

Introduction

Defence economics is a relatively recent addition to the discipline of economics. One of the pioneering texts in the field was *The Economics of Defense in the Nuclear Age* published in 1960 (Hitch and McKean, 1960). Other pioneering developments followed in the 1960s with economic analysis applied to arms races (Richardson, 1960), the weapons acquisition process (Peck and Scherer, 1962), military alliances (Olson and Zeckhauser, 1966) and military personnel (Oi, 1967).

Another landmark in the development of the discipline came with the launch of a new academic journal, namely, *Defence Economics*, which was first published in January 1990. Publication of the journal signalled that the field of defence economics was a recognised and acceptable specialism within the academic discipline of economics. In 1994, the journal's name was changed to *Defence and Peace Economics* and later, publication expanded from four to six issues annually. The launch by Cambridge University Press of the new Elements in Defence Economics series further establishes the field within the economics discipline.

This Element focuses on the achievements of defence economics and some of the challenges it has faced. The review of achievements starts by defining defence economics, outlining a brief review of the main literature and presentation of the defence economics problem. The main fields of the subject are surveyed giving their theoretical and empirical contributions. The field has not remained static and new developments are discussed, including contributions to the economics of conflict, disarmament, peace and terrorism. The remaining challenges facing defence economics are considered, including data availability and the problems of measuring defence output.¹

1 Achievements

Since 1960 and the publication of Hitch and McKean's *The Economics of Defense in the Nuclear Age*, much has been achieved as reflected in large numbers of theoretical and empirical publications. Defence is not static. It is characterised by change in the form of new threats and new technology. Nations are faced with ever changing threats to their national security reflected in new military alliances and coalitions. Examples include the emergence of threats from Nazi Germany and Japan, in the 1930s and early 1940s, and the later threats from the former Soviet Union, in the late 1940s, leading to the formation

¹ This Element presents an Overview of the discipline and it is not a detailed Review of the Literature. Such a Literature Review is available in Sandler and Hartley (1995); Hartley and Sandler (2001); and Sandler and Hartley (2007).

of new military alliances, namely, NATO and the Warsaw Pact. A new strategic environment emerged following the end of the Cold War and the abolition of the Warsaw Pact with some former members of the Pact changing membership to join NATO. Changing threats affect levels of military spending: increased threats lead to higher defence spending; reduced threats lead to disarmament. The end of the Cold War led to a more peaceful world with disarmament offering prospects of a ‘peace dividend’.

Threats are not the only driver of change affecting defence. New technology brings further change and defence has been greatly affected by technical progress leading to new and costlier weapons. Guns have replaced bows and arrows; cannons meant the end of castles; tanks have replaced cavalry; aircraft and missiles emerged as new weapons; nuclear weapons have replaced some conventional forces; nuclear-powered submarines have replaced conventional battleships; and space is a new frontier for warfare. Communications have increased in importance and cyber warfare has emerged.

Such new technologies have resulted in new arms industries and the companies working within them, as well as new combat forces and even completely new armed forces (e.g. air forces). The aircraft industry did not exist in 1900. The major arms companies, such as Airbus, Boeing, BAE Systems and Lockheed Martin, did not exist before 1945 (Boeing excepted). Defence electronics has developed rapidly leading to new electronics, computer and IT industries. New technology is costly and affects defence spending and increases the importance of economics in defence policy. Armed forces and defence departments cannot ignore the costs and efficiency of their limited resources and the size of their defence budgets reflected in the ‘defence economics problem’.

1.1 Definitions: Defence and Peace Economics

Various definitions are available, some reflecting the difference between defence economics and peace economics. A starting point is defence economics defined as the economics of war and peace, which can be expanded to the economics of defence, conflict, disarmament and peace. More formally, defence economics applies economic analysis to the defence economy comprising the armed forces and defence industries. As an economic problem, the focus is on choices, the alternative-use value of resources (opportunity costs) and optimising behaviour seeking to achieve an efficient allocation of resources.

