Parts of Beretta 92S semi-automatic pistols are stored at the manufacturing plant before the final touches are made, Italy, December 2008. © Andreas Solaro/AFP Photo

Piece by Piece

AUTHORIZED TRANSFERS OF PARTS AND ACCESSORIES

8

INTRODUCTION

The authorized international trade in small arms and light weapons is diverse and dynamic, affecting every region of the world and all levels of society. Recreational hunters and other private individuals buy millions of imported rifles, shotguns, and rounds of ammunition each year. Millions of additional foreign-sourced weapons are procured by military and law enforcement agencies worldwide. Most of these weapons are used in accordance with national and international laws, but a small percentage is misused, poorly managed, or diverted, often with disastrous consequences. Yet, despite the profound implications of this trade, much of it remains opaque. Publicly available sources of data on international transfers of small arms and light weapons cover only a fraction of the total trade, and much of the data that is available is vague and incomplete. As a result, each year thousands of transfers of small arms and light weapons go unreported, and thousands more are inadequately documented. This lack of transparency hinders efforts to monitor arms transfers to problematic recipients and to identify the accumulation of excessively large or destabilizing stockpiles of weapons.

In 2009, the Small Arms Survey launched a four-year project aimed at enhancing our understanding of the authorized trade in small arms and light weapons, their parts, accessories, and ammunition. This chapter summarizes the findings from the fourth and final phase of the project, whose focus is on parts and accessories. Using these findings and those presented in previous phases of the project, the chapter provides a new global estimate for the annual value of the international authorized small arms trade (see Box 8.1). The new estimate is significantly higher than the previous estimate of USD 4 billion, reflecting both an absolute increase in the value of transfers of certain items and a more complete accounting of these and other transfers. Key findings from this chapter include the following:

- Authorized international transfers of small arms, light weapons, their parts, accessories, and ammunition are estimated to be worth at least USD 8.5 billion annually.
- The annual value of authorized international transfers of parts of small arms and light weapons is estimated to be worth at least USD 1,428 million, USD 146 million of which is not documented in publicly available sources.
- The trade in parts for military firearms and light weapons is dominated by weapons-producing countries. The 56 countries that produce military firearms and light weapons imported 97 per cent of parts by value, while the 117 countries that have no known domestic production capacity imported only 3 per cent.
- The value of the authorized international trade in weapon sights is estimated at more than USD 350 million. Available data suggests that sights account for most of the trade in major accessories for small arms and light weapons, but data gaps preclude a definitive assessment.
- The civilian market in weapon sights in Chile, Paraguay, Peru, and Uruguay is dominated by Chinese producers and exporters.

- In 2009 the top exporters of small arms and light weapons (those with annual exports of at least USD 100 million), according to available customs data, were (in descending order) the United States, Italy, Germany, Brazil, Austria, Japan, Switzerland, the Russian Federation, France, South Korea, Belgium, and Spain (see Box 8.4).
- In 2009 the top importers of small arms and light weapons (those with annual imports of at least USD 100 million), according to available customs data, were (in descending order) the United States, the United Kingdom, Saudi Arabia, Australia, Canada, Germany, and France (see Box 8.4).

The chapter begins with a brief summary of key terms and definitions, which is followed by an overview of the methodology used to generate the revised estimate for the value of international transfers. The chapter then looks at international transfers of parts and accessories for small arms and light weapons. The trade in parts is explored through an analysis of supply chains and import patterns. The assessment of accessories is divided into two sections. The first section provides a basic overview of five categories of major accessories, indicating how they work, who uses them, and how they are used. The second section sheds light on the trade in accessories through case studies, one on the civilian market for weapon sights in four South American countries and a second on procurement of accessories by the armed forces of six countries. The chapter concludes with a brief recap of major themes from the four-year study, including the need for more transparency in the small arms trade.

Box 8.1 The four-year study on international transfers of small arms and light weapons

In 2009, the Small Arms Survey launched an unprecedented multi-year study of authorized international transfers of small arms, light weapons, their parts, accessories, and ammunition. The goal of the study was to use new and potentially rich sources of data to reassess the Survey's previous estimate of USD 4 billion for the annual global trade, which was first published in 2001. Over the course of the study, the Survey compiled tens of thousands of records on national procurement and international transfers of small arms and light weapons, including previously unreleased data obtained directly from governments (see Box 8.2). The resulting data review is the largest and most detailed of its kind. To fill in the gaps that remained despite these efforts, the Survey developed new estimation techniques, including that described below.

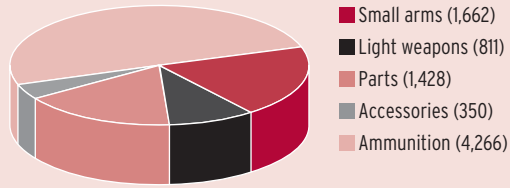
The study was undertaken in four phases. The first phase consisted of a comprehensive overview of multiple data sources on transfers of small arms, including heavy machine guns and anti-materiel rifles up to 14.5 mm in calibre. During this phase, the Survey compiled more than 10,000 records from more than a dozen sources; these records were individually compared and assessed (Dreyfus et al., 2009, pp. 26–30).

Transfers of ammunition for small arms and light weapons were assessed during the second phase of the project. To overcome a near-total absence of usable data on transfers of light weapons ammunition, the Survey contacted more than 70 governments, several of which provided previously unreleased data. The Survey then used this data to generate an estimate for the rest of the world (Herron et al., 2010, pp. 17–20). Similar methods were used to derive an estimate for the value of international transfers of light weapons, including guided missiles, during the project's third phase (Herron et al., 2011, pp. 19–22).

In the fourth and final phase, presented in detail in this chapter, the Survey assessed international transfers of parts and some accessories for small arms and light weapons. It also reviewed previous findings, updating them as necessary. A brief summary of the methodologies used during the study is provided in this chapter, with more detailed information available on the Small Arms Survey's website.[1]

Based on the findings from the four-year study, the Survey estimates the annual value of authorized international transfers of small arms, light weapons, their parts, accessories, and ammunition to be at least USD 8.5 billion (see Figure 8.1). Note that the previous estimate for small arms and light weapons was revised to reflect a recent methodological refinement.

Figure 8.1 Annual estimated value of international transfers of small arms, light weapons, parts, accessories, and ammunition (in USD million)



Note: Reflecting a recent refinement of the methodology, the estimated value for transfers of small arms and light weapons differs from that published in Dreyfus et al. (2009) and Herron et al. (2011).

Box 8.2 Assistance from governments

The Small Arms Survey would like to thank the following governments for the assistance they provided over the course of the four-year study: Bosnia and Herzegovina, Canada, Colombia, France, Germany, Ireland, Italy, Liechtenstein, the Netherlands, Norway, Poland, Portugal, Slovakia, Sweden, Thailand, Ukraine, the United Kingdom, and the United States. Without the data and expertise provided by officials from these governments, which included previously unreleased data on the procurement and transfer of thousands of small arms and light weapons, this study would not have been possible.

TERMS AND DEFINITIONS

Weapons

For the purposes of this chapter, the term 'small arms' refers to the following items:

- pistols and revolvers;
- sporting rifles and sporting shotguns; and
- military firearms, meaning light machine guns, heavy machine guns with a calibre of 14.5 mm or less, sub-machine guns, assault rifles, non-automatic military rifles, military shotguns, and anti-materiel rifles with a calibre of 14.5 mm or less.

The term 'light weapons' is used to refer to the following items:

- mortar systems up to and including 120 mm;
- handheld (stand-alone), under-barrel, and automatic grenade launchers;
- recoilless guns;
- portable rocket launchers, including rockets in single-shot disposable launch tubes; and
- portable missiles and launchers, namely anti-tank guided weapons (ATGWs) and man-portable air defence systems (MANPADS).

Heavy machine guns and anti-materiel rifles—which the UN has defined as light weapons (UNGA, 1997)—are categorized here as 'small arms' because data on transfers of these items is often (inextricably) aggregated with data on transfers of other firearms. In line with previous Survey definitions, mortars up to and including 120 mm calibre are also considered light weapons in this study.[2]

Common parts of small arms

Figure 8.2 depicts a typical assault rifle. The buttstock rests against the shoulder and is used to aim the rifle. One hand holds the pistol grip, and a finger rests on the trigger mechanism, which is protected by the trigger guard. Another hand holds the hand guard, which covers part of the barrel. The magazine feeds ammunition into the receiver (also known as the frame), which contains the working parts of the small arm and is the mechanism that actually fires a cartridge. Sights rest on the top and are used for aiming. Rails are often attached to the hand guard and are used to attach accessories to the assault rifle.

Other types of small arms contain similar parts. The one feature all small arms have in common is a receiver. Designs vary, but receivers house the gun's moving parts and usually contain springs, levers, and pistons. Pistols contain the

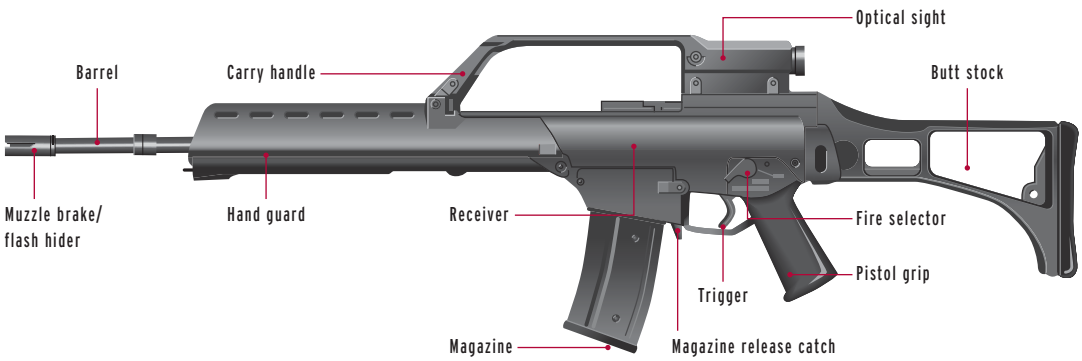
magazine in the pistol grip, and their short barrel does not require a hand guard. Many rifles and shotguns designed for hunting and sport do not have a pistol grip or magazine.

Parts of light weapons

What follows is a partial overview of the parts of various types of light weapon.[3] Mortars, which are primarily muzzle-loaded, are of simple construction and usually consist of a tube, base plate, and bipod. Mortar bombs are fired when they strike a firing pin at the bottom of the tube. Rocket launchers and recoilless rifles, which fire unguided projectiles, consist of a launch tube that is connected to a firing mechanism. MANPADS and ATGWs are complex, technology-intensive systems. Both are based around a missile, which usually contains sensors, a central guidance unit, a warhead and rocket motor, and propellant. The missile is usually propelled from a launch tube. In the case of MANPADS, a gripstock and battery unit are usually attached under the launch tube, and both are necessary to fire the weapon. ATGWs are more diverse, but many contain a tripod and an aiming and fire-control unit (in addition to the missile and launch tube).

An employee of the Colombian weapons manufacturer INDUMIL (Industria Militar) displays the different parts of an assault rifle, May 2006. © Mauricio Dueñas/AFP Photo

Figure 8.2 **Parts of an assault rifle**



Accessories for small arms and light weapons

An 'accessory' is defined here as an item that physically attaches to the weapon and increases its effectiveness or usefulness but, generally speaking, is not essential for the basic, intended use of the weapon. This definition captures a wide array of items, ranging from extended magazine releases for pistols to thermal night sights for anti-tank guided weapons. This chapter focuses on the following major accessories:

- sights (telescopic, reflex, thermal, image-intensifying, and holographic);
- aiming lasers and illuminators that attach directly to the weapon;[4]
- night vision devices that attach directly to the weapon;
- laser rangefinders that attach directly to the weapon; and
- fire-control systems that attach directly to the weapon.

Two elements of this definition call for some elaboration. The first concerns the requirement that the item be physically attached to the weapon. As explained in more detail below, many items are not attached to small arms and light weapons but enhance their usefulness or effectiveness nonetheless. Examples are numerous and include handheld and helmet- and vehicle-mounted variants of the items listed above. Including items that are not physically attached to the weapon would so dramatically expand the list of items categorized as accessories that it would render the term 'accessory' meaningless, especially on a networked battlefield. The greater the battlefield connectedness, the more crucial the physical attachment requirement becomes. Without this requirement, an unmanned aerial vehicle that collects data on a potential target and relays that information to a sniper in range of the target could fit the definition of an 'accessory'. Categorizing the unmanned aerial vehicle, the operating base, and the other networked platforms as 'accessories' for the sniper rifle would be impractical, however.

