

Arms Production, Economics of

7,900 words before, now 9,933 words (10, 527 incl section III.B)

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GLOSSARY

Arms Industry The set of arms-producing companies, which is not a defined sector in industrial statistics but cuts across several of these.

Arms Procurement Government purchases of military equipment.

Arms Production The production of military equipment.

Arms Producing Company A company which produces military equipment, often in addition to civil production.

Conversion The reuse of resources, which previously were tied to arms production, to the production of civilian goods.

Diversification Increasing the variety of manufactured products; civilian diversification involves an increase in the civilian share of total production, either through the reallocation of available resources (conversion), or through an expansion of total production.

Downsizing Reduction of production capacity.

Military Industrial Complex (MIC) Coalitions of vested interests within the state and industry, including the armed services, government politicians and officials, and representatives of the arms industry.

Offsets Compensations by the export country to the import country, in non-monetary forms, including counter-trade, sub-contracting, capital investment, and technology transfers.

ARMS PRODUCTION is a general term for the production of military equipment. It is not a defined industrial sector but cuts across many other sectors in the manufacturing industry, such as aircraft and spacecraft, chemicals, motor vehicles, transport equipment, and weapons and ammunition. While arms production most often takes place within companies which have both military and civilian production, it has some unique characteristics, which distinguish it from other types of production. Firstly, it is the production of the means of violence, which has led to a higher degree of state control and regulation than for other types of production. Secondly, although to some extent it operates under the same economic conditions as the industrial sectors of which it is part, the fact that the state is the sole or main purchaser of many products results in a monopsonistic market, with rather different characteristics.

I. INTRODUCTION

(475 words/old version 540 words)

Arms production has a number of unique features that make the industry rather different to the rest of industry, despite the fact that arms are to a large extent produced within privately owned companies that also produce civilian goods for commercial markets. The primary reason for this difference is the monopsonistic position of the buyer of its products. The demand side for military equipment consists primarily of a single customer, the national government and export customers normally represent a rather small share of the total demand for most categories of military equipment. Thus, the domestic government has—through its procurement decisions—a significant influence over the volume of orders, the type of equipment to be produced, and the technology to be developed. In addition, through its legislative power, the government can also control competition and military exports and so industry structure. On the other hand, the government depends on the defense industrial base for its supplies of military equipment, and therefore tends to protect the arms industry and guarantee it a certain amount of economic viability. Furthermore, the increasing concentration in national arms industries is leading toward oligopolistic and even monopolistic positions of suppliers in certain product areas, which are protected from foreign competition.

Thus, there exists no real competitive “market” for weapon systems, since this “market” by tradition is monopsonistic, and is gradually moving toward increasing interdependence between government and industry. This does not mean that there is no competition between companies. On the contrary, companies make great efforts to win the small number of very large contracts awarded by their own or foreign governments.

During the post-cold war period the arms industry has undergone a major restructuring process, at first initiated by a 10-year long decline in demand for its products. Subsequently, when the demand began to increase again as the United States Government responded to the terrorist attacks on US cities on 11 September 2001 by large investments in military operations in Afghanistan and Iraq and in Homeland Security, the restructuring process shifted to the sectors that benefited from increased spending, especially those producing the capabilities required for the new type of warfighting, primarily electronics and information technology. Post-9/11 developments have also reinforced the trend towards outsourcing of military services and the emergence of a private security industry.

The purpose of this article is to summarize the available knowledge about arms production and the arms industry. **This includes a rough illustration of the size and structure of the global arms industry, a description of the characteristics of the arms market, a survey of the main developments in arms production during the post-cold war period, and an assessment of the economic impact of arms production. The article begins with an explanation of the basic terms used and the status of data in this field.**

II. TERMS AND DATA

A. Explanation of Terms

(482 words/490 before)

There exists no generally agreed definition of arms production. Efforts to develop definitions that are possible to operationalize have proven difficult. In a general sense, arms production can be defined as the production of military goods and services. Military goods are usually defined to include not only weapon systems but also all other products that have been developed and produced specifically for military use, but excluding items such as food, electricity, ordinary computers, and construction activities. Military services are more problematic to define. Activities such as research and development, testing, and evaluation (RDT&E) of weapons systems, and the maintenance, servicing, and repairs of such systems, assume an increasing importance for the armed forces and are often carried out by private companies. These types of services ideally should be included in the definition of arms production, but in practice this is often not the case.

One important difficulty in defining “arms production” is decide on the scope of the definition as regards the production process and the supply chain, i.e. whether production of subsystems, components and parts should be included. Most often the term “arms production” is used to mean only the production of final weapon systems.

An arms-producing company can be defined in different ways. In this article, it is defined as a company that is engaged in arms production, regardless of the proportion of military sales in the total sales of the company. Few companies produce exclusively for the military market. Most companies have a mixed military and civil production, but most arms-producing companies have divisions or units that are specialized on military production.

The arms industry is a vague concept. It is sometimes used to refer to the sum of arms-producing companies, while sometimes it refers only to the arms-producing parts of these companies. The difference can be great, since arms production can take up a small part of a company’s total sales and employment. In this article the term arms industry is used to refer only to the arms-producing activities of companies.

The defense industrial base (DIB) or the defense technology and industrial base (DTIB) is a broader concept than the arms industry. It encompasses the entire national resources required for providing and maintaining the national requirements of military equipment. There are many different definitions of the defense industrial base. A general definition is as follows: “The defence technology and industrial base is defined as the combination of people, institutions, technological know-how, and facilities used to design, develop, manufacture, and maintain the weapons and supporting defence equipment needed to meet national security objectives. It consists of three broad elements—R&D, production and maintenance” (Office of Technology Assessment, 1992).

In general, it should be noted that all these terms are used in a rather fluid way, especially in empirical studies, because of the difficulties of applying any of those definitions properly in the real world and finding the appropriate data.

B. Data on Arms Production

(419 words/400 before)

Data on arms production are not shown separately in the official industrial statistics, since the arms industry is not treated as an industrial sector of its own but cuts across several industrial sectors, such as aircraft and spacecraft, chemicals, motor vehicles, transport equipment, and weapons and ammunition. Therefore, the available data are produced in special projects and are based on different types of surveys of the industry, conducted by governments, industry associations and research institutes. These are usually national or international aggregations of data reported by individual companies.

