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Sources and Methods for SIPRI Research on Military Expenditure, Arms Transfers and Arms Production

● Introduction

Since it was established as an independent international research institute in 1966, SIPRI has forged a reputation for providing unbiased facts and figures—all based on open sources. The projects on world military expenditure and arms transfers are two of the longest running programmes of the Institute. The arms production project was started in 1989.

This fact sheet has been drawn up to supplement the descriptions of sources and methods which the military expenditure, arms transfers and arms production projects contribute to the *SIPRI Yearbook*. Our intention is to facilitate the reading of these studies and to avoid misinterpretation of data published by the Institute. SIPRI's *Yearbooks*, monographs, research reports and other publications are distributed to a wide range of policy makers, researchers, journalists, organizations and the interested public throughout the world.

The collection of data and measurements of trends and developments in these three closely related areas of study make an important contribution to the solution of analytical questions. The traditional SIPRI approach has been both to provide narrative description and to quantify military expenditures, arms transfers and arms production in an empirical manner as important supplements to theoretical studies and policy prescriptions in these areas of research. In accordance with SIPRI policy the raw data stored in the project data bases are derived from open source literature. Publications from countries throughout the world are consulted on a routine daily basis by an experienced international, multidisciplinary team of researchers. Often, published information cannot provide a comprehensive picture because data and developments are not fully reported in the open literature. Published reports provide partial information, and substantial disagreement among

reports is common. Skilled evaluation by the research teams is an important part of compiling the data bases.

Data offered to SIPRI by government agencies or arms manufacturers are accepted only on the understanding that SIPRI will cite the sources.

The military expenditure, arms transfers and arms production projects share a number of objectives. Each project maintains an extensive data base which is the backbone of the Institute's published works in these fields. Each data set is prepared according to specific criteria and for a specific purpose. The aim is to provide continuity in data sets in order to permit the measurement of trends and to support the research programme of the Institute. While the data generated by these three projects are stored primarily for internal use in SIPRI research, as there is an external demand for the data the Institute also makes them available on a limited basis. The policy is not to publish or make available the entire data set—but each project considers requests for basic data on a case-by-case basis and is prepared to assist researchers subject to the overall rules and procedures of the Institute.

To minimize the possibility of their misuse the Institute also makes public the methods by which the data were compiled. On occasion, however, the data sets have been misinterpreted and it is to avoid such misinterpretation that this fact sheet has been prepared to explain the methodology and sources used in preparing each data set.

This fact sheet was prepared by the project leaders: Paul George, Canada (military expenditure); Ian Anthony, UK (arms transfers); Elisabeth Sköns, Sweden (arms production); and editors Billie Bielckus and Connie Wall.

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● Military expenditure

The military expenditure project collects information on and monitors trends in military spending throughout the world. The data provide a solid basis for comparisons and evaluations of military spending and of the economic burden of such expenditures.

The data are presented in three different ways in the *SIPRI Yearbook*: (a) in local currency and current value, i.e., the basic input data; (b) in US dollars and constant prices, to show real-term absolute changes; and (c) as the ratio of military expenditure to gross domestic product (GDP), to show how big a share of national product is allocated to the military sector. SIPRI military expenditure data are therefore transparent. Tables of military expenditure in current and constant prices, as well as military spending as a share of GDP, are published annually in the *Yearbook* where they are presented as a 10-year time-series of military spending for individual countries. For many countries it is not possible to apply an internationally standardized definition of military expenditures. The minimum level of ambition, therefore, is to provide the best possible time-series for each country according to a specific definition for that country.

Methods and definitions

The military expenditure data base is the basis for the tables published in the *SIPRI Yearbook*.¹

All figures in the *Yearbook* are presented on a calendar-year basis on the assumption that military expenditure occurs evenly throughout the fiscal year. This permits the provision of a uniform picture of trends in military expenditure even though budgetary information is not reported by individual countries on the basis of a common fiscal year. The consumer price index (CPI) is used to deflate current prices into constant values, and period-average market exchange rates are used to convert domestic currencies to US dollar figures using the base year (currently 1990) exchange rate. The ratio of military expenditure to gross domestic product or gross national product is calculated in domestic currency (at current prices).