The second element that requires some clarification is the definition's exclusion of items that are essential for the basic, intended use of the weapon. While most of the major accessories listed above conform to this definition, there are some notable exceptions, including telescopic sights for long-range sniper rifles and some fire-control systems.

The physical limitations of the human eye preclude effective sniping beyond a certain range without a telescopic sight. Similarly, the 25 mm airburst munitions fired from the XM25 would be of little use without the fuse setter in the weapon's fire-control system. As the number of small arms and light weapons that fire 'smart' munitions increases, the line between a 'part' and an 'accessory' will become increasingly blurred, but for now most of the items listed above fit the definition of 'accessories' adopted for this study (see Box 8.3).

Box 8.3 When parts become accessories: an introduction to modular weapons

This chapter defines 'accessories' as items that physically attach to a weapon to increase its effectiveness or usefulness but, generally speaking, are not essential for the basic, intended use of the weapon. In contrast, 'parts' are defined as items that are integral to the weapon and necessary for its basic functioning (such as a barrel). This distinction reflects the characteristics of the majority of current small arms involving a combination of the basic weapon and several 'add-ons'. Nevertheless, this distinction is becoming increasingly blurred with the entry into the market of weapons whose main parts, such as barrels and receivers, can be easily changed by soldiers to adapt them to the specific operational context. These interchangeable components remain 'parts' in nature but become 'accessories' in use; they are necessary for the basic functioning of a weapon, but they can be switched in just a few moments to alter its characteristics and increase its performance in a given context.

The need for a more flexible type of weapon that could be easily reconfigured to meet different operational needs and could accommodate a range of sophisticated accessories led to the evolution of infantry rifles into 'modular weapons'. The idea behind the concept of modularity is simple: each rifle has a core section (usually the upper receiver) around which all other parts can be switched directly by the soldier to obtain different configurations, depending on the need. These reconfiguration operations can be done without the use of any tool and are simple and quick. The Beretta ARX160 illustrates the advantages of a modular weapon. This assault rifle enables the user to switch between three different types of barrels: the special forces (12-inch barrel), carbine (16-inch barrel), and designated marksmen or light sniper (16-inch heavy barrel). In addition, the soldier can choose between the standard configuration with a 5.56 x 45 mm NATO calibre or easily and 'tool-lessly' swap the bolt head, lower receiver, and barrel, to reconfigure the rifle to use 5.45 x 39 mm, 7.62 x 39 mm, or 6.8 mm SPC rounds (Beretta, n.d.).

The diffusion of modular weapons could have significant implications for the international small arms trade by altering current patterns of procurement. To date, national holdings typically include several types of weapon, purchased from different producers and representing national preferences in each small arm and light weapon category. With the spread of modularity, procurement will probably select the modular weapon that, through its configurations, best meets national needs. This 'single-source' approach to small arms and light weapons procurement would have the following main consequences:

- from a state perspective: reduce acquisition and maintenance costs;
- from an industry perspective: reduce production costs and provide a strong incentive for research and development; and
- from a market perspective: reduce the number of procurement contracts, increase the quantities per individual contract, and, possibly, reduce the number of suppliers.

In addition, the market for weapon components is likely to become larger, with procurement of spare parts for maintenance purposes as well as of main components for reconfiguration purposes.

Modular weapons pose several challenges from an arms control perspective. Record-keeping, and consequently tracing, could become more difficult unless relevant control measures, such as the International Tracing Instrument, are adapted to reflect the new trend towards modular weapons design. It will be especially important to identify a 'control component' of a modular weapon, for example the upper receiver, so that, whatever changes occur in the weapon's configuration, it can be tracked during its life cycle using the markings (including serial number) on the control component and other basic information about it, including the manufacturer, type, and model. This discussion has barely begun, however (UN, 2011).

Author: Giacomo Persi Paoli

ESTIMATING THE INTERNATIONAL SMALL ARMS TRADE

A well-known and indeed chronic problem in studying global transfers of small arms and light weapons is the lack of comprehensive data. Information is lacking on virtually all segments of the international trade, including the weapons themselves, their parts, accessories, and ammunition. Sporting rifles, sporting shotguns, pistols, revolvers, and small-calibre ammunition are the only categories for which there is customs data that is both widely reported and sufficiently disaggregated by weapon type. The UN Commodity Trade Database (Comtrade) remains the most extensive source of data on international transfers of such items, even though not all states report to the instrument.

The trade in light weapons and their ammunition, as well as parts and accessories for military firearms and light weapons, is more difficult to estimate since UN Comtrade combines transfer data on these items with that of other goods. Moreover, transfers of these items are only partially reported in other public data sources, such as the UN Register of Conventional Arms, national reports, and procurement documentation. Through outreach to approximately 70 governments, the Small Arms Survey was able to obtain hundreds of detailed records on transfers of thousands of weapons. This data provides new insight into the small arms trade, including transfers of items that are often poorly (publicly) documented, even by transparent countries. Nonetheless, these records were not sufficient to fill in all of the data gaps and, consequently, models and estimation techniques have become the methodological backbone of the endeavour to generate a global estimate of the annual trade in small arms and light weapons, their parts, accessories, and ammunition.

The authorized trade study uses an interpolation model to fill in the missing data points.

The estimation technique

A key technique for estimating the value of global transfers in small arms and light weapons is the use of interpolation models. This method was used to estimate the value of international imports of small arms and light weapons ammunition as well as of light weapons (Herron et al., 2010; 2011). Imports, as opposed to exports, were studied because more data is available; at the global level, more countries report on their imports than on their exports. For this chapter, interpolation models were used to estimate the value of the trade in parts of military firearms and light weapons as well as to revise previous estimates of the transfers in small arms (Dreyfus et al., 2009, pp. 7–59).

The authorized trade study uses an interpolation model to collect detailed and fairly complete import data on a sufficiently large sample of countries, then 'interpolates' from this sample to fill in the missing data points for all non-sample countries worldwide, and finally adds all of the data points to generate a global figure. The underlying assumption of this method is that, generally speaking, similar countries have similar levels of imports and that any variation between the imports of different countries is due to specific explanatory factors.

Key explanatory factors are used to create different country groups. In the case of military firearms, light weapons, and light weapons ammunition, the groups are based on military spending per soldier and the size of each country's armed forces.[5] Once the average imports of sample countries in a certain group had been calculated, that average was applied to group members outside of the sample. In some cases, modifiers were applied to non-sample countries to reflect domestic production of small arms and light weapons or involvement in armed conflict. When applied to all countries, this process yielded estimated dollar values for the undocumented international trade in military firearms, light weapons, and light weapons ammunition.

The number of available sample countries depends principally on two factors: the quality of the data provided by individual countries and the number of years for which import data is available. Data over a longer period is

generally preferred to balance fluctuations in military procurement and the resulting variations in imports from year to year. In some cases, however, there was a lack of hard data, and the number of sample countries was comparatively small: 11 for the trade in light weapons ammunition, 26 for non-guided light weapons, and 25 for ATGWs (Herron et al., 2010, pp. 18–19; 2011, p. 20).

While the Survey had previously estimated the annual value of authorized transfers of small arms, light weapons, and their ammunition, the assumptions and data on which the estimates were based were revisited and, in the case of small arms and light weapons, revised, leading to a new estimate (see Annexe 8.1). The documented trade in small arms has an average annual value of USD 1.560 billion, while the undocumented trade is estimated at USD 102 million, yielding a total value of USD 1.662 billion. Annual transfers of ammunition for small arms and light weapons are estimated at USD 4.266 billion,[6] while the trade in light weapons is believed to total USD 811 million (see Table 8.3).[7]

Estimating the trade in parts of small arms and light weapons

All countries were divided into four principal and mutually exclusive groups.

There are significant variations in data on transfers of different types of parts. Customs data on transfers of parts of pistols, revolvers, sporting rifles, and sporting shotguns is sufficiently plentiful and disaggregated to allow for a calculation of their overall value without the use of an estimation model. The model is needed, however, for parts of military firearms and of light weapons. As disaggregated data on the transfers of such parts are neither reported to the UN Register, nor provided in most national reports, customs data was the only suitable data source.

Customs data for imports, rather than exports, was used because some major exporters, such as China and the Russian Federation, do not report comprehensively on their exports.[8] While the export trade is dominated by a few states, imports of parts of military firearms and light weapons are distributed among a large number of countries and are reported by many of them, rendering non-reporting by a few states less of a problem than in the case of major exporters. While the available customs data is not very precise, in that the categories of parts for military firearms and for light weapons are partially conflated with larger conventional weapons, reporting is relatively comprehensive: 83 countries have reported their imports for the period from 2005 to 2009.[9] Chapter calculations rely on a long time period because many small countries do not appear to import parts for military firearms and for light weapons every year; a significant proportion of these imports would not appear in a dataset covering a shorter time period.

This section explains how the data from the 83 countries was used to estimate the undocumented imports of parts of military firearms and of light weapons of 90 countries for which no data was available.[10] It also explains how data on transfers of parts for light weapons was disaggregated from data on larger-calibre conventional weapons.

The first challenge was to identify the main factors that best explain variation in imports of light weapons parts. To this end, a dataset containing all available data on imports in parts as well as numerous potential explanatory variables was set up.[11] Through a regression analysis, three factors were found to be relatively important and statistically significant: gross domestic product (GDP), membership in the Organisation for Economic Co-operation and Development (OECD), and whether the production of light weapons in a country was mainly state-owned (see below). The regression analysis did not yield results strong enough to warrant the use of the statistical relationships to compute import values for non-sample countries directly.[12] However, the three most important variables could be used to construct country groups as part of a simple interpolation model. Thus, all countries were divided into four principal and mutually exclusive groups: OECD members with and without predominantly state-owned production and non- OECD states with and without predominantly state-owned production (see Table 8.1).

Table 8.1 Principal country groups in the interpolation model

	Predominantly state-owned production	No predominantly state-owned production
OECD member	**Group 1:** OECD members with predominantly state-owned production (such as Poland)	**Group 2:** OECD members without predominantly state-owned production (such as Germany)
Non-OECD states	**Group 3:** Non-OECD states with predominantly state-owned production (such as the Russian Federation)	**Group 4:** Non-OECD states without predominantly state-owned production (such as Singapore)

The four groups were further subdivided into categories based on GDP in order to reflect large differences in GDP within the principal groups. In each sub-group, the average ratio between GDP and imports was calculated. Next, the imports of every non-sample country were estimated using the country's known GDP value and the average ratio for its GDP-based sub-group. The resulting import estimates for all countries were then compared to mirror data from exporting states in order to distinguish between documented imports, which are captured by mirror data, and undocumented imports, which are not.[13] The sum of all import values constitutes a preliminary global estimate for the imports of light weapons parts.

One problem remained after this step. As mentioned before, UN Comtrade combines data on parts of military firearms and of light weapons with data on parts of larger conventional weapons, such as artillery (Harmonized System (HS) code 930591). In order to distinguish between these sets of parts, the share of imports of complete light weapon systems, on the one hand, and of imports of larger artillery systems, on the other hand, was calculated (see Table 8.2). In 2009, 75 per cent of the total imports in these categories concerned military firearms and light weapons combined. The other 25 per cent consisted predominantly of larger artillery systems and other major conventional weapon systems. Consequently, a proportion of 25 per cent was subtracted from the overall value of all imports of military weapons parts listed under HS code 930591. The resulting figure of USD 969 million is taken to be the average annual value of imports in parts of military firearms and of light weapons. Together with the aggregate value for imports of parts of pistols, revolvers, sporting rifles, and sporting shotguns, it represents the overall value of the trade in parts of small arms and light weapons.

Table 8.2 Share of imports, by weapon category and type, 2009

Weapon category (HS code)	Weapon type	Percentage of imports[14]
Military firearms (930190)	Small arms	41%
Grenade launchers, rocket launchers, etc. (930120)	Light weapons	33%
Self-propelled artillery (930111)	Larger conventional weapons	11%
Mortars, non-self-propelled artillery (930119)	Larger conventional weapons but mixed with some light weapons	14%

Source: UN Comtrade (n.d.)