Company practices of releasing data on their defense production vary widely. Some companies provide rather detailed information in their annual or quarterly reports, while others do not compile separate statistics for military production or keep such data secret. It is often difficult even for the companies themselves to identify separate revenues, profits, and employment in the military business segment of the company because of the fact that most arms-producing companies also produce for the civil market and resources flow between their civil and military production processes.

Data collections for several countries are provided by research organizations. The Stockholm International Peace Research Institute (SIPRI) maintains a database on the major arms-producing companies in the OECD and developing countries (apart from China for lack of data). Financial and employment data for the 100 companies with the largest arms sales are published in the SIPRI yearbooks. These data are based primarily on company annual reports and company responses to questionnaires and also on information in official documents, military journals, and newspapers. The Bonn International Conversion Centre (BICC) collects data on global arms industry employment that are published in the BICC conversion surveys.

Aggregate data at the national level of the output and/or employment in arms production are provided by a few governments, although not always on a regular basis. Some countries have national defence industry associations, which also provide such data for their member companies. The problem with such data is that they are usually rough approximations and are calculated in different ways in different countries. Some data refer exclusively to the production of final weapon systems, while other data also include the production of parts and maintenance and repairs of military equipment, and some countries include all types of equipment procured by the armed services (Weidacher 2002: 366-372). Some estimates include also the production by subcontractors and suppliers of parts and raw material to the prime contractors. Therefore, data on national arms production are difficult to interpret and must be treated with caution.

III. THE GLOBAL ARMS INDUSTRY: SIZE AND STRUCTURE

A. Global Arms Production

(386 words + 1 table, if IIIB is excluded/before 520 words + 1 table)

The capacity to develop and produce major weapon systems is highly concentrated in a few countries. While a number of countries also have some small scale manufacturing capability for small arms and light weapons, few have a significant defense industrial base and so most depend on imports for their acquisition of arms, at least for major weapon systems.

A general impression of the structure of the global arms industry is given in Table 1, which presents estimates of the value of national arms production, employment in arms production, and arms exports in 1995. Twenty major arms-producing countries accounted for more than 90 per cent of global arms production, with the United States by far the biggest arms-producing country, with estimated arms production of \$90 billion. The US accounted for roughly half of global arms production, followed by the United Kingdom and France, each with roughly 9 per cent, and Germany, Japan and Russia, with shares of 3-7 per cent. Although similar data on arms production are not available for later years, it is clear that the US dominance has increased significantly since 1995. US DOD outlays on arms procurement and RDT&E have increased from \$90 billion in FY1995 to \$148 billion in FY2005 and \$160 billion in FY2006 (US DOD 2006: 132-133) and US DOD prime contract awards for procurement (including supplies, RDT&E and other services) to private industry have increased from \$70 billion in FY1996 to \$163 billion in FY 2005 (US DIOR 1976 and 2005). Simultaneously, US arms exports have increased by over \$3 billion between 1995 and 2004 (table I). Thus, the value of US arms production is likely to have increased to at least \$150 billion in 2005. Other countries have not increased their arms production on this scale. Although several countries increased their arms exports between 1995 and 2004 (table I), this still accounts for a very small share of total arms production in most countries, Russia, Israel and the Ukraine **being the exceptions**. In Europe, arms procurement expenditure remained constant or increased only.

Table I: The Global Arms Industry

Countries are ranked by the value of their arms production.

Figures in US dollars are at current prices and exchange rates.

| Arms production Intervals 1995 (in \$ billions) | Country | Arms production ^a 1995 (in \$ billions) | Employment in arms production ^b 1995 (in thousands) | Employment in arms production ^b 2003 (in thousands) | Arms exports ^c 1995 (in \$ millions) | Arms exports ^c 2004 (in \$ millions) |
|---|---------------------------|--|--|--|---|---|
| >75 | USA | 90 | 2,200 | 2,700 | 15,266 | 18,555 |
| 50-75 | | | | | | |
| 25-50 | | | | | | |
| 15-25 | UK ^d | 18 | 330 | 200 | 7,455 | 9,454 |
| | France | 18 | 310 | 240 | 3,800 | 8,851 |
| 10-15 | | | | | | |
| 5-10 | Germany ^e | 9 | 120 | 80 | 1,385 | 1,402 |
| | Japan | 9 | 100 | 80 | 0 | 0 |
| | Russia | 7-9 | 1,700 | 780 | (1996) 3900 | 5,780 |
| 2.5-5 | Italy ^f | 4 | 40 | 26 | 755 | 596 |
| | Canada | 4 | 35 | 25 | 325 | (2002) 484 |
| | South Korea | 3-5 | 60 | 45 | (1996) 45 | 420 |
| | Israel ^f | 3 | 50 | 30 | 1,369 | 2,600 |
| | China | n.a. | 3,500 | 2,100 | n.a. | n.a. |
| 1-2.5 | Poland | 2 | 90 | 50 | n.a. | (2002) 80 |
| | Sweden | 2 | 30 | 25 | 465 | 992 |
| | Netherlands ^g | 1-2 | 15 | 10 | 641 | 775 |
| | Spain | 1.5 | 35 | 20 | 130 | 504 |
| | India | 1.5 | 190 | 170 | 30 | (2003) 94 |
| | Switzerland | 1-1.5 | 18 | 7 | 119 | 323 |
| | Australia ⁱ | 1-1.5 | 10 | 10 | 29 | (2001) 51 |
| | South Africa ^h | 1 | 75 | 33 | 235 | (2003) 410 |
| | Ukraine | n.a. | 600 | 180 | 180 [??] | (2003) 500 |
| | Total 20 | 180-186 | 9,620 | 6,849 | n.a. | n.a. |
| | World total | 200-205 | 10,620 | 7,479 | n.a. | 44,200-53,300 |

Notes:

a Data on the value of arms production are based on official statistics, either on arms production or on domestic procurement plus arms exports and minus arms imports, unless otherwise stated.

b Data on employment include indirect employment (employees in the production of materials and parts).

c Data on arms exports are based on statistics reported by governments and defence industry associations. These figures are for actual deliveries, unless otherwise stated.

d The figures for arms exports for the UK are for the value of deliveries of defence equipment and additional aerospace equipment and services, as provided in *UK Defence Statistics 2004*, Defense Analytical Services Agency, UK Ministry of Defence. They may include some non-defence items.

e The figure for arms exports for Germany in 1995 is for military equipment, while the figure for 2004 is for “weapons of war”. Both figures are known to be based on a narrow definition of arms. Furthermore, the definition was more narrow in 2004 than in 1995, which is shown by the overlapping years of the two series in 1997-2001, when the latter type of figure was only half of the former type.

f The figure for the value of arms production for this country is an estimate based on arms sales of the major arms producing companies.

g The figures for arms exports for the Netherlands are for granted export licenses, not deliveries.

h The figure for arms exports for South Africa is for granted export permits, not deliveries.