Defence economists and peace economists have different viewpoints. Peace economists focus on conflict management, reduction or resolution and apply

economics to understanding the causes of violent conflict and the methods by which conflict can be avoided, managed and resolved. Peace economists analyse peace and quantify its value by estimating the economic cost of violence and showing that peace is a positive, tangible and achievable measure of human well-being and development. Peace economics encompasses studies of war, arms rivalry, arms control, proliferation, offence–defence balance, game theory and experimental economics. Peace economists often have a normative element in their analysis in the form of a commitment to reduce military spending and the application of economics to promote peace over efficiency in the defence economy. A recent development has been the emergence of conflict economics, which applies economic principles and methods to the study of war, terrorism, genocide, mass atrocities and peace. Conflict economics analyses these events as the result of choices that respond to incentives (Anderton and Carter, 2019).

In contrast, defence economists are more focused on positive economics and the efficiency with which the defence economy uses its resources (Anderton and Carter, 2007; Isard, 1994). Nonetheless, there are substantial overlaps between the two fields of study. Both are concerned with theoretical and empirical work on conflict, arms rivalry and arms control, arms industries, the arms trade, disarmament and the conversion of resources from military to civilian uses. Both seek reputable data sources and apply economic theory, including game theory and experimental economics methods. Contrary to popular views about security and secrecy, there are available substantial published data for defence and peace economists. The next section presents an overview of some of the major data sources. It is illustrative rather than comprehensive.

1.2 Data: Sources

Data are available from national defence ministries and departments, from government and international agencies (e.g. the US Congress, UK Parliament, United Nations (UN), NATO, European Union (EU)) and from ‘think tanks’ such as the Stockholm International Peace Research Institute (SIPRI), the International Institute for Strategic Studies (IISS), the Rand Corporation and the Correlates of War Project.

Some national defence departments publish data on military spending with varying degrees of detail. Examples of countries publishing detailed time-series data on total defence spending and their armed forces include Canada, New Zealand, the UK and the USA. Some nations also provide detailed analysis of major defence projects (e.g. the UK House of Commons Defence Committee Reports, UK National Audit Office, US Congressional Budget Office (CBO)). The US CBO provides detailed reports on various aspects of

US defence policy and spending. Examples include the financial implications of future defence spending, funding overseas conflicts and the costs of replacing the US aviation fleet (CBO, 2020).

International agencies such as NATO, the EU and the European Defence Agency (EDA) also provide time-series data on military spending and military personnel. Some sources provide both total figures and figures for some individual components. For example, NATO publishes various indicators of total spending in current and constant prices and spending on equipment, personnel and infrastructure by member states (NATO, 2019). The EDA publishes annual statistics on defence expenditure and its components, numbers of military and civilian personnel, and collaborative spending by total for the EU and for each member state (EDA, 2018).

The SIPRI is an independent international institute specialising in research on conflict, armaments, arms control and disarmament. It is a major data source for various aspects of military spending. Its *Yearbook* provides annual data on military expenditure for the world and by country, data on arms production by the top 100 arms firms, annual data on international arms transfers including explanations of the sources and methods used to collect the data (SIPRI, 2018). Public databases are also available for military expenditure, arms transfers, the top 100 arms firms and multilateral peace operations.

The International Institute for Strategic Studies (IISS), a British research institute specialising in international affairs, aims to provide accurate, objective information on international strategic issues (e.g. future conflict and cyber security; non-proliferation and nuclear policy). It publishes an annual *Military Balance*, which provides an independent and comprehensive assessment of the military capabilities of many nations. There are international comparisons of defence spending and military personnel as well as data on arms orders and deliveries together with detailed country studies (IISS, 2019).

A leading world think tank is the US Rand Corporation created in 1948 to undertake analysis and research for the US armed forces, especially for the US Air Force (USAF). Later it expanded to other areas of social science, including health care and social policy. It publishes original analysis of aspects of defence policy, including procurement options, defence industries, human capital and privatisation with supporting data (e.g. on aircraft unit costs (Rand, 2018)). Rand pioneered research in game theory and war gaming and has been associated with leading economists (e.g. Arrow; Nash; Schelling; von Neumann; Williamson).