As mentioned above, data on transfers of parts of pistols, revolvers, sporting rifles, and sporting shotguns is sufficiently robust to conclude that the undocumented trade is probably small for these categories. There was thus no need to estimate the undocumented trade. Documented annual transfers of parts of pistols, revolvers, sporting rifles, and sporting shotguns are worth USD 459 million, based on UN Comtrade data. Thus, the value of the annual trade in all parts of small arms and light weapons is USD 1.428 billion. Of this value, transfers worth USD 1.282 billion are documented transfers, whereas undocumented transfers account for USD 146 million.

Estimating the trade in accessories (weapon sights) for small arms and light weapons

This process yielded a global estimate of approximately USD 350 million for imports of weapon sights annually.

The methodology used to estimate the value of authorized international transfers of accessories is very different from the interpolation model described above. Data on international transfers of accessories is extremely sparse. Customs data made available through UN Comtrade is overly aggregated; all of the relevant HS codes contain data on transfers of unrelated items. The same is true of regional reporting mechanisms and national reports on arms transfers. The UN Register of Conventional Arms—an important source of data on transfers of small arms and light weapons—contains almost no data on transfers of accessories. Publicly available data on national military procurement of accessories is a bit more plentiful, but most contract award notices and other data sources reviewed for this study were too vague[15] or incomplete to serve as substitutes for trade data. Hoping to fill these data gaps, the Small Arms Survey contacted more than 30 governments, four of which responded with data on procurement of accessories for their armed forces. This data—provided by Colombia, Portugal, Sweden, and the UK—sheds important light on the procurement of accessories but does not constitute a sufficiently large sample size for use in an interpolation model. Furthermore, the data on government procurement does not reflect imports for civilian end users, which represent a significant percentage of international transfers in certain types of accessories, such as weapon sights.

While these data gaps preclude the calculation of a comprehensive estimate for the international trade in all accessories, there is sufficient data on transfers of weapon sights to capture that portion of the trade. Transfers of weapon sights are reported under several HS categories in UN Comtrade. Sights exported with rifles and other small arms and light weapons are reported with the weapon and therefore most are captured in the abovementioned estimates for the weapons themselves.[16] Most sights exported separately are reported under a different commodity code, namely HS code 901310. Data submitted to UN Comtrade under this HS code is plentiful. From 2007 to 2010, nearly 130 countries submitted data to UN Comtrade under this code.

Since the data under HS code 901310 includes items other than sights,[17] converting it into an estimate for the global trade in weapon sights required several additional steps. The first step was to gather disaggregated data on imports of weapon sights from as many sample countries as possible. To this end, using various sources, the authors obtained data on the following countries: Chile, India, Paraguay, Peru, Taiwan, Uruguay, and the United States. For 2007–10, the combined annual value of imports of weapon sights transferred to these seven countries was approximately USD 124 million.

The data from the seven sample countries was then used to calculate the value of weapon sights as a percentage of the total value of imports reported under HS code 901310 for each of these countries. Next, the ratios of sights to other items for each country were used to generate an average ratio for all seven sample countries, which was then applied to (overly aggregated) data from 125 countries and territories submitted to UN Comtrade for the period 2007–10. This process yielded a global estimate of approximately USD 350 million for imports of weapon sights annually.[18]

Table 8.3 **The average annual value of transfers of small arms and light weapons, their ammunition, parts, and accessories (USD million)**

	Annual average value of documented transfers	Annual average value of undocumented transfers	Overall average annual value
Small arms	1,560	102	1,662
Light weapons	256	555	811
Parts of small arms and light weapons	1,282	146	1,428
Accessories of small arms and light weapons (weapon sights)[19]	350	n/a	350
Ammunition	1,903	2,363	4,266
All small arms and light weapons, their parts, accessories, and ammunition	5,351	3,166	8,517

Note: All figures are rounded to the nearest USD million. Differences between the column totals and the sum of the individual figures in the columns are due to rounding.

The annual global value of small arms transfers

As a result of this multi-year project, the global annual value of the trade in small arms and light weapons, their parts, accessories, and ammunition has been found to be at least USD 8.517 billion (see Table 8.3)—a number significantly higher than all previous estimates. This number does not include the trade in parts of guided missiles and components of light weapon ammunition and accessories other than weapon sights, none of which could be accounted for due to the near-total lack of data. Assuming the value of the missing elements is high (see below), it is conceivable that the total trade value could reach, or perhaps even exceed, USD 10 billion.

TRANSFERS OF PARTS FOR SMALL ARMS AND LIGHT WEAPONS

The analysis of authorized international transfers of parts in this chapter can only provide a snapshot. There is insufficient data on parts of several important types of equipment—particularly man-portable guided missiles and other light weapons ammunition. As parts of these weapons are not included in the estimates presented in this section, they will underestimate the value of the trade, probably significantly, especially in view of the high value of production of man-portable missiles and other types of light weapons ammunition and the value of associated parts, which is most probably high (Herron et al., 2010; 2011). In a previous Small Arms Survey chapter dealing with global transfers of ammunition, parts of small-calibre ammunition and shotgun shells were accounted for separately and included in exports of finished ammunition (Herron et al., 2010, pp. 23–27).

In general, data on the trade in parts is available only from UN Comtrade. While this source provides much useful information, it was not designed to be a transparency mechanism for the arms trade, as discussed above. Indeed, UN Comtrade aggregates some types of parts with other equipment to the extent that the data cannot be used. Other data sources that have been used in previous phases of the authorized transfers project, such as national reports or

the UN Register of Conventional Arms, do not contain useful information on parts. Parts are either completely absent from the data or aggregated to the extent that no useful information can be gleaned from the sources.

In addition, the authors have had to set conceptual boundaries on what could be studied. The production chain can be traced much further back than the import of the parts discussed in this chapter. For example, this study considers the trade in shotgun barrels, but not in the steel used to make them. In addition, parts of accessories (such as lenses used in optical sights) were not examined, nor were intangibles, such as blueprints and production or export licences. Again, the paucity of available information means that estimating the global value of such transfers is currently impossible.

An overview of the parts trade

As will be shown, the most important use of internationally traded parts is in the production of small arms and light weapons. Imports of parts for repair and maintenance—by parties that already own the finished weapons—is of secondary importance.

Supply chains

Small arms production is carried out through globalized production chains.

Over the past few decades, one of the most striking developments in economics has been the creation by manufacturing companies of global supply chains. This model of production is a radical departure from the traditional plants of old, in which all aspects of production occurred under one roof. Now, in globalized firms, a final factory assembles the finished products from parts that have been produced elsewhere. These parts were themselves assembled from smaller components, which were supplied by other factories, often located in other countries. Globalized production is organized in the form of a supply chain, with firms progressively supplying more complex parts up the chain until they are assembled at the top into a finished product.

Research conducted for this chapter indicates that, in many countries, the production of small arms and light weapons is carried out through such globalized production chains. Countries with small arms production industries import much larger quantities of parts than countries that do not produce small arms. Other countries, such as Norway, export more parts than finished weapons. Their industries specialize in the production of parts rather than finished weapons.

Parts of small arms and light weapons are transferred through the production chain between several types of organizations and under various contractual conditions:

- **Outsourcing** occurs when parts are purchased from a separate company, rather than being produced by the manufacturer of the finished product. In some cases, a large number of firms may compete and produce similar parts, which may be sold to manufacturers of finished products through an intermediary, such as a dealer. In others, one company may be highly reliant on another as a sole supplier or purchaser (Williamson, 1981).
- Under **licensed production** agreements, one organization grants another a licence (usually for a fee) to produce a particular weapon (or other product). Licensed production is normally accompanied by the transfer of intellectual property (such as designs). In addition, the licensor may also provide production machinery and parts that will be used by the licensee to produce the finished weapons. Initially, the licensee may be dependent upon imports of parts from the licensor, but, over time, they may be able to switch to local suppliers or to producing the parts themselves (Gimelli Sulashvili, 2007).
- In **co-production**, two or more companies (often located in different states) agree to develop and produce a weapon system jointly. An example is the MILAN anti-tank weapon, which was originally developed by Euromissile, a consortium of the French Aerospatiale Group and Germany's Daimler-Benz Aerospace (Gander and Cutshaw, 1999, p. 355).

- **Offset and countertrade** arrangements occur when a supplier agrees to buy products from the country purchasing the finished weapon (Brauer and Dunne, 2004). For example, a ministry of defence might procure missiles from a producer in another country, and a condition of the deal might be that the missile producer buys parts from companies based in the same country as the ministry of defence.
- Transfers of parts also occur within elements of **multinational corporations**. Parts produced in a plant in one country may be sent across the border for assembly in another.

The industry is not uniformly globalized. This research finds that OECD members import many more parts than non-members. Membership in the OECD serves as a proxy for countries whose industries have embraced a globalized production chain.[20] In contrast, non-members, including some with large production industries, import relatively few parts from abroad. One example is Brazil, which has one of the world's largest pistol-exporting industries but imports very few parts of pistols. Brazilian firms are either engaged in producing parts themselves or prefer to purchase parts from domestic suppliers. Countries and firms may choose not to source parts internationally for several reasons. Ministries of defence that place security of supply as the highest priority may decide that they do not wish to become dependent on foreign suppliers for crucial parts of weapons used by their armed forces. State-owned firms may prioritize local employment over cost savings (Dimitrov and Hall, 2012).

International transfers of most parts are controlled through export and import licences.

Furthermore, there is a strategic concern that distinguishes small arms and light weapons from other industrial production. Exports of a majority of parts used in small arms and light weapons manufacture are controlled goods that require an export licence and, potentially, re-export controls. Such transfer controls can restrict the direct or indirect transfer of parts, for example from the United States to arms-producing firms in China. Such retransfer controls also influence trade among Western countries. The United States has strict retransfer controls over exports of parts that require importing firms to request permission before the parts are transferred to another country (for example, as part of a finished weapon). In some cases, these controls have led European producers to source parts from domestic or other European suppliers in order to avoid US retransfer controls.[21]

Producers of parts for small arms and light weapons may specialize in those industries or, alternatively, they may specialize in manufacturing a wide variety of parts and other products. For example, Lothar Walther is a specialist manufacturer of gun barrels with a worldwide network of dealers (Lothar Walther, n.d.). The Dandong Xunlei Technology Company of China has a much wider range of products but still targets the small arms market. The company makes parts for small arms, such as buttstocks, hand guards, and rails, along with other accessories, such as telescopic sights, flashlights (to be attached to the weapon), and laser pointers (DXT, n.d.). A company far less focused on small arms production is the US-based Connecticut Spring & Stamping Corporation. It makes a wide variety of springs and stamped metal products for the medical, aerospace, defence, automotive, and small arms industries (CSS, n.d.). While both Lothar Walther and the Dandong Xunlei Technology Company are part of the small arms industry, the designation is not entirely appropriate for the Connecticut Spring & Stamping Corporation. It is a general manufacturer that includes parts for small arms in its diverse range of products.

Commercially available off-the-shelf—or COTS[22]—products are items that are sold in large quantities in the commercial marketplace and can be purchased by an arms-producing company in exactly the same form as is available to the public. For example, commercially available electronics components, such as semi-conductors or printed circuit boards, are often used in military equipment. National laws and regulations differ, but such parts can often be exported freely without a licence.

Repair and maintenance

A further use for internationally transferred parts is for maintenance, repair, and upgrade. Parts are replaced when weapons are routinely maintained. An example is replacement barrels for machine guns. Additional repairs may occur when a weapon is unexpectedly damaged. Weapons may also be upgraded when old parts are replaced with new, frequently better, ones. Research carried out for this chapter indicates that repair, maintenance, and upgrade are not significant components of the overall trade in parts, as imports are affected by production industries rather than the size of armed forces. The analysis shows that, in 2005–09, 56 countries—all of which engage in domestic production—imported 97 per cent of the financial value of all parts for military firearms and light weapons.