Sources: Data on arms production: SIPRI Arms Industry Files; data on employment: *BICC Conversion Survey 2005*. Bonn International Centre for Conversion. Oxford: Oxford University Press, 2005; data on arms exports: the *SIPRI Yearbook 2006*, pp. 472-473, and data provided on the SIPRI website at URL<http://www.sipri.org/contents/armstrad/at_gov_ind_data.html>.

B. The Top 100 Arms-Producing Companies (219 words + 1 table/before 150 words + 1 table)

The global size and pattern of the arms industry can also be illustrated by the volume of arms production of the 100 largest arms producing companies in the world and their geographical distribution. Table II provides data on the top 100 arms-producing companies in the OECD and developing countries (apart from China for lack of data) in 2004, according to SIPRI data.

The value of the combined arms sales of the Top 100 companies in 2004 was \$268 billion. This represents a significant increase over 1995, when the Top 100 arms sales amounted to \$154 billion (SIPRI Yearbook 1997). The Top 100 companies account for a major share of global arms production. In 1995 they accounted for about three-quarter of the world total. Although no precise estimate is available, it is likely that the share of the Top 100 of global arms production was somewhat higher by 2004 because of the concentration process that has taken place during the post-cold war period.

The data for the Top 100 companies also show a strong dominance of US companies. Forty U.S. companies, accounted for 63.3% of the combined Top 100 arms sales in 2004, while 40 European companies, including Russia, accounted for 29.3%. Nine companies in other OECD countries accounted for 3.1% and 14 companies in non-OECD countries for 4.1%.

Table II. Top 100 Arms-Producing Companies in the OECD and Developing Countries^a Arms Sales^b and Regional/National Shares, 2004
Figures are in US dollars, at current prices and exchange rates.

| Number of companies | Region/ country | Arms sales (in \$ billions) | Share of total sales (%) |
|---------------------|-----------------------------|--------------------------------|-----------------------------|
| 41 | North America | 170.3 | 63.5 |
| 40 | USA | 169.8 | 63.3 |
| 1 | Canada | 0.5 | 0.2 |
| 40 | Europe | 82.1 | 30.6 |
| 11 | UK | 32.4 | 12.1 |
| 8 | France | 19.8 | 7.4 |
| 1 | Trans-European ^c | 9.5 | 3.5 |
| 3 | Italy | 6.6 | 2.5 |
| 6 | Germany | 5.2 | 1.9 |
| 4 | Russia ^d | 3.1 | 1.2 |
| 2 | Sweden | 2.3 | 0.9 |

| | | | |
|------------|---------------------------|--------------|--------------|
| 2 | Spain | 1.7 | 0.6 |
| 1 | Switzerland | 0.7 | 0.2 |
| 1 | Norway | 0.4 | 0.1 |
| 1 | Finland | 0.4 | 0.1 |
| 9 | Other OECD | 8.2 | 3.1 |
| 6 | Japan | 6.5 | 2.4 |
| 2 | Korea, South ^d | 1.3 | 0.5 |
| 1 | Australia | 0.4 | 0.2 |
| 10 | Other non-OECD | 7.8 | 2.9 |
| 4 | Israel | 3.5 | 1.3 |
| 3 | India | 2.7 | 1.0 |
| 1 | Singapore | 0.9 | 0.3 |
| 1 | South Africa | 0.5 | 0.2 |
| 1 | Brazil | 0.4 | 0.1 |
| 100 | Total | 268.3 | 100.0 |

OECD = Organisation for Economic Co-operation and Development

^a China is not included because of lack of data.

^b Arms sales include both sales for domestic procurement and export sales.

^c The company classified as trans-European is EADS, which is based in three countries—France, Germany and Spain—and registered in the Netherlands.

^d Data for Russian and South Korean companies are uncertain.

Source: SIPRI Yearbook 2006, table 9.1, p. 388.

IV. THE CHARACTERISTICS OF THE ARMS MARKET (634 words/430 before)

The arms industry has very specific characteristics. It is usually a monopsonistic market in which the national government is the main customer and regulates exports. This means its size, structure, and trade are all determined by government policy. As Dunne (1995) states, the general characteristics of arms production are:

- (i) An emphasis on the performance of high technology weaponry rather than on cost.
- (ii) The bearing of risks by governments who often finance R&D and in some cases provide investment in capital and infrastructure.
- (iii) Elaborate rules and regulations on contracts, as a result of the lack of a competitive market and to assure public accountability.
- (iv) Close relations between the contractors, the procurement executive and the military.
- (v) Outside of the US many companies will be national monopolies or close to it.

These characteristics create a market that tends to favour firms who specialise in defence work, as they know their way around the red tape and will have the contacts within the military and the procurement executive. They will focus on becoming experts at getting money out of government, rather than being successful in commercial markets. The companies seek involvement in the development programs for technologically advanced weapons systems as the best means of obtaining the subsequent production contracts. This can lead to 'buy ins', where firms understate risk or cost to win initial contracts, making up the losses later. In addition, past programmes have seen 'gold plating' where the military continually ask for extras or continuous technological improvements over the contract period. This allows renegotiation of contracts or additional payments, usually to the advantage of the contractor. The granting of large R&D contracts with risk borne by government together with specific types of production contracts with guaranteed cost coverage has created a tendency toward high profitability in spite of low efficiency in production.