The Correlates of War Project publishes time-series data on various types of wars (from 1816) as well as data on military expenditure,

numbers of military personnel, alliances and national military capabilities (COW, 2020). Mention must also be made of a major and original data source on defence equipment costs, the *Source Book of Defence Equipment Costs* (Pugh, 2007). The *Source Book* provides data on unit production costs and cost increases for a complete range of air, land and sea systems. Examples include aircraft carriers, submarines, surface warships, tanks and artillery, fixed wing aircraft and helicopters, as well as cruise and ballistic missiles.

It should to be recognised that definitions of what constitutes defence spending vary between data sources. Some organisations publish data based on standard definitions of military expenditure. NATO data, for example, uses an agreed definition of defence expenditure and SIPRI also uses a published and standard definition of military expenditure. Some of these definitions differ from national definitions. Typically, definitions of defence spending differ due to the inclusion of ‘other military forces’ (e.g. national police forces), pension payments, mixed civil–military activities, peacekeeping forces and humanitarian operations. Also, some defence spending might be included in the expenditure of other government departmental and not just that of defence departments. Examples include civil defence, transport, government support for industry and R&D. Many of the examples used in this Element are taken from the UK, which is a world military power, and provides a different perspective from the US-dominated empirical literature.

1.3 Data: Stylised Facts

Examples of typical questions asked about defence include the following.

- i) How do we measure a nation’s defence spending and its defence burden?
- ii) How much does the world spend on defence and how large are its military forces?
- iii) What have been the trends over time for military spending?
- iv) Which are the world’s top military spending nations?
- v) Which nations are the largest arms exporters and importers?
- vi) Which are the world’s largest arms companies?
- vii) Are data available on the numbers of military personnel and who has the largest army, navy and air force?
- viii) How much is spent on defence R&D and which nations spend the most on military R&D?
- ix) Are there measures of conflict and terrorism?
- x) What are the outputs of defence spending?

Table 1.1 Illustrative data on defence spending

Topic	Answer
World's leading defence spending nation: 2018	USA: US\$649.0 billion; US defence share of GDP: 3.2%
World defence spending: 2018	\$1,780 billion
World defence spending trends over time (constant 2017 prices)	1990: US\$1,411 billion 2018: US\$1,780 billion
Largest arms exporter: 2018	USA: US\$10,508 million
Largest arms importer: 2018	Saudi Arabia: US\$3,810 million
Largest arms company: 2018	Lockheed Martin (USA): US\$47,260 million of annual arms sales
Numbers of world military personnel: 2017	27.5 million
Numbers of military personnel for European States: 2017	Land forces: 673,000 Air forces: 230,000 Naval forces: 177,000
US defence R&D spending: 2017	US\$47.2 billion
Boeing (defence and aerospace) R&D: 2017	US\$4.6 billion
European Union defence R&D spending, 2017)	US\$1.9 billion
Terrorism and conflict	Measured by Correlates of War data; Global Terrorism Index; Global Peace Index; and ITERATE
Outputs of defence spending	Traditionally assumed that inputs equal outputs

Sources: SIPRI (2019), NATO (2019), IISS (2019), IEP (2018a, 2018b), ITERATE (2019).

Often, non-specialists believe that data are not available to answer these questions. For example, it is claimed that defence is dominated by secrecy, which makes research in the field difficult and impossible. In fact, the reality is that data are available to answer these questions. Table 1.1 presents some answers to the ten questions posed above. It can be seen that the USA is dominant in levels of defence spending, arms exports and defence R&D, and is home to the largest arms firm. By 2017, China was listed as the world's second largest arms producing nation behind the USA, with Russia in third. The largest Chinese arms company was AVIC (Aviation Industry Corporation), which was ranked sixth in the world. The Chinese North Industries Corporation (NORINCO) was

ranked eighth in the world and the world's largest producer of land systems (SIPRI, 2020).²

Data are also available on terrorism and peace. For example, the data show a peak of deaths caused by terrorism in 2014 and a decline in deaths caused by terrorism between 2014 and 2018. The economic cost of terrorism was estimated to be US\$52 billion in 2017 and US\$33 billion in 2018. More widely, the economic impact of violence was estimated to be US\$14.1 trillion in 2018 (IEP, 2019a, 2019b).