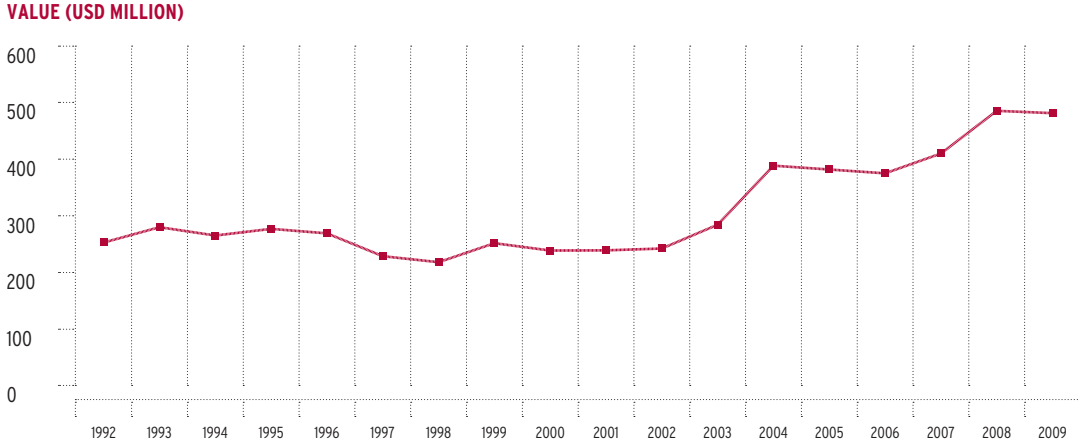
Although there is no statistical relationship between the size of a state's armed forces and the import of parts of military firearms and light weapons, there is one with the production of those weapons. This may be because finished weapons that have been imported are often returned to their manufacturer abroad for repair and upgrade.[23] In such cases, the import of parts associated with repair and maintenance would be carried out in the country with the production industry and not necessarily the country with large armed forces. It is important to note, however, that light weapons parts, in particular, are often supplied with the finished weapon when it is initially exported and so may be recorded as part of that transaction.[24] The value of the parts may thus be included in the value of the finished weapon, thereby 'hiding' some parts transfers within other data categories. This effect, though, is likely to be small.

With respect to pistols, revolvers, sporting rifles, and sporting shotguns, civilian purchasers of small arms may simply replace a damaged weapon (which may have cost only a few hundred dollars in the first place) rather than attempt to repair it.[25] In this way, the demand for small arms parts, like that for light weapons, is centred on the production of new small arms rather than the maintenance of old ones. For example, for Sturm, Ruger & Co., a US manufacturer of pistols, revolvers, and rifles, parts and accessories accounted for about half of one per cent of total small arms sales in 2010 (USD 11.5 million out of USD 251.7 million). The company's average for 1993–2010 is 0.32 per cent.[26]

The international trade in parts of pistols, revolvers, sporting rifles, and sporting shotguns

A great deal of data on the international trade in pistols, revolvers, sporting rifles, and sporting shotguns can be found in the UN Comtrade database. The data on parts of revolvers and pistols includes the following: back sights,

Figure 8.3 **Value of exports of parts of pistols, revolvers, sporting rifles, and sporting shotguns (in USD million)**



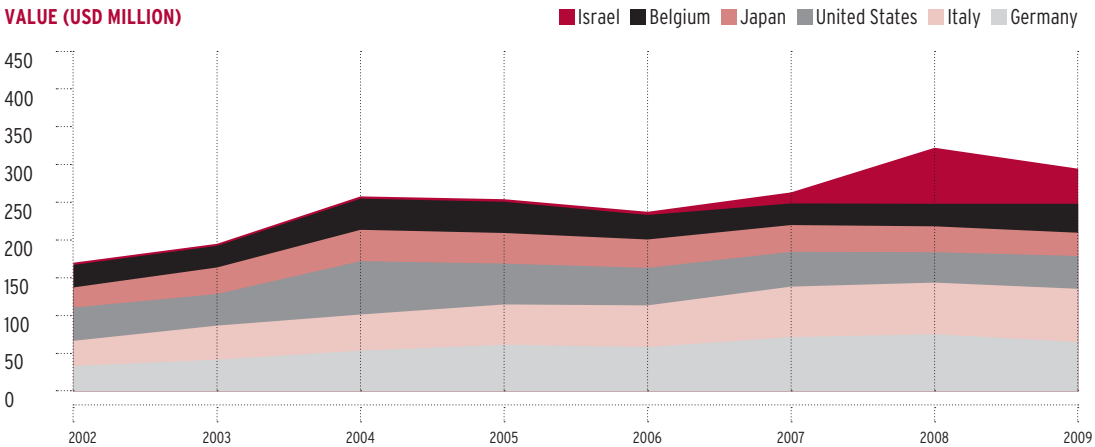
Note: All values in constant 2005 USD.

breeches, butt plates, butts, buttstocks, butt swivels, castings, cocking pieces, cylinders for revolvers, extractors, and forgings. Parts of sporting rifles and sporting shotguns include: back sights, breeches, butt plates, butts, buttstocks, butt swivels, castings, cocking pieces, ejectors, extractors and extracting equipment, forgings, front sights, rifled barrels, and shotgun barrels.[27]

The period 1992–2009 witnessed an 88 per cent increase in the value of the documented trade in these parts (after adjusting for inflation). As is shown in Figure 8.3, the trade fluctuated within a relatively narrow range over the 12 years from 1992 to 2003, after which there was a marked increase.

As is shown in Figure 8.4, the overall rise in exports is explained by overall increases by Belgium, Germany, Israel, and Italy. The United States and Japan were important exporters, but over the eight-year period US exports declined by 1.4 per cent and Japan's increased by a modest 13.3 per cent. Figure 8.5 shows that the six largest increases in 2002–09 were by Israel, China, South Korea, Turkey, the Czech Republic, and Mexico. Aside form Israel, these countries' increases began at a low level and thus did not significantly affect the overall value of the trade.

Figure 8.4 **Value of parts of pistols, revolvers, sporting rifles, and sporting shotguns exported by six most significant exporters, 2002–09**



Note: All values in constant 2005 USD. The selected countries accounted for at least one per cent of global exports.

Figure 8.5 **Six largest percentage increases in exports of parts of pistols, revolvers, sporting rifles, and sporting shotguns, 2002–09**

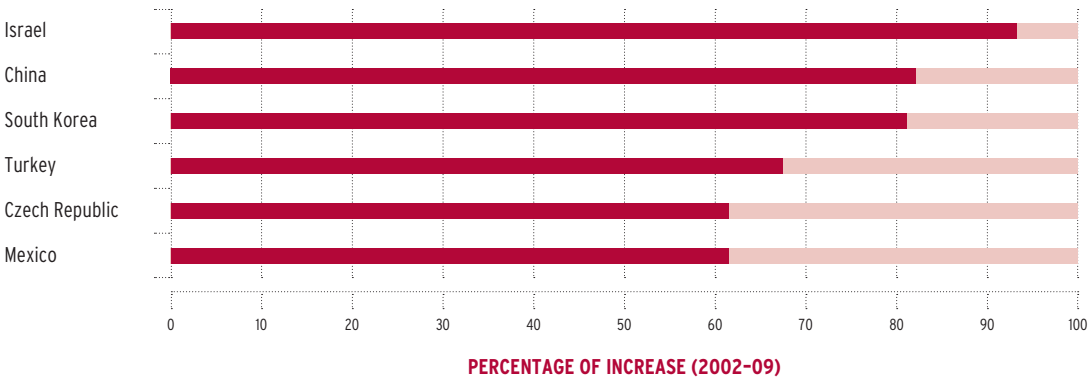


Figure 8.6 **Value of parts of pistols, revolvers, sporting rifles, and sporting shotguns imported by six most significant importers, 2002–09**

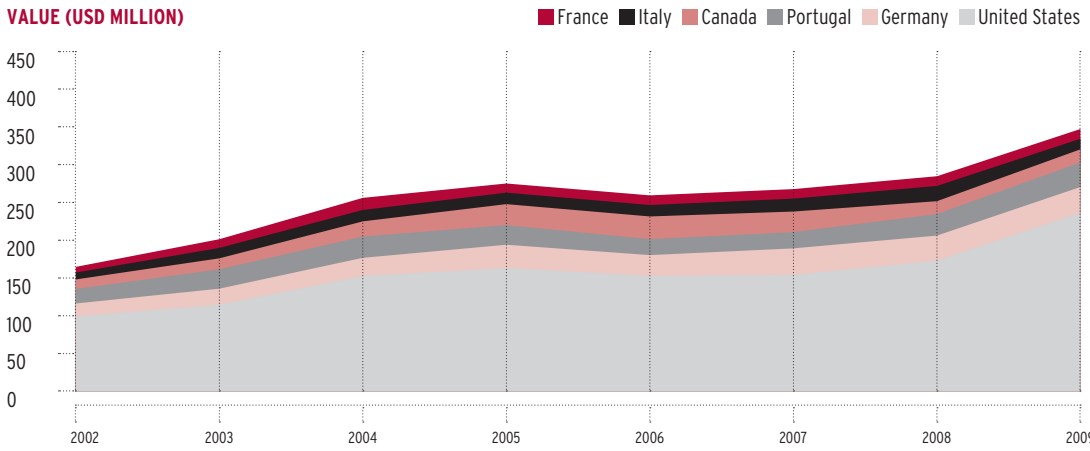
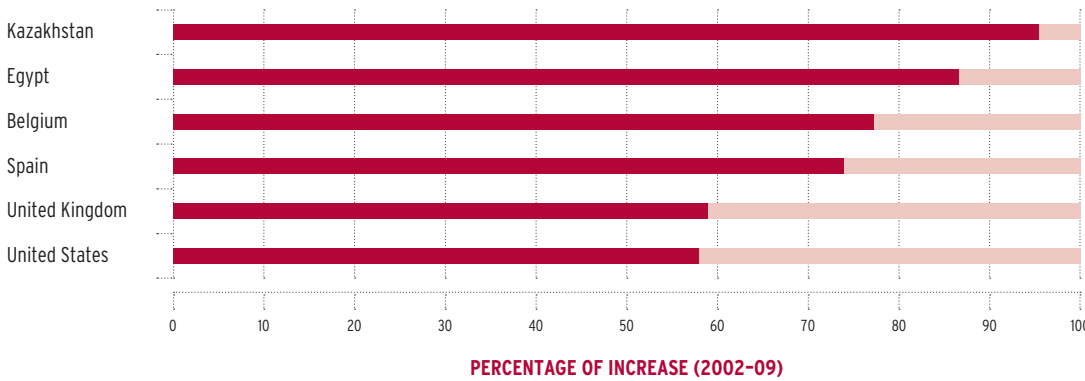


Figure 8.7 **Six largest percentage increases in imports of parts of pistols, revolvers, sporting rifles, and sporting shotguns, 2002–09**



Imports are the other half of the market analysis. As Figure 8.6 shows, the United States dominated the global import market; the rise in imports by the country was largely responsible for the general increase in the global trade, although increases in imports until 2009 by other countries—particularly Germany, Portugal, and Italy—contributed to the overall increase. Several of these countries are also important exporters of small arms to the United States (Dreyfus et al., 2009).

Figure 8.7 presents the six countries with the largest relative increase in exports. Aside from the United States, their absolute increases were not enough to significantly affect the overall value of the trade.

The transfers of parts of pistols, revolvers, sporting rifles, and sporting shotguns can further be disaggregated into parts of pistols and revolvers; shotgun barrels; and parts of shotguns and rifles. Each of these market segments is analysed below. This disaggregation also reflects the available data on the production of small arms in the United States; a further research task could be to analyse this source of information, as well as UN Comtrade, in order to gain a better understanding of manufacturing of small arms by US firms.

Transfers of parts of pistols and revolvers

Documented exports of parts of pistols and revolvers were worth USD 195 million in 2009. Four countries accounted for half of that amount: Italy (USD 43 million), Germany (USD 26 million), Israel (USD 25 million), and Austria (USD 21 million). Three further countries had exports of more than USD 10 million: the United States (USD 15 million), India (USD 11 million), and South Korea (USD 11 million). The largest market by far for these exporters is the United States.

The importance of the United States is reflected in documented imports of parts of pistols and revolvers. The country imports slightly more than half of these parts—at a value of USD 108 million in 2009 (its main suppliers being the first four countries listed above). Germany has imports worth USD 14 million (mainly from the Netherlands, Italy, Spain, and Switzerland). No other country has imports worth more than USD 10 million.

The transfers of parts to the United States appear to be associated with globalized production. For example, the Austrian producer Glock and the Italian manufacturer Beretta both make pistols that are widely sold in the United States, where both also have plants.[28] Glock exports parts from Europe for assembly at their US-based plants (Sweeney, 2008, pp. 98–99); these transfers may explain the reported exports of parts from Austria to the United States.