As a result of the structure of the market there are both barriers to entry and barriers to exit which led, to the Cold War defence industrial base (DIB) showing remarkably stability in terms of its composition of main contractors. These barriers, market, technological and procedural, mean that not only has it been difficult for companies to enter into the defence sector to produce weapons systems, or to upgrade from subcontractor status, but also that it is difficult for the defence companies to leave the industry. The emphasis on performance and the large scale of R&D programs are associated with a trend of rising costs of research and development (R&D), which in turn has made it increasingly difficult for single companies or even single countries to develop new advanced weapon systems. This has created a pressure in the arms industry toward concentration into fewer and larger companies, and toward international collaboration in arms production (Dunne et al, 2007).

The links between these large contractors, the state and the military has been described as a military industrial complex (MIC), reflecting the interrelation between the groups with a vested interest in arms production irrespective of rational considerations of national security. In addition, while most manufacturing industries, went multinational, the arms industry remained national and smaller countries, which could not afford the large fixed costs, imported major weapons systems.

With the fall in demand, following the end of the Cold War, the ability of even the major countries to maintain a domestic defence industrial base was called into question. Governments had to decide whether to allow mergers and acquisitions which would reduce competition and in particular whether to allow mergers and acquisitions which involved foreign partners. They were also in a situation where the change in the security environment made it harder to justify previous levels of support for the industry and 'competitive procurement policies' aimed at value for money were introduced in a number of countries (Dunne et al?, 2007).

V. POST-COLD WAR DEVELOPMENTS IN ARMS PRODUCTION (4,146 words + 2 tables/1825 + 1 table before)

Introduction (1427 words)

During the post-cold war period, global arms production has undergone profound changes in most parts of the world. These changes are driven by four main factors. First, the rapid development in military technology, which pushes up the R&D content in advanced weapon systems and makes these increasingly difficult to finance on a national basis; second, a changing relationship between military and civil technology, with civil technology in many areas has taking the lead and is becoming increasingly important in the production of military equipment;

third, changes in the level of demand for military goods and services worldwide; and fourth, qualitative changes in demand due to changed military doctrines and ways of warfare.

The cost growth in advanced military equipment is a long term trend continuing from the cold war. It has accelerated greatly through the development of new military technologies, as a result of the 'revolution in military affairs' (RMA), involving a range of sophisticated technology, often summarized as C4ISTAR (command, control, communications, computers, intelligence, surveillance, target acquisition, and reconnaissance), needed for the new concept of network centric warfare, more recently called network centric operations. During the cold war military technology tended to in advance of civil technology, but gradually developments in civil technology caught up and superceded military technology in many areas, particularly in electronics and information technology. Today there is much less reference to the "spin-off" of military technology to the civil sector and instead a focus on "spin-in" of civil technology into military equipment.

The demand for military goods and services went through two main phases during the post-cold war period. During the first phase, covering roughly the 10-years period 1989-1998, there was a continuous and significant decline in world military spending (roughly one-third in real terms) and with it a fall in the demand for military goods and services from the arms industry. The fall was greatest in Central and Eastern Europe, where military spending in 1998 was only one-tenth of its 1989 level, primarily because of the sharp reductions in the former Soviet states. There was also a significant reduction in military expenditure in North America—by one-third — while reductions were more moderate in Western Europe—a fall of 14 per cent in real terms (Sköns et al. 1998: 191-192). The most profound change took place in Russia, which inherited most of the Soviet arms industry after the disintegration of the Soviet Union in 1991, with a 78 per cent cut in arms production between 1991 and 1998 (Cooper 2006:440). As well as these reductions in domestic demand in the main centres of arms production, there was also a simultaneous decline in the international arms market. During the second half of the 1990s, the fall in demand bottomed out, both domestically in the arms-producing countries and in their export markets. Part of the reason for this was that a growing mismatch emerged between ongoing procurement programs and planned funding of these, in particular in the United States. Few procurement programs for cold war type warfare had been cancelled so they still absorbed substantial funding, while simultaneously new military requirements emerged with the transformation of the armed forces resulting from the RMA.

This mismatch between what the military services wanted and available funding changed over night after the Al-Qaeda sponsored terrorist attacks on New York and Washington on 11 September 2001. The US response to these attacks had major implications for the US arms industry, and indirectly for European arms industry. The shock that the attacks resulted in the release of massive supplementary budget allocations under the heading 'Global War on Terrorism' (GWOT), to cover the costs of military operations in Afghanistan and Iraq as well as for homeland security. Between September 2001 and February 2006, the supplementary appropriations for Department of Defense (DOD) activities in response to 9/11 amounted to \$338 billion (CBO 2006:7) and resulted in a 47 per cent real increase in US military expenditure over 4 years to \$507 billion in 2005 (SIPRI Yearbook 2006). The industry has benefited greatly from this development, as shown by the fact that US DOD prime contract awards to companies increased from \$70 billion in FY1996 to \$163 billion in FY 2005 (US DIOR 1976 and 2005). This sharp rise in military expenditure after 9/11 has been limited to the United States. In Europe, there was no corresponding increase in demand after 9/11, although the decline in military spending and arms procurement did level off. There has been an increase in demand also in China and Russia, but the magnitudes and rate of their increases are much lower than those in the USA. Russia increased the military output of its arms industry by 129 per cent between 1995 and 2005, but this still leaves the overall level of Russian arms production at less than half of its 1991 level and future projections points to another contraction in the future (Cooper 2006: 440). Recent assessments of Chinese defence-industrial capabilities indicate that China's long-term modernization of its defence industrial base is beginning to produce significant qualitative improvements (Medeiros et al. 2005). However, no data are available on the value of Chinese arms production or on the impact of current developments on the size of the industry. While employment in the Chinese arms industry is declining (table I), this is most likely the result of rationalization and increased efficiency and not declining output.

The end of the cold war and the ensuing changes in the security environment also produced a qualitative change in the types of equipment required. With the end of the cold war, the future war scenario was no longer a traditional large-scale war between East and West, in delimited theatres of war. Instead, in some countries the focus shifted to new roles for the armed forces in crisis management and peacekeeping missions to countries in armed conflict in the developing world, which changed both the nature and structure of the required armed forces and the type of weapon systems required. In the United States, the main qualitative shift in demand was from deterrence strategies involving nuclear technologies to a strong emphasis on war-fighting capabilities. This shift has been reinforced in the post-9/11 period and the military operations in Afghanistan and Iraq, which have reinforced the role of RMA

technologies for war-fighting. The use of new technologies in these battlefields also served as demonstration of their utility, which generated further demand.