Table 1.1 is meant to be illustrative and not comprehensive. For example, there are questions about a nation's defence burden. There are at least two measures of burden, namely, the level of defence spending and the defence share of gross domestic product (GDP). Using defence shares of GDP shows substantial differences in defence burdens. For example, defence shares of GDP in 2018 ranged from 8.8% for Saudi Arabia and 5.3% for Algeria compared with shares of 0.4% for Ghana and 0.2% for Mauritius. Questions arise about explanations for such differences leading defence economists to develop and test models of the determinants of military spending.

Data on military spending and defence shares for the world's top fifteen nations in 2018 are presented in Table 1.2. The USA and China dominate the major spending nations. The rankings change with different measures. Based on defence shares, Saudi Arabia is a top nation together with Russia followed by the USA.

Terrorism is a relatively new form of conflict but it has a long historical tradition. In its recent form, terrorism has become international with a greater use of suicide methods. A number of data sets have emerged on transnational terrorism. One example is ITERATE, which provides data for the period 1968 to 2016 on the characteristics of transnational terrorist groups, their activities and the environment in which they operate. Inevitably, ITERATE makes judgements on the definition of terrorism. For instance, it excludes declared wars and guerrilla attacks on military targets.

Questions also arise about the determinants of a nation's defence spending and whether there are economic models of military spending, wars and conflicts. Similarly, does economic analysis contribute to an understanding of terrorism and offer any guidance on appropriate policy measures? Other topics addressed by defence and peace economics include civil wars, genocides and mass atrocities. Initial answers showing the contribution of defence economics are available by reviewing the existing literature.

² SIPRI published new data on the Chinese arms industry in January 2020 (SIPRI, 2020). These data are summarised in the text.

Table 1.2 World's top fifteen defence spending nations in 2018

Nation	Military spending (US\$ billion)	Defence share of GDP (%)
USA	649.0	3.2
China	250.0	1.9
Saudi Arabia	67.6	8.8
India	66.5	2.4
France	63.8	2.3
Russia	61.4	3.9
UK	50.0	1.8
Germany	49.5	1.2
Japan	46.6	0.9
S Korea	43.1	2.6
Italy	27.8	1.3
Brazil	27.8	1.5
Australia	26.7	1.9
Canada	21.6	1.3
Turkey	19.0	2.5

Note: Countries ranked by levels of military spending.

Source: SIPRI (2019).

1.4 Brief Literature Review: Some Original Contributions

The early economists debated the 'proper' role of government. Adam Smith favoured free market capitalism but recognised a limited role for government in the form of national defence to protect the property of its citizens from theft by foreign powers. He argued that the first duty of a sovereign is the protection of society from violence and invasion by other nations. He also accepted further roles for government in the administration of justice (law and order, e.g. the enforcement of property rights and contracts), the provision of public works (e.g. transport infrastructure) and the provision of universal education (Smith, 1776). Other early economists, such as Mill, allowed a role for government in the protection of people and property and also explored the idea of soldiers as 'unproductive' labourers involved in 'useless and destructive wars' that were a 'waste of resources'. Furthermore, Mill advised on the wisdom of state intervention: '... interference must work for ill, if government, not understanding the subject which it meddles with, meddles to bring about a result which would be mischievous' (Mill, 1883, p. 552). Later, Alfred Marshall, reviewing

the First World War, stressed the need for the public control and management of some ‘crucial’ industries. However, the early economists devoted little effort to the specific and specialised study of defence. This changed in 1960 with the publication of *The Economics of Defense in the Nuclear Age*.