Beretta has similarly exported parts from Italy to its US plant. Its production of the M9 pistol is an example of how the import of parts for manufacture can change over time. In 1985, it won a major USD 75 million contract to supply the US armed forces with a new standard-issue pistol (Gabelnick, Haug, and Lumpe, 2006, p. 21). Initially, Beretta's new US plant used parts manufactured in Italy (under the auspices of US inspectors) and assembled the pistols in the United States. But in 1989, it started producing parts for the M9 in its US factory and, as of the following year, the pistols were fully produced there (Thompson, 2011, pp. 21–22). After the large Department of Defense orders were completed with the delivery of more than 600,000 pistols, Beretta's US plant continued to produce a variety of pistols for the law enforcement and civilian markets (p. 23). The continued large-scale export of parts of pistols from Italy to the United States suggests that the US-based manufacture of Beretta pistols for civilian and police markets still employs parts sourced from Italy, probably along with parts made in the United States.

The United States imports half of all transfers of parts of pistols and revolvers.

Transfers of shotgun barrels

The documented trade in barrels for sporting shotguns was worth about USD 47 million in 2009. Some USD 37 million of this trade was accounted for by the top five exporters: Belgium (USD 10 million), Mexico (USD 9 million), Japan (USD 8 million), Italy (USD 7 million), and the United States (USD 4 million). Again, the United States was, by far, the largest importer of shotgun barrels from the (other) top exporters. Other countries with exports of more than USD 1 million were: Germany (USD 4 million), Israel (USD 3 million), and Turkey (USD 2 million). The largest recipient of shotgun barrels manufactured in Turkey was Italy. This relationship can perhaps be explained in part by the ownership by Beretta Holding (which controls Fabbrica d'Armi Pietro Beretta) of Stoeger Silah Sanayi, a shotgun-manufacturing firm based near Istanbul since 2005 (Stoeger, n.d.).

As reflected in the export figures, the United States dominates the import market. In 2009, it accounted for USD 33 million of all imports, or 70 per cent of the global market. Other countries with imports worth more than USD 1 million were: France (USD 3 million), Mexico (USD 2 million), and Italy, the UK, and Greece (with around USD 1 million each).

US Customs and Border Protection (CBP) provides rare insight into the supply chain involving shotgun barrels exported from Mexico to the United States. In a ruling concerning O. F. Mossberg & Sons, a shotgun manufacturer based in the US state of Connecticut, CBP reports that:

Mossberg exports lengths of U.S. origin steel rod and barrel extensions to Mexico for processing into unfinished shotgun barrels (consisting of a barrel tube and a barrel extension). Upon importation into the U.S., the shotgun barrels are shipped directly to a Mossberg facility where they are subjected to certain finishing operations, which include attachment of the sights, polishing, and applying the finish (bluing). The shotgun barrels are then assembled with U.S. origin components (i.e., stock, butt, forearm, receiver, magazine, trigger and bolt assemblies, etc.), into finished shotguns. The shotguns are tested to ensure proper functioning and precision fit, and then are partially disassembled to facilitate packaging and shipping (CBP, 2001).

Transfers of parts of sporting rifles and sporting shotguns

The value of the documented trade in parts of sporting rifles and sporting shotguns was worth USD 293 million in 2009 (this figure excludes shotgun barrels, which are covered above). The top ten exporters accounted for some USD 230 million. They were: Germany (USD 42 million), Belgium (USD 33 million), the United States (USD 28 million), Italy (USD 28 million), Japan (USD 26 million), Israel (USD 19 million), China (USD 19 million), Turkey (USD 17 million), Mexico (USD 10 million), and Austria (USD 8 million).

Transfers of parts of sporting guns were worth USD 293 million in 2009.

The United States dominates the import markets, but to a lesser extent than with shotgun barrels or parts of pistols and revolvers. Its 2009 imports were worth USD 118 million, or 40 per cent of the market. The ten largest importers accounted for USD 233 million (80 per cent of all imports). After the United States, they were: Portugal (USD 30 million), Germany (USD 23 million), Canada (USD 14 million), Italy (USD 10 million), Austria (USD 9 million), France (USD 9 million), the United Kingdom (USD 8 million), Spain (USD 6 million), and Thailand (USD 4 million).

Portugal's position as the second-largest importer of shotgun and rifle parts in the world can be explained by the assembly of Browning Arms Company sporting rifles and sporting shotguns at a plant at Viana, using parts made in Belgium by FN Herstal and exported to Portugal (Browning, n.d.a; n.d.b). Belgium is the largest supplier of parts to Portugal.

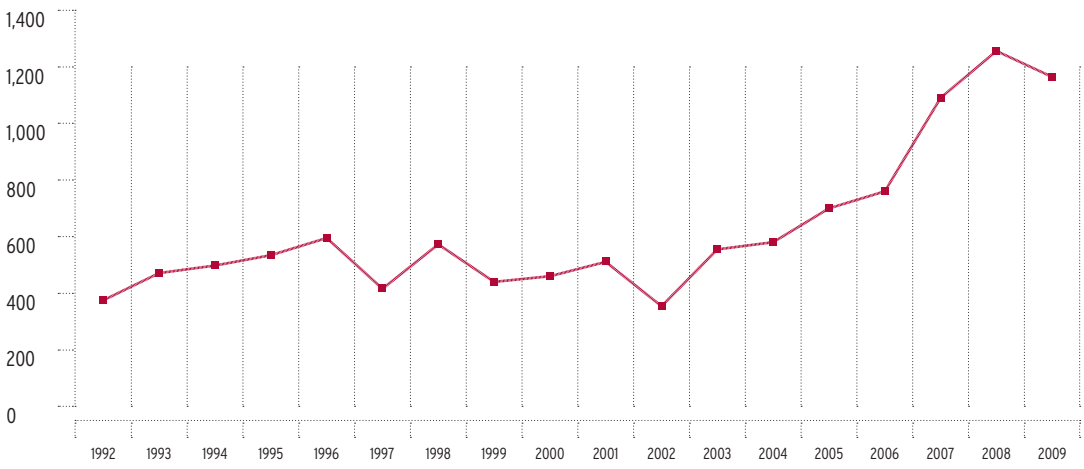
CBP provides additional insight into the highly globalized manufacture of sporting rifles. In a ruling, it states that:

We are informed that the barreled actions are completed rifles without rifle stocks. The barreled actions are manufactured in Belgium by E. Dumoulin and Co. from a series of components consisting of trigger mechanisms from England or Belgium, trigger guards from Spain, screws from Belgium and rifle barrels from the United States, as well as incomplete bolt assemblies, bolt stop assemblies and receivers from China (CBP, 1996).

The international trade in parts of military firearms and light weapons

Data on the international trade in parts of military firearms and light weapons can be found in the UN Comtrade database.[29] The data covers parts of military firearms and of some light weapons (including grenade launchers, mortars, and rocket launchers). Relevant parts include: back sights, barrels, breeches, butt plates, butts, buttstocks, butt swivels, carriages, castings, cocking pieces, ejectors, extractors, forgings, front sights, hammers, levers, liners, locks, magazines, Morris tubes, mountings, percussion hammers, piling swivels, plates, protective cases and covers, recoil mechanisms, safety catches, slings, sound moderators (silencers), stampings, triggers, tripods, and turrets. UN Comtrade data does not disaggregate parts of guided missiles or commercially available off-the-shelf components (see above). The data also comprises parts for weapons larger than what the Small Arms Survey defines as a light weapon, in particular artillery and mortars larger than 120 mm. In calculating the figures presented below, an attempt has been made, using the methodology described above, to remove such large equipment, but doing so adds a further element of imprecision.

Figure 8.8 **Value of documented exports in parts of military firearms and light weapons**



Note: All values in constant 2005 USD.

Between 1992 and 2004, the global value of documented transfers of parts of military firearms and light weapons (adjusted for inflation) remained largely stable. After 2005, though, there was a dramatic threefold increase until 2009 (see Figure 8.8).

Figure 8.9 shows the main components of this increase between 2005 and 2009. After a rise in 2007, US exports slipped back; they were 17 per cent lower in 2009 than in 2005. The most dramatic absolute increases were by the UK and Norway. Canada and Sweden also increased their exports of parts. For Canada, Norway, and the UK, the United States was, by far, the most important recipient of parts. For Sweden, India was the most important export market (see below). South Korea had a large relative increase but its absolute exports were much smaller than those cited above. The significant variations in exports are shown in Figure 8.10; aside from France, the countries with the largest absolute increases also had the largest relative increases.

Figure 8.9 **Value of parts of military firearms and light weapons exported by six most significant exporters, 2005–09**

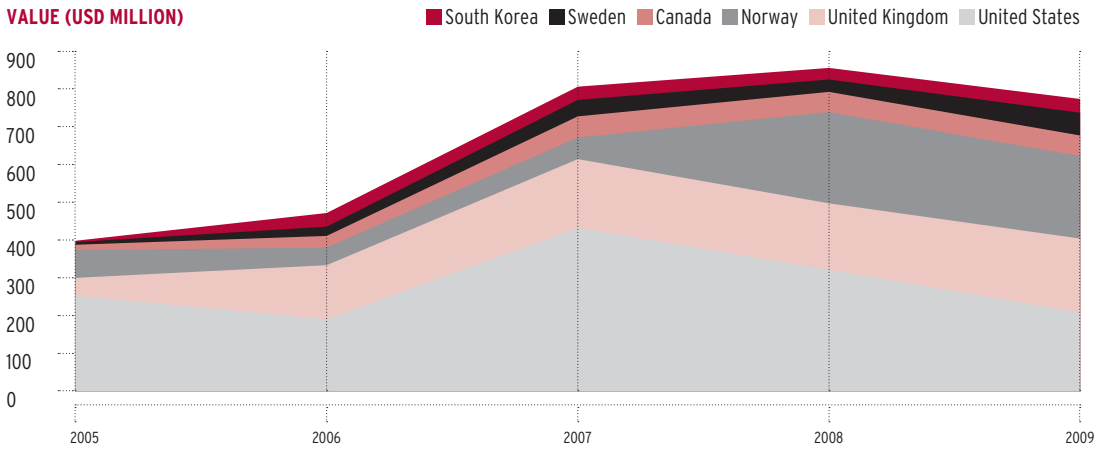


Figure 8.10 **Six largest percentage increases in exports of parts of military firearms and light weapons, 2005–09**

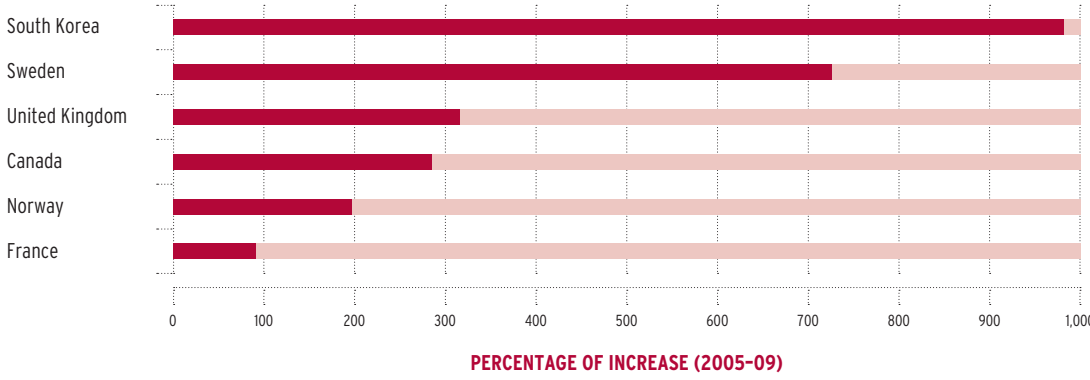


Figure 8.11 indicates the destinations of this increased export trade. Increased US imports are responsible for the overall increase over the five-year period. Imports by South Korea and Japan peaked in 2007 and were responsible for the overall peak of global transfers in that year. Figure 8.12 summarizes the six largest increases in imports in 2005–09; India, Thailand, Norway, and Canada had large relative changes but their absolute imports were not large enough to significantly affect the overall total.

Exports of parts from Norway to the United States include the Kongsberg remote turret. In 2007, the US Army awarded Norwegian company Kongsberg Defence Systems a USD 1.4 billion contract to supply remote turrets. These high-technology systems allow a machine gun to be mounted with sensors on the roof of an armoured vehicle; the weapon is controlled and fired by personnel safely ensconced within (Cox, 2007). Following a CBP decision, the remote turret was defined as a part (as are other turrets) (CBP, 2010).