The strategic options available to arms-producing companies to adjust to the changing demands included (i) reducing their dependency on arms sales, either by full or partial exiting from arms production, or by diversification to increase their civil production; (ii) strengthening their position on the arms market, by increased military diversification or specialization, by different forms of cooperation with other companies, or by increasing their arms exports, whether through new sales and marketing strategies or by accessing new markets. In the countries where the arms industry was largely state-owned, a privatization process took place, to facilitate restructuring. Some of these strategies could be achieved by organic growth in civil or military production, but in most cases they involved also divestitures of existing units or acquisitions of other companies or parts thereof. Furthermore, in many cases, growth through acquisition could be achieved only through cross-border purchases. However, companies' choices were constrained by government policy towards their national defence industrial bases and by the nature of the financial systems within which they operated. During the post-9/11 period, the adjustment process in the US arms industry were linked to the changes in demand produced by the military operations in Afghanistan and Iraq, giving a boost to new military technologies and to the outsourcing of military services, and impacting on both the pattern of acquisitions and on the composition of the US arms industry.

Table III: Developments in the arms industry during the post-cold war period

| | |
|-----------------------------------|--|
| Driving forces | Increasing R&D content in advanced weapon systems |
| | Changing relations between military and civil technology |
| | Changes in the level of demand |
| | Demand for new types of military goods and services |
| | Defence industrial policy |
| Developments in the arms industry | Exiting |
| | Diversification and conversion |
| | Specialization on the military market |
| | International cooperation, mergers and acquisitions |
| | Arms exports |
| | Privatization and outsourcing of military services |

A. Exiting, diversification and conversion (442 words)

A significant number of companies have exited from arms production, in most cases by selling off their arms production units and in a few cases through plant closures or even bankruptcies. According to SIPRI data, by 2003, 18 of the companies that had been among the Top 100 arms-producing companies in 1990, had left the arms industry. Another 25 companies had become integrated into other companies, through mergers and acquisitions. Out of the Top 100 in 1990 only 53 companies survived as independent arms-producing companies until 2003 (while the fate of the remaining 4 is unclear).

The companies that diversified into civil production developed new commercial activities either through organic growth of new businesses or by acquiring existing businesses. This strategy was more successful where the firm could build synergies between the military and civil parts of their activities, which was easier for firms with relatively low dependency on arms sales. Some companies, for example Daimler-Benz (Germany), made acquisitions of smaller companies to develop the conglomerate into a broad-based technology company and so reduced their dependency on arms production. Another example of successful diversification was that of Racal (UK), which built, and then divested, the Vodafone mobile phone business. The remaining arms producing unit of Racal was subsequently sold to Thomson-CSF (France) to form the multinational Thales. However, there are more examples of efforts at civil diversification that had limited success. In principle, the conversion of plants producing military products to producing civil products was also an option to achieve civil diversification, but there are very few examples of a successful conversion strategy in this narrow sense in this period.

Among the 53 survivors in the SIPRI data set, 15 companies had been able to successfully diversify their production so that their civil sales increased while their arms sales decreased, and another 25 companies had increased both their civil sales and their arms sales. However, this was a much smaller number than in 1998, when there was a similar number of survivors but a much higher number of diversifiers—33 out of 57. While these figures show a high degree of diversification, they tend to understate the degree of conversion overall, as companies that successfully moved out of arms production became less visible—they left the Top 100 and so do not count as 'survivors'—and gradual policy changes may not make headlines. In 1998 there was also a much

smaller number that had increased their arms sales. This changed after 1998 as the demand turned upwards again and as a result of the concentration process in the US arms industry that took place in the years immediately before 1998. (Dunne and Surry, 2006)

B. Military specialization (365 words)

The trend towards military specialization has been most marked in the United States and the United Kingdom. The diversification efforts of US companies came to an abrupt end following a decision by the US Department of Defense in 1993 to stimulate mergers and acquisitions. At a dinner for arms industry executives, that has become known as the 'last supper', the then-Deputy Secretary of Defense, William J. Perry, announced the DOD decision that companies would be eligible to be reimbursed for parts of their costs of mergers and acquisitions, if it could be shown that these would result in future savings and result in reduced costs to the DOD. This sparked off a wave of mergers and acquisitions in the US arms industry. The remaining US arms producers no longer based their business plans on a broad-based and diversified product range but on specialization in defence products. This was reinforced by Wall Street transactions, which encouraged companies to concentrate on what the stock market called 'pure play' and 'core competences'. The policy ended when the DOD decided it had gone far enough and blocked the merger of Lockheed Martin with Northrop Grumman in early 1997. This left four major US contractors in 1998: Boeing, Lockheed Martin, Northrop Grumman and Raytheon—which are now four of the top five companies in the SIPRI Top 100 for 2004.

In Europe, with its much smaller national markets, the arms industry was already highly concentrated. The main case of a major merger on the national level in Europe during the post-cold war period, was the formation of BAE Systems (UK) in 1999 through the acquisition by British Aerospace of the defence division of GEC. However, in general, further concentration of the European arms industry would have to involve cross-border mergers, which raised political issues. Furthermore, in several European countries, notably France, Italy, Portugal and Spain, there was a high degree of state ownership of companies at the end of the cold war. This made the kind of financially driven merger boom that took place in the USA more difficult in Europe. Nonetheless, the driving forces in Europe were similar and led to an increase in concentration.

