhaul facilities, virtually all Brazilian aerospace firms use foreign engines in their aircraft.

In armored vehicle production, the Brazilian firm Engesa recently scored a major success with its \$3 billion sale of the 40-ton Osorio tank to Saudi Arabia. The Osorio beat out West German, French, British, and U.S. competition for the deal. Engesa has also proved to be a world arms competitor in light armored vehicles with its Urutu armored personnel carrier and Cascavel armored car.

Although Brazilian firms that produce missiles and rockets have recently met some financial difficulties with the demise of the Iran-Iraq War, their advances in design and production capability are impressive. Avibras is a major exporter of surface-to-surface rockets, particularly the Astros 2 rocket artillery saturation system. And Avibras has developed a 300 km ground-to-ground ballistic missile system, anticipating international replacement sales for the Scud B missile. Orbita, Brazil's other major missile production firm, is involved in several missile codevelopment projects being derived from foreign technology. However, Orbita has recently gained most of its attention from its development of the Sonda IV 700-1000 km rocket and its MB/EE series of tactical missiles. Some analysts argue that these could be configured to carry nuclear weapons.

#### **IV. FACTORS BEHIND THE BRAZILIAN "SUCCESS" STORY**

The rapid growth of Brazil's defense industrial sector can be attributed to factors also observed in other mid-level producers such as Israel. These include relatively ample investment resources, an active government role in the cultivation of weapons production, and limited preconditions on the end-use of equipment sold abroad.

Despite--and thanks to--its massive \$115 billion debt situation today, Brazil has enjoyed fairly generous funding for its defense establishment. With the largest GNP in Latin America (11th largest in the world), abundant deposits of copper, aluminum, and iron ore, and a diversified export economy, its resources are quite substantial. Today Brazil is the world's seventh largest steel producer, ninth largest producer of cars, largest coffee and sugar exporter, and the third largest exporter of corn.<sup>1</sup> And largely because of its 21 years of military rule, from 1964 to 1985, arms production was and is a favored industrial sector.

Arms production in Brazil is just one of many examples of an industrial sector highly controlled by the government. By one account, government spending and spending of state-owned companies consumes at least half of Brazil's annual GDP.<sup>2</sup> Approximately 40 percent of Brazil's industrial investment is made by its more than 600 state-owned companies, and even among private firms public regulation is severe.<sup>3</sup> As noted earlier, the defense sector, particularly aerospace, was protected as an infant industry through tight restrictions on imports and subsidization of research and development expenditures.<sup>4</sup>

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<sup>1</sup>"Brazil--Unstoppable," *The Economist* (25 April 1987), 4.

<sup>2</sup>Tomorrow's Italy," *The Economist* (17 June 1987), 20.

<sup>3</sup>*Ibid.*, pp. 20-21. James S. Henry, "Brazil Says: Nuts," *The New Republic* (12 October 1987), 28.

<sup>4</sup>For an extensive discussion of this import-substitution program, see Green.

A third factor facilitating the success of the defense sectors in Brazil has been its willingness to sell equipment abroad somewhat less discriminately than the United States would like. Officially Brazil's National Security Council approves or disapproves arms sales based on the following criteria:

- no sales are to be made to subversive or guerrilla groups;
- sales are not made to countries where the supply of weapons could escalate hostilities;
- sales to "unstable governments or those with unsavory reputations" are to be avoided.<sup>5</sup>

However, Brazil does not include end-use provisions in its sales abroad, and some recent sales appear to conflict with the above criteria. For example, Brazil has supplied armored vehicles to Iraq throughout the Iran-Iraq War and allegedly may develop and sell it tactical surface-to-surface missiles. Officials in Brasilia have denied that tactical missiles will be sold to Iraq and have argued that the sale of armored cars is not destabilizing and will not affect the war's outcome.<sup>6</sup>

The U.S. Congressional Research Service has alleged that Brazil has agreed to exchange liquid fuel technology from the PRC for its own solid fuel technology and weapons. It has also argued that Astros rockets have been sold to Libya, and perhaps to be followed by armored cars, battle tanks and missiles.<sup>7</sup> In 1987 the Brazilian government faced embarrassment when it was leaked to a São Paulo newspaper that the government was considering selling equipment to the Suriname regime of strongman Lt. Col. Desi Bouterse.<sup>8</sup> And Embramil, a subsidiary of Embraer, announced in December 1987 that it would offer rocket launchers and mine detectors for sale to the Nicaraguan

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<sup>5</sup>Branco, p. 86.