India also offers an interesting illustration of the trade in parts. It produces the Carl Gustaf recoilless rifle under licence from Saab of Sweden.[30] Given that the largest destination of parts from Sweden was India, it is likely that some of the parts exported from Sweden to India are for the production of Carl Gustafs. India has also, since 1985, produced under licence the Franco-German MILAN anti-tank guided missile system. The production of this missile

Figure 8.11 **Value of parts of military firearms and light weapons imported by six most significant importers, 2005–09**

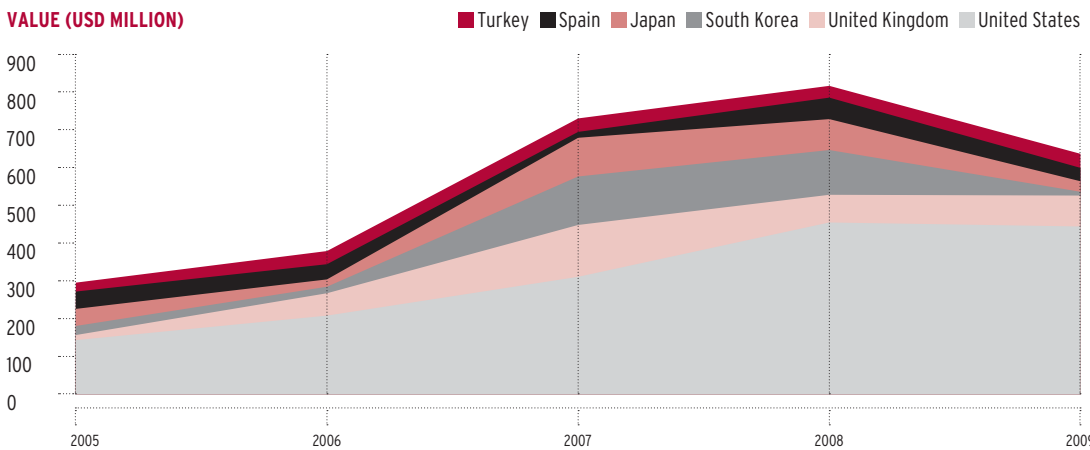
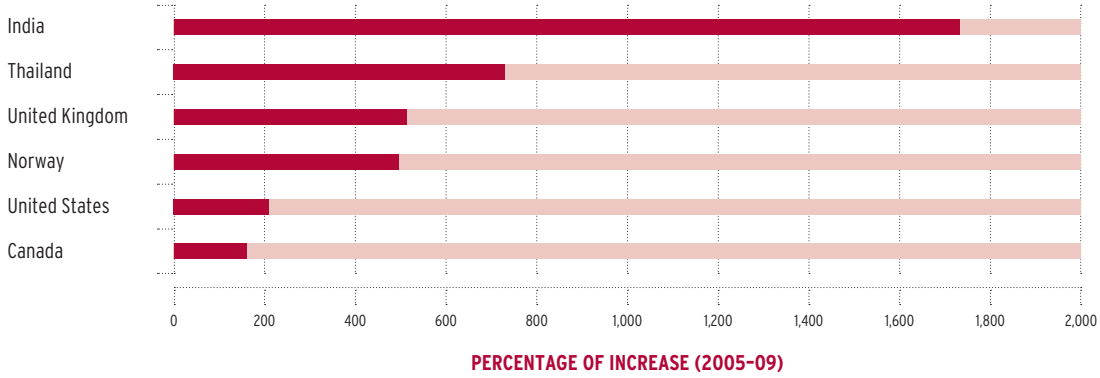


Figure 8.12 **Six largest percentage increases in exports of parts of military firearms and light weapons, 2005–09**



system illustrates how the trade in parts can change. Bharat Dynamics of India started production in 1985 (Mohanty, 2004, pp. 19–21). Initially, production was based on the assembly of imported parts; by 2004, the local content of the updated MILAN2 was reportedly 'expected to reach 75%' (Khan, 2004, p. 251). In all, some 30,000 MILAN missiles were manufactured in India in the period up to 2009, and production continues to this day, with an increasing emphasis on domestic production (*Vayu,* 2010).

ACCESSORIES FOR SMALL ARMS AND LIGHT WEAPONS

Despite their widespread military and civilian use and increasingly important role on the battlefield, accessories for small arms and light weapons have received little attention from researchers and policy-makers. This section attempts to improve our understanding of accessories for small arms and light weapons by providing an overview of the types and models of major accessories and their roles, capabilities, and characteristics. The contours of the authorized international trade are also captured through an analysis of data on recent international transfers to Chile, Colombia, India, Paraguay, Peru, Portugal, Sweden, the UK, the United States, and Uruguay.

As explained above, the Small Arms Survey defines accessories as items that physically attach to small arms and light weapons and increase their effectiveness or utility but, generally speaking, are not essential for the basic, intended use of the weapon. This section focuses on the following items:

- weapon sights;
- aiming lasers and illuminators;
- night vision devices;
- laser rangefinders; and
- fire-control systems, including ballistics calculators.

Accessories are sold with the weapons on which they are used, as part of upgrade packages,[31] and as stand-alone orders.[32] Many are attached to rails mounted on the weapon, including the widely used Picatinny rail. While most of the items categorized above are not essential for the basic use of the weapon to which they are attached, as indicated earlier, there is a small but growing list of exceptions, including telescopic sights for long-range sniper rifles

and fire-control systems for weapons that fire airburst munitions. These items are nevertheless considered accessories for the purposes of this chapter.

Many of the technologies used in accessories for small arms and light weapons have a wide range of military and commercial applications. Roles for thermal imagers range from long-range sniping to detecting leaks in thermal insulation and spotting cases of bird flu (Saletan, 2009; Dove, 2010). Similarly, laser rangefinders, which are used by militaries to calculate superelevation angles for grenade launchers and programme airburst munitions, are also used by interior designers to measure floor space and by golfers to determine the distance to the next green (Baily, 2009; Bosch, n.d.).

These technologies take several different forms on the battlefield. Image-intensifier tubes used in night vision weapon sights are also used in night vision goggles, helmet-mounted monoculars, handheld binoculars, and other surveillance systems. Thermal imagers are used in weapon sights, unmanned aerial vehicles, goggles, handheld cameras, and vehicles (Gething, 2008). Laser rangefinders, fire-control systems, and the other accessories listed above are also deployed on various platforms.

Small arms and light weapons accessories and the modern battlefield

Accessories for small arms and light weapons are an important part of the modern battlefield. The need to engage elusive enemy forces operating in heavily populated areas quickly and accurately while minimizing civilian casualties requires precision, situational awareness, and robust command and control, all of which can be enhanced by the accessories listed above. However, these benefits must be weighed against the budgetary and logistical strain caused by the ever-expanding list of items issued to dismounted infantry. Balancing these often-competing demands is the key challenge facing military procurement officers (Gelfand, 2011).

The various soldier modernization programmes being pursued by militaries worldwide provide some insight into trends in military technology and the goals of those attempting to harness their tactical and operational potential. Common to most of these programmes is the vision of a networked battle space in which the dismounted soldier is one of several platforms contributing to—and benefiting from—a real-time exchange of data. Accessories for small arms and

A US Army soldier makes his way through underbrush with his Land Warrior System at Fort Benning, August 2001.
© Ric Field/AP Photo

light weapons are key components of this vision, which is epitomized by the Pointer system developed by the British firms QinetiQ and Qioptiq. The Pointer system collects data from gunshot detectors, rangefinders, and other sensors and transmits that data to all networked (Pointer) weapon sights, instantaneously if desired. The data is displayed in the sight as intuitive symbols that direct the shooter to the target while providing information on the range and position of the target and nearby friendly forces (QinetiQ, n.d.; Brown, 2011).

This technology could be game-changing. In theory, at least, a single shot fired by an enemy sniper in an area where Pointer is deployed would result in the near-instantaneous identification and targeting of that sniper by every networked soldier within range. Weapon sights fielded in recent years also have the capacity to capture and transmit video imagery through wireless links, allowing the commander to see what the shooter sees (Pengelley, 2008). This capability has the potential to reduce friendly fire and civilian casualties, both of which are high-priority goals of most modern militaries.

Yet the tactical and operational benefits from accessories must be balanced against real-world constraints, such as finite procurement budgets and physically overburdened soldiers. The latest accessories are expensive. For example, a ThOR 3 colour-imaging scope costs more than USD 13,000 per unit (Firearm Blog, 2011)—more than some countries spend annually on all equipment for individual soldiers.

Weight and power consumption are other factors that shape demand for weapons and equipment, including accessories. UK soldiers conducting patrols in Iraq carried an average of 54–64 kg of equipment (Gelfand, 2011). Reducing this burden (or at least not adding to it) has become a central preoccupation of military procurement officers in the UK and elsewhere.[33] In response, defence firms have reduced the weight of their products. The defence firm ITT, for example, markets night vision weapon sights that are 'the size of a middle finger' (Gelfand, 2011). But even as the weight of individual items has decreased, the number of items issued to soldiers has increased, offsetting many of the gains from industry efforts to reduce the weight of accessories and other items (see photo). During an interview with Jane's Information Group, a Canadian official pithily summarized this dilemma: 'Twenty years ago our soldiers were compelled to carry 100 lb of heavy equipment; now they carry 100 lb of very light equipment' (Pengelley, 2009b).

The tension between operational needs and budgetary and logistical constraints is likely to continue to shape the development and procurement of military technology, including accessories for small arms and light weapons, for the foreseeable future.

A Spanish soldier is equipped with an H&K G36 rifle fitted with accessories, procured as part of the 'Future Soldier' programme. © Spanish Ministry of Defence

Weapon sights, aiming lasers, and clip-on night vision devices

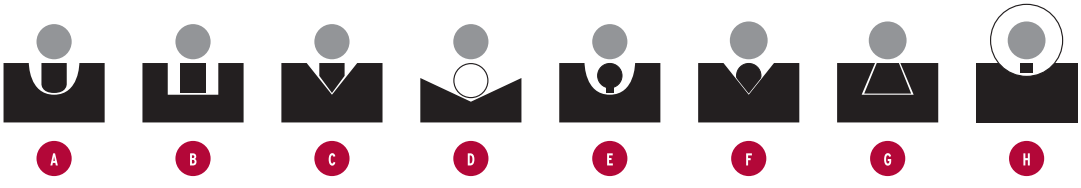
Weapon sights[34] are among the most widely exported accessories for small arms and light weapons. There is significant variation regarding which types of sights are deployed and how widely, however. Use of telescopic sights, for example, ranges from universal (weapons with built-in sights)[35] or near universal (long-range sniper rifles) to negligible (pistols and single-shot disposable rocket launchers). Many models are used on several different types of weapons. For example, versions of the AN/PAS-13 thermal sights are used on the US M4 assault rifle, the M136 recoilless rifle, the M249 light machine gun, the M240B machine gun, the M24 sniper rifle, the MK19 automatic grenade launcher, and 'surface-to-air missile launchers' (Brown and Wasserbly, 2009).

For the purposes of this chapter, sights are divided into seven (sometimes overlapping) categories: iron sights, telescopic sights, reflex sights, image-intensifying sights, thermal sights, holographic sights, and laser sights. Since many aiming lasers often take the form of sights, they are discussed with laser sights. A brief description of each category follows.

Iron sights are the oldest and most widely used type of sight. Iron sights come standard on most small arms and many light weapons and are the only type of sight used on some weapons.[36] Most iron sights for small arms consist of two main components: a front sight, which is typically positioned at the end of the muzzle barrel, and a rear sight, which is commonly positioned on or over the receiver. Iron sights are generally divided into two categories: open sights and aperture sights. With open sights, the front sight is typically a post or bead, and the rear sight is a notch. The shooter lines up the front sight (post or bead) inside of the rear sight (notch) and below the target (see Figure 8.13).

A German Bundeswehr Army soldier uses the laser pointer on his weapon during a joint patrol with Afghan National Army soldiers north of Kabul, September 2008.
© Fabrizio Bensch/Reuters

Figure 8.13 **Various open sights, along with one aperture sight (H)**



Key:
A) U-notch and post, B) Patridge, C) V-notch and post, D) Express, E) U-notch and bead, F) V-notch and bead, G) trapezoid, H) ghost ring.
The grey dot represents the target.

Source: Wikipedia (n.d.)