C. International cooperation, mergers and acquisitions (632 words)

International cooperation has always been common in the arms industry. Companies can use international armaments collaboration, joint ventures and strategic alliances to achieve benefits of size without losing independence. All of these techniques have been adopted by arms-producing companies during the post-cold war period, in particular in Europe, where cross-border acquisitions have been difficult to achieve. (Dunne et al 2006). Joint ventures are partnerships, often in the form of a jointly owned company, where two or more companies share profit, loss and control. They are an option for companies which want to combine without having to merge. During the post-cold war period, formation of joint ventures increased significantly in Europe. Major intra-European examples of cross-border joint ventures include Eurocopter, formed in 1992 to join together French and German helicopter activities; Astrium, formed in 2000 to combine the space activities of France, Germany and the UK, now wholly owned by EADS; and MBDA, formed in 2001 to combine the missile activities of France, Germany, Italy and the UK. These joint venture companies, owned by the parent companies of the combined activities, are today among the major arms-producing companies not only in Europe but also internationally. The main transatlantic example is French-US Thales-Raytheon Systems, formed in 2001, and described as the first transatlantic alliance between two global arms-producing companies.

Cross-border mergers and acquisitions are the most radical forms of international integration and were rare during the cold war when the production of armaments was a sector characterized by strict national protection. During the post-cold war period this has begun to change, in particular within Europe. Two major examples of intra-European mergers are the creation of French-German Spanish EADS (the European Aerospace, Defence and Space Company) in 2000 and the acquisition of Racal Electronics in the UK in the same year by the leading French defence electronics company Thales. There have also been a number of US acquisitions in Europe, the most important of which are Bofors Weapon Systems (Sweden), FiatAvio (Italy), QinetiQ (UK) and Steyr Fahrzeuzeug (Austria). European companies have also made great efforts to acquire US companies and establish subsidiaries in the USA, but without much success due to the strict US rules facing foreign-owned companies. The main exceptions are British companies, which have been given special treatment. As a result British companies, and in particular BAE Systems have made a number of acquisitions in the US Arms industry. However, at the prime contractor level there has been no major transatlantic merger similar to the creation of EADS in Europe. Cross-border acquisitions have been successful in accessing foreign markets. For example, Thales has become the second largest defence contractor in the UK and BAE Systems now have more sales to the US DOD than to the British Ministry of Defence.

What is emerging is a web of cross-border ownership and collaboration relationships between companies, primarily within Europe, but also across the Atlantic and with other countries. In the transatlantic dimension, joint ventures and teaming arrangements for bidding on arms procurement contracts still serve as second best solutions to access each others' markets. At the European level, BAE Systems and EADS form the two poles around which most other European defence and aerospace companies have regrouped since the late 1990s. By 2005 this had resulted in a significant degree of European integration. However, while this represents a significant change in comparison with the cold war arms industry, it can nevertheless not be defined as a pan-European arms industry. Furthermore, European integration has been concentrated to the aerospace and electronics sectors, while there has been only limited integration in other sectors, such as shipbuilding and land armaments (Sköns 2005).

D. Arms exports (308 words)

Another means of replacing cuts in domestic demand was through efforts to increase arms exports. Companies tried to capture a larger slice of a rapidly declining export market, and governments, mindful of the need to keep costs down by maintaining or increasing the scale of production of domestic arms producers, supported and encouraged the search for orders abroad. This has resulted in some long-term changes in the global arms market. Arms exports became heavily subsidized, both directly and indirectly; government involvement in support of major export contracts increased; and there has been a strong increase in offset arrangements in arms export contracts. These changes have led to increased competition among arms producers but failed to prevent the inevitable consolidation within the industry.

Offset terms are now a standard element in military contracts. An offset is an agreement between a supplier and a buyer that imposes obligations on the seller to compensate the buyer for the costs of the purchase. They can be either direct or indirect. Direct offsets involve the goods and services in the sales agreement while indirect offsets involve any other goods and services. The most common types of offsets are subcontracting, licensed production or co-production in the importing country, technology transfers to and capital investment in the importing country, and counter trade. Arms trade offsets normally amounts to more than 100% of the arms deal. This means that the value of the compensation exceeds the full value of the arms sales contract, which is possible because of the strong position of the importers in the current international arms market. Apart from export sales of finished goods, companies are also internationalizing their supply chains. The growth of offsets deals has encouraged this and given importing countries the opportunity to develop niche markets, by being part of the supply chain of a major international producer.

H. Privatization and out-sourcing (352 words)

Another significant development during the post-cold war period is increased privatization, both of previously state-owned arms-producing companies and of a number of functions previously performed by the armed forces and defence ministries, through outsourcing. During the post-cold war period much of the remaining state-owned arms-producing industries in Europe have been privatized. However, this does not necessarily mean that the state has abandoned control over these companies.

Outsourcing of military functions to private companies has increased dramatically during the post-cold war period (Wulf 2005). While outsourcing of military functions to private companies is most pronounced in the United States, this policy is increasingly adopted also by European governments (Holmqvist 2005). Although some of the contracts for the outsourcing of military functions from the armed forces contracts are awarded to traditional arms-producing companies, a large part of these contracts go to private security companies. This industry emerged after the end of the cold war as a result of a number of factors, including excess supply of military personnel due to downsizing, the changing nature of warfare, and a shift in government policies towards greater acceptance of outsourcing of military functions to the private sector. With estimated annual sales of about \$100 billion (Singer 2003: 78-81), this industry has been given a strong boost during the military operations in Iraq, where companies have taken on support roles that previously would have been the responsibility of the armed forces. The wars in Afghanistan and Iraq have also produced a large market for post-war reconstruction work.

In combination with the rapid growth of the homeland security market in the United States and elsewhere, these developments have generated a new periphery of private security companies with government contracts and homeland security business and a new group of civil companies that are increasingly involved in arms production. The increasing privatization of military services and post-conflict reconstruction work could be producing a group of influential, profit-chasing companies that have a vested interest in armed conflict, similarly to what arms-producing companies have in the production of weapons and increasing demand for them. (Dunne et al 2006:415-416).

I. Outcome (520 words + 2 tables)

There are three main outcomes of the developments in the global arms industry during the post-cold war period: (1) an increased US dominance in global arms production; (2) an immense growth in the size of the biggest arms-producing companies; and (3) an increased concentration in the group of Top 100 companies.

US companies account for 63 per cent of the Top 100 companies in the world apart from China, according to SIPRI data (table I). The United States also has a lead in military technology and is the major military spender in the world, accounting for 48 per cent of world military spending in 2005 (Stålenheim et al. 2006)

The arms sales of the largest arms-producing companies have tripled between 1990 and 2004. While in 1990, the three largest arms-producing companies on the SIPRI Top 100 List had arms sales of \$7.5–9 billion, in 2004 the three largest companies all had arms sales exceeding \$25 billion (table IV), an amount equal to the entire gross domestic product of countries such as Guatemala and Bulgaria.