A basic problem arises from the dearth of disaggregated military spending data for most countries, which makes it difficult to set a common definition of military expenditure for all states throughout the time period covered in the military expenditure series. SIPRI has traditionally used the

NATO definition of military expenditure as a broad guideline for all countries. Where possible, the following items are included: all current and capital expenditure on the armed forces and in the running of defence departments and other government agencies engaged in defence projects and space activities; the cost of paramilitary forces, border guards and police when judged to be trained and equipped for military operations; military research and development, tests and evaluation (RDT&E) costs; and costs of retirement pensions of service personnel and civilian employees. Military aid is included in the expenditure of the donor countries. Items on civilian defence, interest on war debts and veterans' payments are excluded.

The United Nations Unified Reporting System might become a useful source of reliable military expenditure data in the future. However, despite its promise of providing greater disaggregation of data in a uniform fashion, the UN system has thus far proved a disappointment. Few countries report their military spending under the UN system and even fewer do so consistently and accurately. Similarly, Organization for Security and Co-operation in Europe (OSCE—formerly the Conference on Security and Co-operation in Europe) participating states are required to report their military spending along the lines of the UN definition, raising the possibility of far more information on a large number of states becoming available from this source in the future. To date, this resource is restricted for OSCE use only, with free access for representatives of member states. Many governments offer SIPRI the same information in response to individual requests.

Sources

The data are collected from national and international publications such as defence budgets, government financial statistics and other economic information and are stored electronically. Supplementary material on military expenditure is collected through systematic scanning and analysis of a wide range of journals, magazines and newspapers. This information is integrated into the data base to provide the broadest possible overview of developments in global military expenditure. Where accurate data are not available, and for the most recent year's figures, this methodology allows the best possible estimates of a particular country's military spending to be made.

For the majority of countries in the SIPRI data base, military expenditure estimates are taken primarily from the International Monetary Fund (IMF) *Government Finance Statistics Yearbook*. Information on the CPI, exchange rates and GDP/GNP data are taken from the IMF's *International Financial Statistics Yearbook*. Official NATO publications provide the data for member countries and reflect NATO's definition of military spending rather than domestic budgetary information. Data for Central

¹ See appendices on 'Sources and methods' in *SIPRI Yearbook 1990: World Armaments and Disarmament* (Oxford University Press: Oxford, 1990), pp. 201–202, and *SIPRI Yearbook 1991: World Armaments and Disarmament* (Oxford University Press: Oxford, 1990), pp. 179–80, and *SIPRI Yearbook 1992: World Armaments and Disarmament* (Oxford University Press: Oxford, 1992), pp. 269–70.

and East European (CEE) countries are taken from domestic budgets provided by their respective embassies in Stockholm or from the ministries of defence in certain countries. Because of the current unreliability of data and the general statistical chaos in the former Soviet republics, military expenditure tables are not produced for these countries.

Supplementary information for all countries—and particularly for those for which no official information can be found—is sought from a wide variety of sources. For example, in addition to analysing journals, newspapers, defence White Papers and standard reference works, the military expenditure project writes to all countries with diplomatic accreditation in Stockholm every year to request current defence budgetary information. In many cases, SIPRI does receive useful material from this effort but, unfortunately, very often information is not forthcoming. Other sources regularly consulted include: the UN publication *National Accounts Statistics: Main Aggregates and Detailed Tables*; *Statistik des Auslandes/Länderbericht* (Federal Statistical Office: Wiesbaden) and *Europa Yearbook* (Europa Publications: London). Supplementary sources inevitably provide inconsistent, contradictory figures and so 'best estimates' are provided from available information where necessary.

● Arms transfers

Each year in the *SIPRI Yearbook* the arms transfers project presents the following information: (a) a narrative description and evaluation of events during the previous calendar year; (b) a register detailing major weapons on order or under delivery, or for which the licence was bought and production was under way or completed during the previous calendar year; and (c) tables and appendices containing data on transfers of major conventional weapons expressed in SIPRI trend-indicator values.

Together, these three elements offer the best available single overview of developments in the international arms trade.

The raw data used in constructing both the arms transfer register and the trend-indicator values are stored electronically in a relational data base. These data are combined to produce the desired output using applications tailored to the needs of the project. The data base has three components:

1. Country and regional data. As the data are linked to state behaviour, countries are chosen as units in the data base rather than sub-state units such as the industry (as producers and suppliers of equipment) or the armed forces (as recipients).