With aperture sights, the rear sight consists of a ring instead of a notch. There is a wide variety of iron sights, which range from a simple groove milled into the receiver of some pistols to the elaborate adjustable aperture sights used by competition target shooters (see photo).[37]

Telescopic sights, which are often referred to as 'scopes', are basically weapon-mounted telescopes with a reticle (crosshair). Telescopic sights aid in targeting and improve accuracy by magnifying the image of—and projecting a reticle onto—the target. They also require less eye coordination than iron sights. Drawbacks of telescopic sights include the need to position the eye a specific distance from the sight and a limited field of view, meaning that the operator sees less of the surroundings while looking into the sight. Generally speaking, telescopic sights are also less durable than iron sights and can be significantly more expensive.

Telescopic sights have been widely used by hunters, military snipers, and others engaged in longer-range shooting for decades. Their use has grown in recent years as militaries attempt to improve the accuracy and range of standard-issue rifles. Low-magnification sights are now widely issued to soldiers in the militaries of many countries.

Image intensifiers for military end users have been produced in at least 26 countries.

Reflex sights display an illuminated reticle that is superimposed on the image of the target in the sight window.[38] Because the reticle often takes the form of a red dot, reflex sights are often referred to as 'red dot' sights. Reflex sights are popular because the shooter's eye can be positioned at more angles and at greater distances from reflex sights than from telescopic sights. Consequently, target acquisition is much faster with reflex sights than with telescopic and iron sights. The shooter can also look through the sight with both eyes open, allowing for a fuller field of view and therefore better situational awareness than with telescopic sights (White, 2010). For these reasons, reflex sights 'have become a staple requirement for [military] small-arms programmes around the world' (White, 2010); they are particularly useful in close-quarter combat and other scenarios in which targets must be engaged quickly (Ring Sights, 1998).

Holographic sights feature a hologram of a reticle that is recorded at the time of manufacture and then displayed on the sight window by a laser. The major advantage of holographic sights is that the reticle is fully visible regardless of the angle and distance at which the sight is viewed. The image remains visible even if the sight itself is partially obscured by mud, snow, or rain (Jones and Ness, 2011, p. 617; L3 Communications, n.d.). The major disadvantages of holographic sights are their comparatively high cost and power consumption.

Image-intensifying sights use image-intensifier tubes to gather existing (ambient) light, such as starlight, moonlight, and certain infrared light. The light is then amplified and converted into an image that is displayed in the sight. Since the first military night vision devices were fielded in the late 1930s, several additional generations of image-intensifier tubes have been developed. Generational improvements include brighter and sharper images, improved performance in low-light conditions and light-polluted areas (such as cities), and longer target detection ranges.

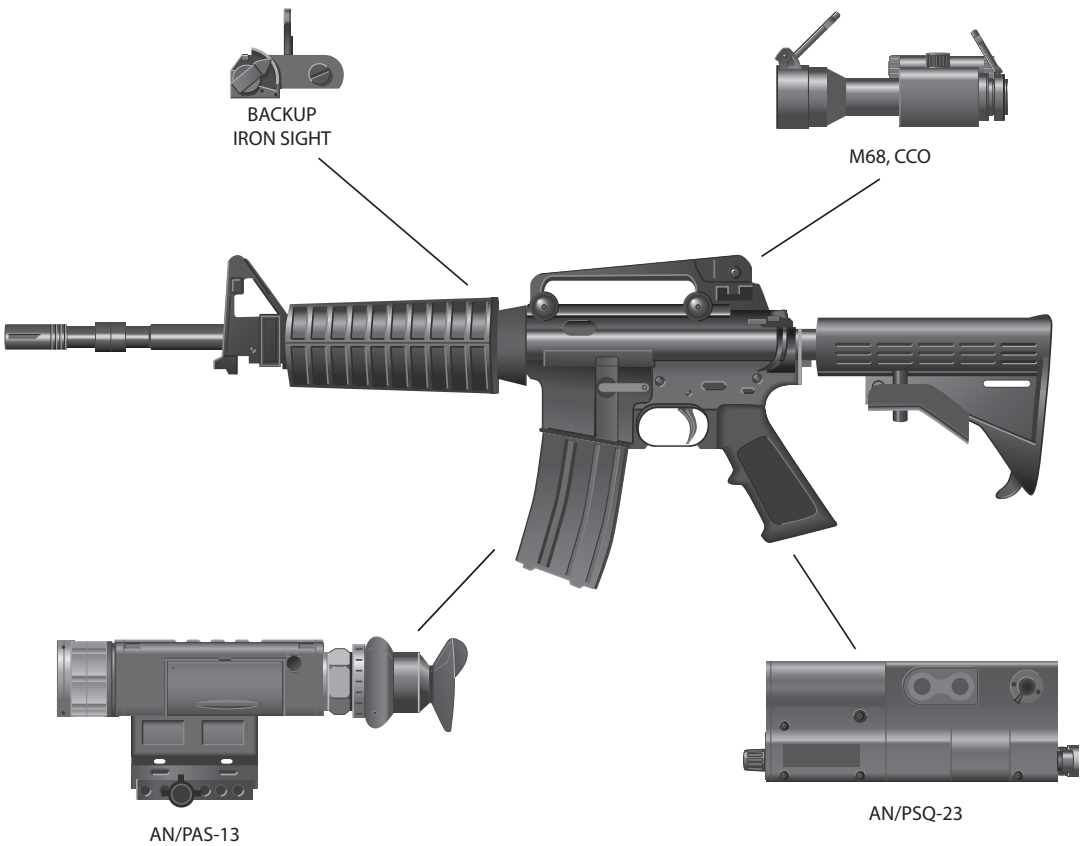
Image intensifiers for small arms and light weapons are available as stand-alone sights and clip-on units used with day sights. An example of the latter is the Clip-on Sniper Night Sight used with the US military's Semi-Automatic Sniper System (IQPC, 2010). Sights or clip-on units featuring image intensifiers for military end users have been produced in at least 26 countries (Jones and Ness, 2011, pp. 633–63).[39]

Thermal sights differ from image-intensifying sights in that they detect infrared radiation emitted by the target rather than light reflected off the target (Electrophysics, n.d.). The vast majority of thermal sights feature uncooled detectors, which are less sensitive than cooled detectors but are also lighter, quieter, and less expensive (Gething, 2008).[40] Since thermal sights do not rely on ambient light, they are much more effective than image intensifiers in the

low-light environments encountered in underdeveloped and sparsely populated countries such as Afghanistan. They can also 'see' through dust, fog, sand, and other obscurants (USMC, 2004, p. 143). The major drawback of thermal sights is their cost. According to US Army budget documentation, the per-unit cost of the AN/PAS family of thermal sights procured in 2010 ranged from approximately USD 7,900 for the light sight designed for use with assault rifles to USD 9,500 for 'heavy' sights used with sniper rifles, heavy machine guns, and automatic grenade launchers (US Army, 2011; DRS Technologies, 2010).[41] These costs are likely to decline, however, which will make them increasingly attractive vis-à-vis image-intensifying sights.[42]

Laser sights and other aiming lights[43] project a beam of visible or infrared light at the target. The beam is typically aligned with the barrel of the weapon (boresighted) and therefore laser sights are often used instead of iron sights and telescopic sights when rapid target acquisition is required (White, 2010; Jones and Ness, 2011, p. 622). When the shooter is operating as part of a team, laser sights are also used to identify and hand off targets. Some aiming lights are used for illumination (Laser Devices, 2010, p. 8). Aiming lights, including laser sights, are used by armed forces, law enforcement agencies, and civilians and vary significantly in price and performance. Low-powered laser sights for pistols, which typically have a range of a few dozen metres, can be acquired for as little as USD 20 online (Opticsplanet.com, n.d.a). On the other end of the spectrum is Insight Technology's CNVD-T2 Clip-On Thermal Imaging Sight with Laser Pointer, which sells for USD 25,000 (Opticsplanet.com, n.d.b).

Figure 8.14 **M4 MWS with accessories**



Laser sights and other aiming lights have several limitations. Visible lasers can reveal the presence and the position of the shooter, alerting the target and exposing the shooter to counter-fire. The same is true of infrared lasers if the enemy is equipped with night vision devices. Many aiming lights are also less effective in bright light and against backgrounds in which there is no surface, such as the sky (Tai et al., 1996).

Figure 8.14 includes several examples of the accessories described above and indicates where they are mounted on a typical assault rifle. These accessories include a reflex sight (M68 Close Combat Optic), a back-up iron sight, a thermal sight (AN/PAS-13), and a range-finder (AN/PSQ-23).

Other accessories

The term 'rangefinder' is used to refer to a variety of instruments ranging from the 'stepped slot, indicating the apparent length of an average tank at [specific] ranges' in the foresight of the RPG-75 to the US military's AN/PSQ-23 Small Tactical Rifle Mounted Micro-Laser Range Finder (Jones and Ness, 2007, p. 451). This chapter focuses on ***laser rangefinders***, which measure the time it takes for a laser projected at a target to 'bounce back' to the rangefinder. A microprocessor in the unit calculates the distance to the target by measuring the length of time between when the beam is projected and when it bounces back (Shideler and Sigler, 2008, p. 49).

As mentioned above, laser rangefinders have numerous military and civilian purposes. Features found in more expensive hunting rangefinders include filtering technology that improves readings in obscurants such as rain, haze, and dust; a scanning mode that allows for the tracking of moving objects; and the ability to exclude false readings from objects in the path of the target, such as tree branches (Shideler and Sigler, 2008, p. 49). Some are integrated into riflescopes, but most appear to be sold as binoculars. Many military rangefinders are integrated into fire-control systems that perform multiple functions (see below) and can significantly increase the range and accuracy of the weapons to which they are attached. Use of a laser rangefinder and thermal optic reportedly increases the range of the Shoulder-launched Multipurpose Assault Weapon II rocket by 200–500 m and can increase first-round hit rates to more than 80 per cent (Gething, 2010).

Fire-control systems vary significantly in terms of technological sophistication and complexity.

A **fire-control system** (FCS) is a device that assists in acquiring and tracking targets, computing targeting data, and controlling the rate and direction of fire.[44] While commonly associated with mortars, fire-control systems are used with many small arms and light weapons and take various forms. Some are mounted on vehicles, others are handheld—often consisting of a personal digital assistant or tablet computer (Pengelley, 2011)—and still others are attached to dismounted weapons. Some fire-control systems are not 'accessories' as defined in this chapter since they are built into the weapon at the time of manufacture and are essential for one or more intended uses.

Fire-control systems vary significantly in terms of technological sophistication and complexity. The COCOS COmmando COntrol System for 60 mm mortars, for example, does only one thing. Its microprocessor uses data on the range of the target and the position of the barrel to determine when the angle of the barrel matches the range data (Jones and Ness, 2011, p. 678). Other systems are more technologically sophisticated and perform a variety of functions. Rheinmetall's Vingmate FCS for heavy machine guns and automatic grenade launchers features a ballistics computer, day camera, magnetic compass, global positioning system (GPS), and laser rangefinder. With the Vingmate, the operator of an automatic grenade launcher can: (1) detect and recognize man-size targets at distances greater than 1,100 m, (2) calculate the distance of targets located up to 4,500 m away, (3) compute the proper superelevation angle for the grenade launcher, (4) programme the fuses of airburst munitions, (5) send streaming video and other

data to command posts and other networked units, and (6) receive data, including the locations of friendly forces (Pengelley, 2009a; Rheinmetall Defence, n.d.b).

For the militaries that can afford them, fire-control systems offer many benefits. The systems eliminate the need to 'walk' rounds into the target, a major liability of light weapons such as automatic grenade launchers (Pengelley, 2011). To hit a target with a conventional grenade launcher, the gunner often has to fire a round, observe where it lands, adjust the position of the barrel, fire another round, and repeat this process until a round hits the target. This process wastes ammunition, increases the likelihood of collateral damage, allows the target to take cover, and exposes the gunner to counter-fire. Systems such as the Vingmate increase the likelihood of a first-round hit, thereby addressing many of these problems.

Advanced fire-control systems can be costly. According to one industry official the cost of a basic FCS for the MK19 automatic grenade launcher is approximately US 50,000,[45] significantly more than the grenade launcher itself. Fire-control systems for mortars appear to be even more expensive. The estimated unit cost of the FCS for the M150 dismounted mortars budgeted for procurement by the US Army in 2010 was USD 107,000 per unit (US Army, 2011).

The international trade in accessories for small arms and light weapons

As discussed above, data on international transfers of accessories for small arms and light weapons is less plentiful and detailed than data on transfers of the weapons themselves. Detailed, disaggregated data on accessories is generally not published through any of the multilateral reporting mechanisms, and few national reports include such data. Consequently, comparatively little is known about the international trade in small arms accessories.