As a result of the merger and acquisition activity during the post-cold war period, there has been a clear change in the structure of the industry. Table V shows the changes in concentration of the Top 100 arms-producing companies for the period 1990–2003. At the end of the cold war the international arms industry was not very concentrated, with the top 5 companies accounting for 22 per cent of the total arms sales of the SIPRI Top 100. By 2003 their share of the Top 100 had increased to 44 per cent. This large increase in the share of the top companies is continued further down the list of companies, as shown for the top 10, 15 and 20. In all cases, the big change occurred between 1995 and 2000.

Although by 2003 the five largest arms-producing firms accounted for 44 per cent of total Top 100 arms sales, this is still a very low degree of concentration compared to other high-technology markets. The market for major weapon systems would probably have become more highly concentrated, like those for civil airliners or pharmaceuticals, if national governments had not inhibited the growth of multinational firms to protect their defence industrial base.

However, there is also a strong element of continuity. The post-cold war arms market is still primarily a government market. While market forces have been allowed to work more freely in the military sector during the post-cold war period, this process is still to a great extent government controlled. However, government capacity to control arms production is to a great extent limited to the countries that dominate the system. For smaller producer countries the difficulties to maintain control over their arms industry have been reinforced, not because of increased foreign ownership and privatization but because of greater dependence by small arms-producing companies on the large companies that can compete on the international market for systems integration. This forces the governments of these countries to adjust their policies to facilitate the integration of their companies into larger international military industrial networks.

Table IV. The top 20 arms-producing companies in 2004

| Rank | Company | Country | Arms sales (in \$ billions) | Share of arms sales in total sales (%) |
|------|--|---------|--------------------------------|--|
| 1 | Boeing | USA | 27.5 | 52 |
| 2 | Lockheed Martin | USA | 26.4 | 74 |
| 3 | Northrop Grumman | USA | 26.0 | 87 |
| 4 | BAE Systems | UK | 19.8 | 80 |
| 5 | Raytheon | USA | 17.2 | 85 |
| 6 | General Dynamics | USA | 15.2 | 79 |
| 7 | EADS | Europe | 9.5 | 24 |
| 8 | Thales | France | 9.0 | 70 |
| 9 | United Technologies | USA | 6.7 | 18 |
| 10 | L-3 Communications | USA | 6.0 | 87 |
| 11 | Finmeccanica | Italy | 5.6 | 52 |
| 12 | Science Applications (SAIC) | USA | 4.7 | 65 |
| 13 | Computer Sciences Corporation | USA | 4.3 | 31 |
| S | MBDA (BAE Systems, EADS, Finmeccanica) | Europe | 3.9 | 100 |
| 14 | Rolls Royce | UK | 3.3 | 30 |
| 15 | DCN | France | 3.2 | 100 |
| 16 | Halliburton | USA | 3.1 | 15 |
| 17 | General Electric | USA | 3.0 | 2 |
| 18 | Honeywell International | USA | 2.8 | 11 |
| 19 | Mitsubishi Heavy Industries | Japan | 2.5 | 10 |
| 20 | ITT Industries | USA | 2.4 | 36 |

| | | | | |
|---------|--|--|--|--|
| Top 20 | | | | |
| Top 100 | | | | |

Notes:

S= Subsidiary

The totals exclude MBDA because its arms sales is included in the arms sales of its parent companies.

Source: SIPRI Yearbook 2006, table 9A.1.

Table V. Concentration of the arms industry, 1990-2003

Figures are percentage shares of the arms sales of the SIPRI Top 100 arms-producing companies.

| | 1990 | 1995 | 2000 | 2003 |
|--------|------|------|------|------|
| Top 5 | 22 | 28 | 41 | 44 |
| Top 10 | 37 | 42 | 57 | 61 |
| Top 15 | 48 | 53 | 65 | 69 |
| Top 20 | 57 | 61 | 70 | 74 |

Source: Dunne and Surry 2006, table 9.3.

VI. THE ECONOMIC IMPACT OF ARMS PRODUCTION (564 words + 1 table/before 520 words + 1 table)

In a global perspective, **the arms industry accounts for a small share of world output and employment. In 1995, global arms production, estimated at \$200-205 billion, corresponded to 0.7% of global gross domestic product (GDP). Global employment in arms production, estimated at 10.9 million people in 1995, including indirect employment (BICC 1997), corresponded to 0.2% of the world's population and 0.4% of the global labor force in that year.**

When measured as a share of national output in the main arms-producing countries, the arms industry is also relative small. To get some idea of its size, some figures for the 20 major arms-producing countries in the world in 1995 are presented in Table VI. In most of the countries arms production accounts for around 1% or less of gross domestic product, national employment, and total exports and this is unlikely to have changed in more recent years.

Despite this small size the industry clearly has a high profile and it is often argued that it has significant economic and industrial effects, mainly through its high R&D intensity and the high tech nature of production of most advanced weapon.

Whether this is a positive or negative impact is an issue of debate that is linked with the general debate over the economic effects of military spending. A large literature has addressed the issue with empirical studies that use a number of different theoretical perspectives. In neoclassical supply side models economic growth is derived from the aggregate production function, that is, the input of labor, capital, and technology. Military spending is assumed to have a direct impact on growth, or an indirect one via its impact on technology. In Keynesian demand-side models economic growth is derived from the aggregate demand function, that is, the output of consumption, investment, military expenditure, and balance of trade. The neoclassical models tend to find a negative effect of defence expenditure on growth, due to the competition for resources with civil investment, while Keynesian models find a small positive impact of defence spending on growth due to the multiplier effect of defence spending. Models that combine the Keynesian and aggregate production function approaches, find that the negative demand-side impact tend to outweighs the slightly positive supply-side effect (Dunne, 1996; Sandler and Hartley, ???). Other studies have eschewed the use of formal theoretical models, with some case study analyses have focused on qualitative as much as quantitative analysis and others focussing upon meso- and microeconomic analyses of arms-producing enterprises, sectors and geographical areas.