2. Data on major conventional weapons as defined by SIPRI (see below for specific definitions).

3. Data on individual bilateral transfers (criteria for inclusion in the register are listed below).

Selection criteria

The SIPRI arms transfer data cover six categories of major weapons or systems: aircraft, armoured vehicles, artillery, guidance and radar systems, missiles and warships. The statistics presented refer to these categories only. The registers and statistics do not include the trade in small arms, artillery under 100-mm calibre, ammunition, support items, services and components or production technology. Publicly available information is inadequate to track these items satisfactorily.

There are two criteria for the selection of major weapon transfers for the registers: first, certain technical parameters of the equipment; and, second, military application.

The *aircraft* category excludes aerobatic aeroplanes and gliders. Micro-light aircraft, remotely piloted vehicles and drones are also excluded although these systems are increasingly finding military applications.

The *armoured vehicle* category includes all types of tanks, tank destroyers, armoured cars, armoured personnel carriers, armoured support vehicles and infantry combat vehicles. Military lorries, jeeps and other unarmoured support vehicles are not included.

The *artillery* category includes multiple rocket launchers, self-propelled and towed guns, and howitzers with a calibre equal to or above 100 mm.

The category of *guidance and radar systems* is a residual category for electronic-tracking, target-acquisition, fire-control, launch and guidance systems that are either (a) deployed independently of a weapon system listed under another weapon category (e.g., certain ground-based SAM launch systems) or (b) ship-borne missile-launch or point-defence (CIWS) systems. The category is not a proxy for missile launchers alone. Rather, the systems in this category represent the lowest mix of systems which can be independently deployed. For example, some surface-to-air systems include a mix of radars, command vehicles and the data links between them.

The values of acquisition, fire-control, launch and guidance systems on aircraft and armoured vehicles are included in the value of the respective aircraft or armoured vehicle. The reason for treating ship-borne systems separately is that a given type of ship is often equipped with numerous combinations of different surveillance, acquisition, launch and guidance systems.

The *missile* category includes only guided missiles. Unguided artillery rockets and man-portable anti-armour rockets are excluded. Free-fall aerial munitions (such as 'iron bombs') are also excluded. In the naval sphere, anti-submarine rockets and torpedoes are excluded.

Missiles and their guidance/launch vehicles are often entered separately under their respective categories in the arms transfer register.

The *ship* category excludes small patrol craft (with a displacement of less than 100 t) unless they carry cannon with a calibre equal to or above 100 mm, missiles or torpedoes, research vessels, tugs and ice-breakers. Combat support vessels such as fleet replenishment ships are included.

Military application is determined by the identity of the recipient organization. To qualify for inclusion in the register, items must be destined for the armed forces, paramilitary forces, intelligence agencies or police of another country. Transport aircraft and VIP transport aircraft are included only if it is known that they bear military insignia or are otherwise confirmed as military registered. Arms supplied to guerrilla forces pose a problem. For example, weapons that were delivered to the Contra rebels were listed as imports by Nicaragua with a comment in the arms transfer register indicating the local recipient.

Sources

The sources consulted are of five general types: newspapers; periodicals and journals; books, monographs and annual reference works; official national documents; and documents issued by international and intergovernmental organizations. The SIPRI registers are largely compiled from information contained in approximately 200 publications from throughout the world.

Because published sources often provide incomplete or conflicting information, the exercise of judgement and the making of estimates are important elements in compiling the SIPRI arms transfer data base. Order and delivery dates for arms transactions are continuously revised in the light of new information, but where they are not disclosed the dates are estimated. Where the equipment type is known but the exact number of weapons ordered and delivered is not, these are also estimated. This is most commonly done for missiles. Reports of arms deals involving large platforms—ships, aircraft and armoured vehicles—often ignore missile armaments classified by SIPRI as major weapons. Unless there is explicit evidence that platforms were disarmed or altered before delivery, it is assumed that a weapons fit specified in one of the major reference works such as the *Jane's* or *Interavia* series is carried.