Defence economics is a relatively new subject area within the discipline of economics. By 2020, it will be sixty years since the publication of Hitch and McKean’s pioneering text book (Hitch and McKean, 1960). The publication, in January 1990, of the first academic journal, *Defence Economics*, signalled that defence economics was a recognised and accepted specialism within the academic discipline of economics. In 1994, the journal’s name was changed to *Defence and Peace Economics*, emphasising its interests in peace and conflict resolution. The remainder of this section presents a limited literature review, focusing on some of the key and original contributions to the literature, all of which were published by American economists in the 1960s.

1.4.1 Economics and Defence Policy

Hitch and McKean’s original and pioneering contribution applied economic analysis to defence policy and choices. It focused on efficiency in the allocation and use of defence resources and looked at military problems from an economic standpoint. On this basis, the book examines the resources available for defence and the efficiency with which defence resources are used. It starts by stressing that resources used for defence are affected by alternative uses. For example, any size of defence budget involves the sacrifice of civilian alternatives such as hospitals, schools, roads, social welfare payments or lower personal taxation. Specific weapons programmes such as a new combat aircraft or a new aircraft carrier require similar sacrifices.

The task for military commanders is to organise their limited resources to achieve specific tasks at minimum cost. Budgets measured in money costs and market prices are used to represent resource costs and the alternatives that are sacrificed by spending on defence choices. Money costs show the possibilities for substitution both *within* defence budgets and *between* defence and civil goods and services. Spending on 100 combat aircraft at US\$100 million per plane means a sacrifice of, say, five aircraft carriers or 2,000 tanks. These are simplistic examples since they exclude the costs of other inputs, such as military personnel, support and maintenance. Similarly, a defence budget of US\$50 billion means a sacrifice of, say, fifty schools or twenty-five hospitals. In democracies, actual choices about the size of the defence budget and its allocation between air, land and sea forces are made by politicians (elected by voters) and by military commanders (appointed by government).

Inevitably, the economic approach to defence choices encountered opposition from established interest groups. Military commanders will claim that defence budgets should be based on their assessment of defence needs and this is reflected in their use of language. Words like ‘essential, vital, indispensable and the absolute minimum’ will dominate debates about defence budgets. Often, we are told by the military that we ‘must have’ a fifty warship navy or an air force of 500 combat aircraft or an army of 100,000 soldiers (the numbers are illustrative). Economists are not popular with the military when they confront such claims by requesting information on their costs. What are the costs of a specific defence need? Is it vital regardless of costs and what would you as a military commander sacrifice to achieve your vital, essential and indispensable needs? There is a further question, namely, what are the contribution of such vital, essential and indispensable needs to defence output and what would be the impact on defence output of small, incremental or marginal changes in spending on specific weapons programmes or military forces?

These basic economic ideas and questions were not remote abstract concepts. Instead, they had a revolutionary impact on defence policy, planning, budgeting and project appraisal. Charles Hitch became Assistant Secretary of Defense (1961–5), in the US Department of Defense under Defense Secretary Robert McNamara, where he was able to apply his economic ideas to defence. He made a major contribution with the introduction of a new budgetary system known as the Planning, Programming and Budgeting System (PPBS: see below). This represented a move from input to output budgeting. Traditionally, defence budgets focused on inputs in the form of military personnel costs, procurement, R&D, operations, maintenance and construction. Output budgeting focused on the missions, final products or objectives of the armed forces, such as strategic nuclear forces, conventional land, sea and air forces, special forces, transport forces and R&D with annual costs presented for each mission.

PPBS also involved the appraisal of specific projects and military capabilities using cost-effectiveness analysis. This requires the identification of the costs and effectiveness of alternative weapons and military forces in achieving a specific objective. For example, the air defence of a city can be achieved by manned fighter aircraft or ground-based missiles and these alternatives need to be assessed in relation to their costs and effectiveness. But problems remain in the form of measuring defence output. Budgets show military capabilities (such as the numbers of warships, submarines, combat aircraft, transport aircraft and numbers of infantry soldiers, tank squadrons and artillery regiments), however, numbers do not indicate the value of these defence forces. Moreover, by