<sup>6</sup>Ibid.

<sup>7</sup>Moises Rabinovici, "Avibras Denies Selling Weapons to Libya," **FBIS-LADR** (21 October 1987), 22. Mac Margolis, "Brazil Plans to Resume Weapons Sales to Libya," **Washington Post** (28 January 1988), 22.

<sup>8</sup>Martin Cohen, "Did a Press Leak Force Brazil to Back Off Suriname Arms Deal?" **Defence & Foreign Affairs Daily** XVI n. 183 (24 September 1987), 1.

Army.<sup>9</sup> This occurred just two years after Embraer was embarrassed by the disclosure that it had sold Tucano trainers to the Honduran government in the midst of the Contadora peace negotiations.

Three factors have especially contributed to the rapid advancement of Brazil's arms production capabilities: ample investment resources, an active government role in the industry's cultivation, and limited preconditions on the end-use of exported arms. These factors have not been without costs to Brazil's economy and political relations. The Brazilian government has expended large amounts of funding and technical support, resources that might have been used in debt payments or alternative investments. And Brazil's somewhat indiscriminate criteria for permitting arms exports has strained its political relations with such countries as the United States. However, these factors have resulted in Brazil's quick rise to preeminence as a leading new exporter of arms in the world market.

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<sup>9</sup>Company to Sell War Materiel to Nicaragua," FBIS-LADR (4 December 1987), 20.

## V. HAVE THE GOALS BEEN ACHIEVED?

This section reviews three generalized hypotheses about the motives of new arms producers in light of the Brazilian defense sector's experience. The arms trade literature often depicts motives as being true for all new producers, disregarding the complexities of each nation's case. The three motives analyzed here suggest that:

- Indigenous production of arms lessens a country's dependency on suppliers and thereby makes it less susceptible to arms embargoes, "spare-parts diplomacy," etc.
- Investment in technologically advanced defense industries leads to subsequent economic growth and modernization in civil industries.
- Arms exports are an important means for earning hard currency and thereby enhance a country's development.

### **LIMITING DEPENDENCY: SUSCEPTIBILITY TO LEVERAGE**

Brasilia has increased its self-reliance through indigenous arms production, but some amount of dependency cannot quickly be overcome. Foreign technology and components are still required in many of Brazil's products, such as the Pratt & Whitney engines used in virtually all of Embraer's aircraft. However, companies have pursued an explicit strategy of increasingly supplying more of their own components. For example, the Engesa conglomerate has gradually grown to include its own avionics company and a research and development unit that absorbs 10 percent of the company's profits.<sup>1</sup>

Although Brazil arms production and export have seen tremendous growth, collaborative production still accounts for a substantial portion of that production. Over the period 1967-78, for example, over 100 joint ventures took place between European and Brazilian defense firms.<sup>2</sup> Dependence on off-the-shelf purchases of foreign arms has been replaced by a Brazilian defense sector that depends to a considerable extent on

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<sup>1</sup>Richard W. Foster, "Brazil's Defense Industry Finds a World Market," *Defense & Foreign Affairs* (March 1986), 10.

<sup>2</sup>Brigagão, p.107.

foreign technology and cooperative production projects with foreign partners.

Aerospacia provides the basis of Brazil's helicopter technology and it was through the joint venture Helibras that their production capability was established. Designs for the AMX dual attack/fighter aircraft were developed in conjunction with the Italian firms Aeritalia and Aermacchi. And Brazil's limited engine overhaul and repair capabilities are largely the result of its collaborative work with General Electric and Pratt & Whitney.

Present tensions between Brazil and the United States are also a reminder that U.S. leverage is not easily surmountable. U.S. officials have called for controls over the transfer of advanced military technology, particularly missile guidance systems, to Brazil and other nations that have refused to sign the Nuclear Non-proliferation Treaty (NPT). As a result, a protocol was signed with France, Great Britain, Italy, the Netherlands, Japan, Canada, and the FRG to establish restrictions on the transfer of technical information on missiles with ranges greater than 300 miles.<sup>3</sup>

Additional pressure has been applied by Washington on Brasilia for its lack of participation in the boycott of arms sales to countries linked to terrorist activities, such as Libya.<sup>4</sup> Despite past emphasis on trade over diplomatic concerns, Brazil's Foreign Ministry has displayed increased sensitivity to U.S. concerns over its Libyan sales. This is partly due to other strains in U.S.-Brazilian relations caused by Brazil's informatics law, which limits the imports of foreign computer software to promote the growth of its own software industry.<sup>5</sup>

In terms of national self-sufficiency in military procurement, the Brazilian army has made the most progress among its fellow services. The ubiquity of Brazilian-made tanks

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<sup>3</sup>Roberto Godoy, "Daily Says U.S. Pressuring Weapons Industry," FBIS-LADR (27 April 1987), D1.