A major channel by which military spending is hypothesised to have a positive impact on the economy is through the transfer of technological innovation from the military sector to the civil one, or technological spin-off. It has been argued that the high level of technology in military production stimulates the modernization of the overall industrial complex in developing countries, though others suggest the linkages to the civil economy in such economies are likely to be small. In addition, while it may have been the case that military innovations were taken up by the civil sector, for example in the case of transistors, more recently rapid development in commercial technologies, especially in electronics, has led to what has been called 'spin in', with civil technologies increasingly used in arms production (Dunne, 2007)

Overall, there is no real evidence that military spending plays a significant positive role in economic development.

Table VI: The relative size ~~economic impact~~ of arms production, data for 1995

Or

Table IV: The economic importance of arms production, data for 1995

| Country | Share of GDP % | Share of total employment % | Share of total exports % |
|--------------|-------------------|-----------------------------------|--------------------------------|
| USA | 1.3 | 1.8 | 2.0 |
| France | 1.2 | 1.1 | 1.4 |
| UK | 1.3 | 1.1 | 1.4 |
| Japan | 0.2 | 0.2 | -- |
| Germany | 0.4 | 0.3 | 0.3 |
| Russia | 1.1 | n.a. | 3.8 |
| Italy | 0.4 | 0.2 | 0.3 |
| Canada | 0.7 | 0.3 | 0.2 |
| South Korea | 0.8 | 0.3 | 0.7 |
| Israel | 3.5 | 2.5 | 6.5 |
| China | n.a. | 0.6 | n.a. |
| Ukraine | n.a. | n.a. | 1.6 |
| Poland | 1.7 | 1.0 | n.a. |
| Sweden | 0.9 | 0.8 | 0.6 |
| Netherlands | 0.4 | 0.2 | 0.3 |
| Spain | 0.3 | 0.3 | 0.7 |
| India | 0.4 | n.a. | 0.1 |
| Australia | 0.4 | 0.1 | 0.04 |
| Turkey | 1.2 | n.a. | 1.1 |
| South Africa | 0.7 | 1.4 | 0.9 |

Sources: SIPRI Arms Industry Files; *BICC Conversion Survey 1997*.

Also See the Following Articles [This is cross-references done by the editors]

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[**Delete?:** There may be a few other countries that would be included among these top 20 arms-producing countries if sufficient data had been available to estimate the value of their annual arms production. Other countries with a sizeable arms production sector can be identified by looking at data on arms industry employment. Table I.B. includes an additional group of 17 countries with estimated arms industry employment of at least 20,000 people. These 17 countries are likely to account for most of the remaining \$20 billion in global arms production in 1995. Among those, the main arms producers are probably Belarus, Egypt, Estonia, North Korea and Slovakia. However, in spite of their considerably high level of employment in arms production, it is not likely that any of these countries would be among the top 20 as concerns value of production, because the productivity in arms production can be assumed to be much lower than in the 20 major producer countries. The high figures for employment in arms production in these countries are not likely to imply production figures of a corresponding size, due to their much lower employment-output ratios. As can be seen from Table I, there is no strong correlation between output and employment in arms production. In spite of their similar size in arms industry employment, China, Russia, and the United States account for widely different shares in global military industrial output and arms exports. Some of the divergence can be accounted for by differences in definitions and reporting of data. However, the main explanation for this divergence in shares is the major differences in national economic environment and industrial organization. Table I.B. also includes another 20 countries with an estimated arms industry employment of at least 3,000 people, which have some arms production capacity, although the scale of their arms production is a small fraction of the global total.]

DELETE?: Table I.B: Other major arms-producing countries: employment and arms exports

Countries are listed alphabetically.

| Country | Employment in arms production ^a (in thousands) | Employment in arms production ^a (in thousands) | Arms exports ^b (in \$ millions) | Arms exports ^b (in \$ millions) |
|---------------------|--|--|---|---|
| | 1995 | 2003 | 1995 | 2004 |
| The Top 20 | 9,620 | 6,849 | n.a. | n.a. |
| Belarus | 100 | 65 | (1999) 399 | n.a. |
| Brazil ^c | 20 | 15 | n.a. | 285 |
| Croatia | 40 | 6 | 154 | n.a. |
| Czech Republic | 25 | 15 | n.a. | 112 |
| Egypt | 60 | 45 | n.a. | n.a. |
| Estonia | 50 | 10 | n.a. | < 1 |
| Indonesia | 30 | 20 | n.a. | n.a. |
| Iran | 40 | 40 | n.a. | n.a. |
| Iraq ^d | 20 | (2002) 20 | n.a. | n.a. |
| Kazakhstan | 40 | 18 | n.a. | (2000) 6 |
| North Korea | 120 | 120 | n.a. | n.a. |

| | | | | |
|---------------------------------|---------------|--------------|-----------|----------------------|
| Pakistan | 50 | 50 | n.a. | 100 |
| Romania | 40 | 18 | (1999) 30 | 42 |
| Slovakia | 60 | 7 | 168 | (2002) 31 |
| Taiwan | 40 | 35 | 83 | < 1 |
| Turkey | 30 | 45 | n.a. | 196 |
| Serbia/Yugoslavia | 35 | 10 | 235 | n.a. |
| Sub-total (17 countries) | 800 | 539 | n.a. | n.a. |
| Other 20 countries | 200 | 91 | n.a. | n.a. |
| World total (57) | 10,620 | 7,479 | n.a. | 44,200–53,300 |

Notes:

a Data on employment include indirect employment (employees in the production of materials and parts).

b Data on arms exports are based on statistics reported by governments and defence industry associations.

c The figures for arms exports for Brazil are for “value of defence exports”. This figure was 4 times greater than the figure for “value of arms exports” in 1999.

d The figures for employment in arms production in Iraq are from BICC, *Conversion Survey 2004* (OUP 2004).

Sources: Data on employment in arms production: BICC, *Conversion Survey 2005*. Bonn International Centre for Conversion. Oxford: Oxford University Press, 2005; data on arms exports: SIPRI Yearbook 2006, pp. 472-473. Available also on the SIPRI website at URL<http://www.sipri.org/contents/armstrad/at_gov_ind_data.html>.]