The trend-indicator values

The SIPRI approach to quantifying arms transfers has been to find a method of measuring the total flow of major conventional weapons. The flow is measured both across time and between countries. The assumption underpinning the approach is that real event data can be transformed into symbols which can then be aggregated and manipulated in ways which shed light on the events themselves. The international arms trade is composed of many

events, no one of which can be regarded as representative. Therefore, aggregation requires that the individual events are turned into an index which can be presented in a variety of ways.

SIPRI trend-indicator values are produced through a very simple calculation. The numbers of major conventional weapons delivered in any given calendar year are multiplied by the SIPRI trend-indicator value assigned to that system. The results may also be modified according to two other criteria—whether equipment is new, second-hand or refurbished in some way; or whether it is transferred direct or produced under licence.

The core of the SIPRI index of trend-indicator values is the average programme unit cost of weapons for which cost data are available. By focusing on the programme cost—including R&D costs—this index reflects the quality as well as the quantity of the weapons transferred.² The SIPRI trend-indicator value is expressed in US dollars because it is based on data on weapon costs.

Past studies have been unable to prove that there is such a thing as 'defence inflation'. Inflation seems to work in the same manner whether goods are bought by ministries of defence or by civilian customers.³ As a result, the inflators/deflators published by different economic agencies are adequate to take into account changes in embedded costs for materials, labour and other overheads in major weapon programmes.⁴

Increases in the cost of weapon systems stem mainly from additional capabilities which are built into them through the addition of newer technologies. Increases in weapon system costs are therefore a reasonable proxy for increases in performance.

Unit cost data for major conventional weapons are not available from most countries, even those which publish information about aggregate procurement spending. However, they are available from certain countries, some of which are important arms exporters. In the USA fairly complete information is available from the Department of Defense and the General Accounting Office. In the UK information is presented to the Select Committee on Defence and the Committee of Public Accounts (both committees of the House of Commons) as well as the National Audit Office.

² For a recent and more extended account of the sources and methods see Sköns, E., 'Sources and methods', *SIPRI Yearbook 1992: World Armaments and Disarmament* (Oxford University Press: Oxford, 1992), appendix 8D.

³ Sköns, E., 'Military prices', *SIPRI, World Armaments and Disarmament: SIPRI Yearbook 1983* (Taylor & Francis: London, 1983), pp. 195–211; Smith, R., 'Defence costs', ed. J. Roper, *The Future of British Defence Policy* (Gower/Royal Institute for International Affairs: London, 1985), pp. 143–63.

⁴ US Department of Commerce, Bureau of Economic Analysis, *Measuring Price Changes of Military Expenditures*, Washington, DC, June 1975.

For countries where cost data are not available it is necessary to make a 'bridge' using known data. If the intention is to assess the economics of acquisition this approach would be inadequate as national economic conditions are different in different countries. However, in the construction of an index intended to reflect relative military worth this process of bridging is acceptable. The SIPRI trend-indicator values for other weapons are estimated on the basis of technical comparisons (of weight, range, speed and first year of production) with weapons for which real costs are available.

In practice the volume of arms transfers cannot be entirely separated from other forms of acquisition. From a theoretical perspective the extreme ends of the acquisition process can be defined reasonably clearly. Imports refer to the acquisition of manufactured end-items entirely designed and constructed outside the recipient country. Indigenous production refers to the acquisition of manufactured end-items entirely designed and constructed within the recipient country. However, most forms of acquisition fall between these extremes.

The practical problem to be addressed is how to draw boundaries between acquisition through trade and acquisition through local production. If a country is doing more than assembling imported kits—for example, if it has a policy of import substitution by progressively adding locally produced components—it can be said that trade is replaced by production. However, few countries which attempt import substitution escape dependence on foreign suppliers for critical sub-systems and technologies.

At SIPRI the assessment of the significance of local content is of necessity calibrated crudely. It is taken into account whether a country undertakes relatively simple manufacturing tasks—such as producing ship hulls. However, more attention is paid to such issues as whether the primary power unit or electronics suite for a system is imported. With the information available, it is impossible to make a more detailed assessment of the full extent of local input—e.g., through component manufacture.

In distinguishing between acquisition through imports and through local production, account must also be taken of the process of design and system integration. Some major conventional weapons with a very high degree of foreign content were nevertheless designed in the country of acquisition. These are excluded from the data for transfers of major conventional weapons.