<sup>4</sup>U.S. Critical of Arms Sales to Libya," Latin American Regional Reports, Brazil RB-88-03 (17 March 1988).

<sup>5</sup>Foster, p. 11.

and armored vehicles has led one military attaché to estimate that 90 percent of its equipment is produced in-country.<sup>6</sup>

The Brazilian Air Force is scheduled to introduce 79 new AMX aircraft into its inventory this year, in addition to its 36 Northrop F-5s, which it uses for a ground attack mission, and 17 Mirage 3s (called F-103s) used for intercept.<sup>7</sup> Although it has toyed with the possible development of a supersonic fighter, Embraer admits that it does not have the technical or financial capabilities at present--thus Brazil must continue to look abroad for this calibre of aircraft.<sup>8</sup> And last year Brazil embarked on discussions with the PRC to consider procuring 100-110 Shenyang F-7M Airguard fighters in exchange for 200 Tucano trainers. China has long pursued arms sales in South America and is most anxious to use a Brazilian sale as an entry into this market.<sup>9</sup> Brazil became interested in acquiring the Chinese aircraft after failing in its attempt to purchase Northrop F-5Es in 1986. New negotiations for the purchase of 26 secondhand F-5s were also recently established between the Brazilian and U.S. Air Forces.

The Brazilian navy continues to be heavily dependent upon international technology and equipment for its inventory.<sup>10</sup> It has, however, begun a nuclear submarine project and hopes to build the vessel by the end of the century at a total cost of over \$300 million.<sup>11</sup>

To conclude, Brazil's indigenous production capabilities have grown considerably since the 1960s, making them a force to contend with in the international arms market.

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<sup>6</sup>Foster, p. 10.

<sup>7</sup>South American Air Forces," *Interavia* (March 1988), 244. "Brazil's Goal of Self-Sufficiency in Arms Impeded by Inflation, Record High Indebtedness," *Aviation Week & Space Technology* (24 August 1987), 40.

<sup>8</sup>Ibid.

<sup>9</sup>Chinese Working on Latin Market," *Defense & Foreign Affairs Weekly* (21 September 1987), 1.

<sup>10</sup>Article Considers U.S. Army Secretary's Visit," *FBIS-LADR* (1 June 1987), M3.

<sup>11</sup>Brazil Nuclear Sub Plan," *London Financial Times* (8 December 1987), 1.

Brasilia has successfully lessened its dependency upon foreign sources for some sectors of its military equipment, such as armored vehicles, military trainers, and with the development of the AMX, subsonic ground attack aircraft. However, Brazil continues to depend upon foreign sources for supersonic aircraft and the majority of its naval vessels. And although Brazilian firms are pursuing more self-sufficiency in component production, their reliance on foreign components continues to be substantial.

### **DEFENSE-LED ECONOMIC GROWTH**

One hypothesis promoted by arms trade scholars suggests that developing countries consider weapons production capability to be a strategic investment in their economies. That is, defense production allegedly improves a nation's competitive position, particularly in advanced technologies. Arms production is associated with a higher value-added than that in other sectors of production, and investment in one's defense sector has long been considered a vehicle for an economy's modernization and economic growth.<sup>12</sup> There can be no dispute that the promotion of military production and export in lieu of alternative paths to development certainly has opportunity costs. However, many foreign governments believe that the technological advancement associated with weapons manufacturing justifies large investment in arms industries.

Judging alone by the volume of press coverage granted Brazil's burgeoning exports, one might well support the validity of the defense-led growth hypothesis. Yet while it would be remiss to discount the phenomenal growth of the Brazilian defense sector, it would also be incorrect to state that the economy's growth was defense-led. Indeed, the success of Brazilian arms production occurred on the heels of rapid modernization of other large manufacturing sectors such as steel and automobiles. It has been suggested

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<sup>12</sup>Edward A. Kolodziej, "Arms Transfers and International Politics: The Interdependence of Independence," in Neuman and Harkavy, pp. 15-16.

that the infrastructure and precedent set forth in these industries provided the springboard for Brazil's advanced manufacturing technologies such as arms production.

Brazilian light and intermediate production industries expanded substantially during the 1940s and 1950s, as reflected by sustained annual industrial and GDP growth rates of well over 5 percent during that period. By the late 1950s, industrial growth rates were sustained at over 10 percent annually. Manufacturing effectively replaced agriculture as the predominant economic sector; and increasingly in the 1960s, manufacturing production took on larger importance among Brazilian exports. Yet it was not until the 1960s to 1970s that modern defense firms began their growth spurts, much later than the expansion of other manufacturing industries.

The growth in Brazil's defense production sector particularly advanced in the 1970s, largely because of the Brazilian government's strategy of facilitating its exports and protecting the industry from import competition. This strategy had succeeded in other manufacturing sectors and is currently being used to promote the growth of Brazil's computer industry. Because of the magnitude of government intervention in all sectors of the Brazilian economy, the case of expansion in its arms industries merely follows the growth pattern displayed in several other economic sectors.

To conclude, Brazilian defense production achieved its highest growth in the 1960s to 1970s, decades after the expansion of other manufacturing industries such as steel and automobiles. The production infrastructure and know-how gained during these earlier experiences at industrialization undoubtedly led the way for Brazil's later success in defense production. It remains to be seen whether scientific research and advanced technology used in Brazil's arms industry will improve that nation's world competitiveness in other production sectors. However, defense production followed rather than preceded the most substantial period of Brazil's civilian economic growth.

## **HARD CURRENCY EARNINGS**

The final hypothesis examined here is that defense exports are highly regarded for their hard currency earnings. That is, among export sectors, the trade of arms brings in substantial hard currency that is particularly needed for payments on Brazil's enormous \$115-20 billion debt to western industrialized nations. Yet because of the nature of modern arms trade and the small dollar value of weapons relative to the entirety of Brazilian exports, it is unclear that its defense sector contributes as much toward its economic stability as is reported in the trade press.

The Sarney government in Brasilia, like other Latin American governments, has been under considerable political pressure to repudiate its debt burden. And to some extent President Sarney has used the rallying cry of debt-related anti-Americanism to evade criticism for his administration's economic policies. Brazil refused to implement orthodox IMF policies and austerity measures, thus receiving no new loans from foreign banks. It even refused to pay interest to western banks on its outstanding debt from February 1987 until early 1988, fueling fears that other Latin American debtor nations might follow Brazil's lead.<sup>13</sup> Foreign debt is an issue that has pervaded all decisions of the Brazilian government, from reduced military budgets for force planning to the imperative Brasilia places behind export earnings.

As Fig. 1 displays, Brazil's balance of trade in defense production has been positive since the 1970s. However, arms trade and civil aerospace exports are small in comparison with Brazil's other export sectors such as automobiles and agricultural commodities. In its peak year, 1982, Brazilian arms exports totalled \$675 million, or 3.3 percent of total exports for that year.<sup>14</sup> As a comparison, animal feed accounted for 10

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<sup>13</sup>James S. Henry, "Brazil Says: Nuts," *The New Republic* (12 October 1987), 25.

<sup>14</sup>Computed from trade figures published in Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1987* (Washington, D.C.: ACDA, April 1988), 93. Also International Monetary Fund, *Direction of Trade Statistics Yearbook 1987* (Washington, D.C.: IMF, 1987), 223.

percent of Brazil's total exports, coffee 8 percent and motor vehicles 6 percent.<sup>15</sup> Rather than serve individually as the predominant export sector for Brazil, weapons production is but one area in a well-diversified export economy.