It must be emphasized that the SIPRI values are not the actual prices of weapons paid in any particular deal. The index produced using the SIPRI valuation system is not comparable to official economic statistics such as GDP, public expenditure or export/import figures. The actual prices paid in arms transfer deals will vary considerably—depending on pricing methods, the length of production runs and the terms of the individual transaction. For instance,

a deal may or may not cover spare parts, training, support equipment, compensation, offset arrangements for the local industries in the buying country, and so on. Furthermore, even if this information were available for all deals, which it is not, using only the actual sales prices would exclude the impact of military aid, grants, credit, barter, and industrial and other offset arrangements. Financial indicators cannot provide a measure of the total flow of arms.

● Arms production

The SIPRI data base on arms-producing companies was created in 1989 as part of a broader research project on Structural Changes in Arms Production in the New Political Environment. The purpose of the data base is to provide an empirical tool for monitoring and analysis of the implications of the reduction in arms production capacities following the end of the cold war. Since its creation, the data base has provided the basis for a number of SIPRI publications and the annual overview of the 100 largest arms-producing companies presented in the *SIPRI Yearbook*.

Coverage

The data base covers about 300 arms-producing companies and their subsidiaries (making a total of some 500 companies) in the member states of the Organisation for Economic Co-operation and Development (OECD) and the developing countries.⁵ Arms-producing facilities of the Central and East European countries are not included, because of data and definitional difficulties.⁶

Each company record includes fields for basic data on its operations. These include arms sales, total sales, profits, foreign sales, employment, the industrial sector of the company's arms-producing activities and, for subsidiaries, identification of the parent company.

Definitions

For a number of reasons it is not easy to define an arms-producing company. It has so far proven impossible to develop a strict, meaningful and operational definition because few companies are

⁵ The 25 member countries of the OECD are: Australia, Austria, Belgium, Canada, Denmark, Germany, Finland, France, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the UK and the USA.

⁶ The arms industry in these countries was the subject of a separate research project at SIPRI, which published Anthony, I., *The Future of the Defence Industries in Central and Eastern Europe*, SIPRI Research Report no. 7 (Oxford University Press: Oxford, 1994).

exclusively devoted to arms production and because of the integration of military and civilian industrial activities.⁷ Thus the SIPRI definition of an arms-producing company is a loose one: a public or private company engaged in the industrial and/or technological stages of the core sector of arms production. Manufacturing or maintenance units which are integrated with the armed services are not included. R&D, manufacture, and repair and maintenance are included—but purely service-oriented companies are excluded. The core sector does not include general-purpose supplies to the armed forces, such as petrol, clothing and office equipment.

Data on arms sales cover all sales of military equipment to the domestic armed forces and in foreign markets. Where companies do not report exact figures on their arms sales, estimates are made on the basis of, for example, contract awards, analysis of divisional sales and interviews. Data on total sales, profits and employment are for the entire company, not for the arms-producing sector alone. Data on total sales are consolidated to include the sales by subsidiaries excluding inter-company trans-

actions. Profits are usually shown after tax, where the information is available. Foreign sales include all sales on foreign markets, that is, exports from the country of the parent company and, where applicable, sales by foreign subsidiaries. Employment data are for the end of the year, where available.

Data are reported on the fiscal year basis used by the company in its annual report. Financial data are reported in local currency, current prices and converted to US dollars using the period-average of market exchange rates of the International Monetary Fund as provided in *International Financial Statistics*.

Sources

The main sources of the data are company annual reports and a questionnaire sent to the companies each year for their data submission. Supplementary sources include the business sections of newspapers and military journals, government reports on prime contract awards, parliamentary reports on arms procurement and production, information from industry associations and company reference handbooks.

The data base is served by a network of correspondents, currently covering 15 countries. These correspondents, experts working in their own countries, provide annual financial and employment data on the arms-producing companies in their respective countries.

⁷ See, e.g., Walker, W., Graham, M. and Harbor, B., 'From components to integrated systems: technological diversity and integrations between the military and civilian sectors', eds P. Gummesson and J. Reppy, *The Relations between Defence and Civil Technologies* (NATO ASI Series and Kluwer: Dordrecht, 1988); and Burns, D., 'What is the defense industrial base?', *Defense Analysis*, vol. 8, no. 2 (1992), pp. 206–208.



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