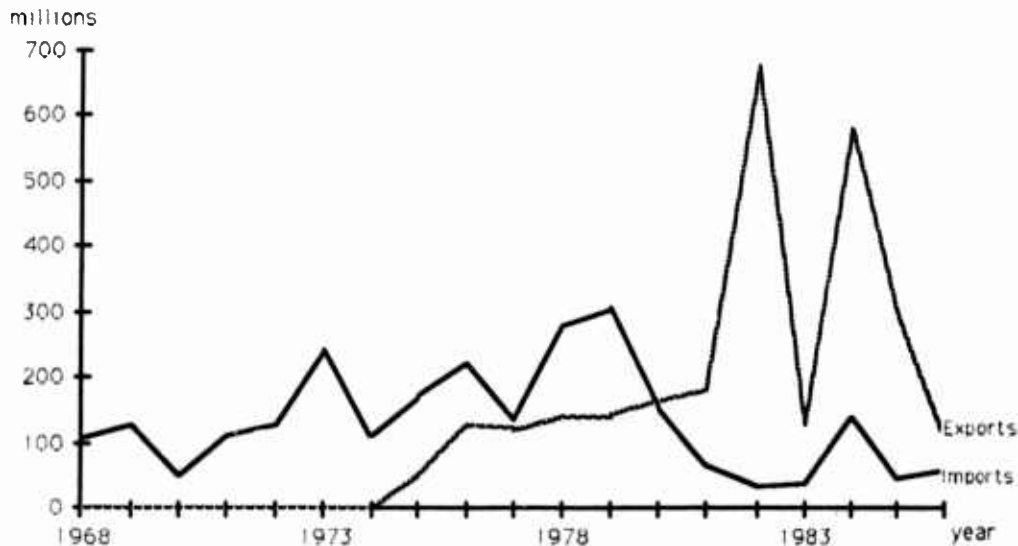


Fig. 1—Brazilian arms exports and imports, 1968-86  
(millions of constant 1982 dollars)

Source: Arms Control and Disarmament Agency. **World Military Expenditures and Arms Transfers 1968-77, 1985, and 1987** (Washington, DC: ACDA Publication 127, April 1977, 1986, and 1988). GNP price deflators taken from **Economic Report of the President** (Washington, D.C., 1987), 244.

Civilian aerospace exports additionally contribute toward Brazil's hard currency earnings. Overall civilian aerospace export figures are not available for Brazil, but U.S. trade data indicate that imports of Brazilian civil aircraft and parts average \$39 million per year over 1980-85.<sup>16</sup> The United States is one of Brazil's biggest external markets for

<sup>15</sup>The Economist Publications, **World Economic Atlas** (London: The Economist, 1985), 115.

<sup>16</sup>Green, p. 29.

civil aircraft. Undoubtedly some synergy exists between the research and development in Brazil's civil and military aerospace sectors, and governmental support for both areas of production may continue to expand their export earnings.

In its present form, arms trade rarely occurs with the simple exchange of hard currency for off-the-shelf weaponry, and Brazil's exports are no exception. Licensed production, coproduction, and joint ventures are standard practices today, as is the use of offsets and countertrade for the financing of weapons purchases. Consequently, hard currency earnings may be somewhat constrained by the form of these transactions. The export of weapons produced under license implies that royalty fees must be paid to the licensing nation. And because many key components of Brazilian weapons are produced abroad, some hard currency outlays are also associated with its export earnings--that is, value added is less than would be the case if all defense components were produced indigenously. The use of barter and countertrade imply that hard currency may not be earned at all; the purchasing nation's export commodities are accepted as payment instead.

Because a sizable portion of its defense exports are sent to the oil-rich Middle East, Brazil has thus far been able to demand and receive hard currency and/or oil (an easily liquidated commodity) for much of its exports. But if Brazil chooses to diversify that contingent of nations purchasing its arms, more exotic arrangements may replace hard currency payments, particularly now that the Iran-Iraq War's cease-fire is in place.

## **CONCLUSIONS**

The tremendous growth in volume of Brazil's defense production appears to be a success story among new mid-level arms producers. Because of Brasilia's careful cultivation and import-substitution strategy, weapons production and export do contribute to that nation's goals of reducing its dependence on foreign weapons and may promote overall economic growth. However, Brazil's ability to achieve total self-sufficiency in

procurement is still far off, as is the goal of alleviating its hard currency shortages through arms exports.

Although great strides have been made in Brazil's ability to indigenously design and produce weapons, major foreign components such as the AMX project with two Italian firms and the high-velocity MSAAV missile with British Aerospace reveal that foreign designs and technology continue to fill gaps in Brazil's indigenous capabilities. And because some gaps do exist, the Brazilian military must continue to look abroad for some of its procurements, such as ships and supersonic aircraft.

An extended period of civilian economic growth preceded and probably set the pattern for achieving Brazil's rapid economic growth in its defense sectors. However, because of Brasilia's investment in high-technology research institutes for defense production, its civilian industries may indeed benefit. This interaction is part of the synergies often seen among economic sectors during the overall process of industrialization.

At a period when hard currency earnings are crucial to fending off the threat of economic collapse, Brazilian arms trade comprises an important portion of export earnings. However, defense exports are but one component of a well-diversified Brazilian export economy.

Brazilian arms production, therefore, receives a mixed evaluation in terms of the achievement of the goals described earlier. To some degree Brazil has been able to lessen its dependency on foreign suppliers for defense materiel, or at least has developed some counterleverage to be used against its former suppliers. However, the dual goals of self-sufficiency and commercial export viability are somewhat competitive. That is, the development of commercially successful market niches such as in armored personnel carriers and military trainers is partly at the expense of using development resources toward more diversified (and thus self-sufficient) defense production.

This paper began by listing numerous goals attributed to the governments of emerging arms-producing nations. Lessened dependency, defense-led economic growth, and hard currency earnings are being advanced somewhat by Brazil's expanding defense production. However, these hypotheses are not nearly as appropriate as one might expect from a casual review of the arms trade literature.

## **Appendix**

**TABLE A.1.**  
**BRAZILIAN ARMS EXPORTS AND IMPORTS, 1968-86**  
(millions of constant 1982 dollars)

| Year | Imports | Exports |
|------|---------|---------|
| 1968 | 106     | 0       |
| 1969 | 126     | 0       |
| 1970 | 48      | 0       |
| 1971 | 113     | 0       |
| 1972 | 129     | 0       |
| 1973 | 242     | 0       |
| 1974 | 111     | 0       |
| 1975 | 169     | 51      |
| 1976 | 222     | 127     |
| 1977 | 134     | 119     |
| 1978 | 277     | 139     |
| 1979 | 305     | 140     |
| 1980 | 152     | 163     |
| 1981 | 64      | 181     |
| 1982 | 30      | 675     |
| 1983 | 38      | 125     |
| 1984 | 139     | 579     |
| 1985 | 45      | 296     |
| 1986 | 61      | 105     |

Source: Arms Control and Disarmament Agency. **World Military Expenditures and Arms Transfers 1968-77, 1985, and 1987** (Washington, DC: ACDA Publication 127, April 1977, 1986, and 1988). GNP price deflators taken from **Economic Report of the President** (Washington, D.C., 1987), 244.

**TABLE A.2.**  
**DESTINATION OF EMBRAER AIRCRAFT DELIVERED OUTSIDE OF**  
**BRAZIL, 1975-83**

| Continent/Country                    | Model       | Number Delivered |
|--------------------------------------|-------------|------------------|
| Africa(Subsaharan)                   |             | 14               |
| Gabon                                | Bandeirante | 6                |
| Nigeria                              | Xingu       | 1                |
| Togo                                 | Xavante     | 6                |
| Upper Volta (Burkina-Faso)           | Bandeirante | 1                |
| Middle East                          |             | 2                |
| Saudi Arabia                         | Bandeirante | 2                |
| North America                        |             | 122              |
| Canada                               | Bandeirante | 1                |
| Mexico                               | Bandeirante | 8                |
| USA                                  | Bandeirante | 113              |
| Central America<br>and the Caribbean |             | 3                |
| Grenada                              | Bandeirante | 1                |
| Panama                               | Bandeirante | 2                |
| South America                        |             | 41               |
| Bolivia                              | Ipanema     | 1                |
| Chile                                | Bandeirante | 9                |
| Colombia                             | Bandeirante | 7                |
| Colombia                             | Xingu       | 1                |
| Paraguay                             | Xavante     | 10               |
| Uruguay                              | Bandeirante | 1                |
| Uruguay                              | Ipanema     | 12               |
| Australia and<br>the Pacific Islands |             | 27               |
| Australia                            | Bandeirante | 15               |
| Fiji                                 | Bandeirante | 4                |
| Guam                                 | Bandeirante | 2                |
| New Zealand                          | Bandeirante | 1                |
| Papua New Guinea                     | Bandeirante | 4                |
| Vanuatu                              | Bandeirante | 1                |
| Western Europe                       |             | 87               |
| Belgium                              | Xingu       | 5                |
| Denmark                              | Bandeirante | 1                |
| Finland                              | Bandeirante | 3                |
| France                               | Bandeirante | 10               |
| France                               | Xingu       | 38               |
| UK                                   | Bandeirante | 28               |
| UK                                   | Xingu       | 2                |
| Total                                |             | 296              |

Source: Derived from Table F in Ronald D. Green, **Brazilian Government Support for the Aerospace Industry** (Washington, DC: Department of Commerce, International Trade Administration, March 1987), 22.