For the militaries that can afford them, fire-control systems offer many benefits.

As a first step towards correcting this deficiency, the Small Arms Survey obtained detailed data on imports of sights and other accessories for small arms and light weapons for ten countries.[46] Data on six of these countries—Colombia, India, Portugal, Sweden, the UK, and the United States—reflects military procurement. Data on the four remaining countries—Chile, Paraguay, Peru, and Uruguay—was obtained from Datamyne, a US provider of trade data collected from national customs agencies, and primarily reflects imports of weapon sights for civilian end users.

The following section summarizes and assesses this data through two case studies. The first case study draws on detailed customs data to assess the international trade in weapon sights used by civilians.[47] The procurement of sights and other accessories by militaries in six countries is the focus of the second case study. The case studies shed important light on the types of accessories most frequently acquired, the major suppliers and countries of origin of these accessories, and recent procurement trends.

Case study: the civilian market for weapon sights in South America

Data on transfers of weapon sights in Chile, Paraguay, Peru, and Uruguay reveals a civilian import market that is dominated by inexpensive sights manufactured and, to a lesser extent, sold by companies located in China. Most of these items appear to be basic telescopic sights for use with hunting and air rifles but other types of sights, including red dot, laser, and night vision sights, are also listed.

China is identified as the country of origin for nearly 90 per cent of the roughly 133,000 imported sights.[48] Spain was the second-largest producing state, accounting for approximately 7,000 units, or roughly 5 per cent, of all imports. Table 8.4 lists the ten largest countries of origin for the imported sights.

China also tops the list of exporting countries, but its share of exports is notably lower. According to the data, approximately two-thirds of all documented imports came directly from exporters based in China. Most of the

Table 8.4 Weapon sights transferred to Chile, Paraguay, Peru, and Uruguay: top ten countries of origin

Country/territory of origin	Quantity of imported sights[49]	Percentage of total imports
China	116,857	88%
Spain	6,898	5%
Hong Kong	3,660	3%
United States	2,199	2%
Unidentified	1,077	1%
Uruguay	492	<1%
Italy	394	<1%
South Korea	286	<1%
Japan	167	<1%
Philippines	135	<1%

Source: Datamyne (n.d.)

remaining sights were purchased from exporters located in the United States and Spain, which captured 15 per cent and 7 per cent of the import market, respectively. Even in these cases, however, China retained a presence in the production and distribution chain; more than half of the sights exported from the United States and Spain were produced in China. Table 8.5 lists the top exporting states and their respective share of imports in three South American countries.

Table 8.5 Weapon sights transferred to Chile, Paraguay, and Uruguay: top ten countries of export[50]

Country/territory of export	Quantity of imported sights[51]	Percentage of total imports
China	83,422	64%
United States	19,021	15%
Spain	9,017	7%
Iquique Free Zone	5,051	4%
Uruguay	4,287	3%
Hong Kong	3,562	3%
Chile	1,950	2%
Montevideo Free Zone	1,201	<1%
Italy	1,199	<1%
Argentina	775	<1%

Source: Datamyne (n.d.)

Table 8.6 **Weapon sights transferred to Chile, Paraguay, Peru, and Uruguay: unit values**

Unit value (USD)	Quantity	% of total quantity	Countries of origin (top five)	Countries of export (top five)
>1,000	6*	<1%	United States, Austria	United States, Austria
500–1,000	20*	<1%	Germany, Austria, United States	Germany, Austria, United States
100–500	464	<1%	United States (53%), Japan (33%), Sweden (5%), South Korea (4%), China (3%)	United States (92%), Sweden (5%), Italy (2%), Germany (<1%), Spain (<1%)
10–100	28,650	22%	China (75%), Spain (13%), United States (6%), Uruguay (2%), Unspecified (1%)	United States (42%), China (23%), Spain (17%), Unspecified (5%), Uruguay (5%),
<10	103,467	78%	China (92%), Hong Kong (3%), Spain (3%), United States (<1%), Unspecified (<1%)	China (74%), United States (6%), Iquique Free Zone (5%), Spain (4%), Hong Kong (3%)

Note: * This quantity excludes one sight whose importer is identified as the Peruvian military.

Source: Datamyne (n.d.)

Also noteworthy is the large percentage of very inexpensive imported sights and the clear stratification of producers and exporters of inexpensive and expensive sights. The data indicates that the vast majority of imported sights had unit values of less than USD 100, and most had values of less than USD 10 per unit. Nearly all of the least expensive items (such as items with a unit value of less than USD 10) were produced in China. US exporters competed more successfully with their Chinese counterparts for the market in sights valued at USD 10–100, but most producers of these sights were also located in China. The commodity descriptions submitted with the customs documentation indicate that most of the least expensive items were intended for use with sporting, hunting, and air rifles.

The trade in more costly sights was small and dominated by companies located in Austria, Germany, and the United States. Imports of sights with a unit value of USD 1,000 or more were negligible, consisting of just six units, four of which were exported to Chile from the United States. These sights include a PS22 night vision scope along with high-end telescopic sights produced by well-known US and European manufacturers. Similarly, only 26 sights with unit values exceeding USD 500 were imported; all of them came from Austria, Germany, and the United States. Sights valued at between USD 100 and USD 500 were slightly more numerous but still constituted less than one per cent of all imported sights. Most were produced in the United States or Japan, and nearly all were exported from the United States. Of the 464 sights in this price band, only 15 were reportedly produced in China, and none were exported from China. Table 8.6 lists the major producers and exporters of sights in each price band, along with the quantities of sights imported per band.

Whether the civilian market for weapon sights in South America is representative of the global market is unknown, but US import data suggests that at least some of its features, including the influential role of Chinese producers and exporters, are more broadly applicable. According to US customs data, three-quarters of imported rifle sights[52] were imported from China (USCB, n.d.). The data also indicates that the unit value of these sights is significantly lower than sights from other countries. Comparably detailed customs data from other countries would allow for a more definitive assessment of the international civilian market for weapon sights and other accessories.

Case study: military procurement of accessories

Data on the acquisition of accessories, including sights, by a small but diverse group of governments highlights several noteworthy features of military procurement of accessories for small arms and light weapons. The data covers procurement, including imports, by the militaries of Colombia, India, Portugal, Sweden, the UK (see Table 8.7), and the United States.

The data suggests that the market for military sights is different from the civilian market in several notable ways. Whereas most of the sights exported to civilian end users in South America came from China, nearly all of the imported sights procured by the six militaries studied were purchased from Canada, Germany, Israel, South Africa, Sweden, or the United States. Common to both markets, however, is the important presence of US producers and exporters, which are listed as the contractors for nearly all accessories procured by the US Army and a large percentage of the sights imported by the other countries.

The data also reflects the rapid expansion of the military market for thermal weapon sights, one of the most significant trends in the development and procurement of weapon sights.[53] In the late 1990s, thermal sights for small arms were comparatively rare, primarily because of their cost, weight, and excessive power consumption (Brown and Wasserbly, 2009). Today, thousands are procured each year by militaries worldwide. This trend is evident in the data obtained for this study and other reports on recent military procurement. Data from budget documents published by the US Army reveals planned procurement of nearly 110,000 thermal sights in US fiscal years 2008–2010, the combined estimated value of which was nearly USD 1 billion (US Army, 2009; 2010; 2011). Deliveries of thermal sights to the US Army by BAE Systems alone topped 100,000 units as of August 2011 (BAE Systems, 2011).

Table 8.7 **Accessories for small arms and light weapons delivered to the UK Ministry of Defence in 2010**

Equipment	Supplier	Country of manufacture[54]	Quantity delivered
Maxikite	Qioptiq	UK	892
Lightweight thermal imager (VIPIR2)	Qioptiq	UK	1,119
Lightweight thermal imager (VIPIR2+)	Qioptiq	UK	18
Thermal weapon sight	DRS Optronics	US	1,066
Sniper thermal imaging capability	Qioptiq	UK	300
AN-PEQ2A	Thomas Jacks Ltd.	US	876
Small arms thermal imager	Insight Technology	US	130
FIST thermal sight	THALES	UK	252
FIST lightweight day sight	THALES	Canada	1,299
FIST close quarter battlesight	THALES	UK	2,778
FIST underslung grenade launcher system	THALES	UK	264
FIST CWS MK2	THALES	UK	200
FIST Maxikite	THALES	UK	180

Source: UKMoD (2011), obtained by Small Arms Survey through a Freedom of Information Act request

While probably the biggest consumer of thermal sights, the US military is not alone. Nearly 2,900 of the approximately 8,200 sights delivered to the British armed forces in 2010 were thermal imagers (see Table 8.7). Other countries that have recently procured—or are planning to procure—thermal sights for small arms include Australia, Bulgaria, France, Germany, India, Israel, Romania, Singapore, and South Korea.[55]

This trend is reflected in interviews with defence industry representatives. According to one representative, the use of thermal sights and image intensifiers on the widely exported Carl Gustaf recoilless rifle is growing, in part because of the preference among militaries to engage in combat operations at night. There is also widespread interest in thermal imagers for the BILL 2 anti-tank guided weapon and the RBS-70 man-portable air defence system.[56]

The data also sheds some light on the military market for other accessories, the procurement of which appears to be small compared to sights. Budget data from the US Army reveals planned annual procurement of fewer than 10,000 rangefinders and fewer than 100 M150 mortar fire-control systems, as compared to more than 100,000 weapon sights. The United States procured more aiming lasers and lights than fire control systems and rangefinders, but the total value of that procurement was a fraction of the budget for sights (US Army, 2009; 2010; 2011). According to data collected for this study, the number of sights procured by Colombia, Portugal, and the UK also far exceeded procurement of other accessories.[57] In addition, interviews with industry

Box 8.4 Trends in the small arms trade

Every year UN Comtrade receives data on arms transfers from more than 150 countries. It is thus the richest single data source and the best means by which trends over time and comparisons between countries can be made. Nevertheless, a lack of reporting by some countries and aggregation of different types of equipment mean the figures presented in this box and in Table 8.8 only reflect a portion of the trade.

An analysis of UN Comtrade data reveals that the total value of reported exports of small arms, light weapons, their parts, and ammunition in 2009 was USD 4.6 billion. This is an absolute increase over the USD 4.3 billion reported for 2008 (Herron et al., 2011, p. 11); these two years continue the trend of a steadily increasing financial value of global small arms transfers (Dreyfus et al., 2009, p. 11). The difference between the global figure presented in this box and the USD 8.5 billion estimate of the value of the trade presented elsewhere in this chapter is explained by the four-year project's use of additional data sources and estimation of the undocumented trade to calculate the higher estimate. However, that methodology is unsuitable for making rankings and assessing trends. For that, a single data source–UN Comtrade–is used.

The analysis shows that 37 countries exported more than USD 10 million. Classified as major or top exporters, these 37 collectively accounted for transfers worth USD 4.5 billion, or some 98 per cent of the global total. Twelve countries exported more than USD 100 million; in descending order, they are the United States, Italy, Germany, Brazil, Austria, Japan, Switzerland, the Russian Federation, France, South Korea, Belgium, and Spain, all classed as top exporters. Together, the 12 countries exported small arms worth USD 3.5 billion, or 76 per cent of the global total. Since 2008, France and Japan have risen to the top category, as they exported more than USD 100 million in 2009. Four countries–Canada, Israel, Norway, and Turkey–exported less than the threshold in 2009 and thus dropped down to the major first tier category (USD 50–99 million). Twenty-five countries exported between USD 10 million and USD 99 million and are therefore classed as major exporters. Together, they exported arms worth USD 1 billion, or 22 per cent of global exports. Four countries–Australia, Bulgaria, Hungary, and the Philippines–were newly classified as major exporters since they exported less than USD 10 million in 2008.

The seven top importers (acquiring more than USD 100 million) in 2009 were (in descending order): the United States, the United Kingdom, Saudi Arabia, Australia, Canada, Germany, and France. Overall, these top importers accounted for 59 per cent of global transfers. The United States was the largest importer by far; its 2009 imports were worth USD 1.8 billion or 38 per cent of the total. There were 47 major importers (USD 10–99 million), which collectively imported 35 per cent of global transfers.

Table 8.8 **Exporter rankings for 2009**

Ranking	Country	Exports in 2009 (USD million)	Change from 2008 to 2009
Top first tier (>USD 500 million)	United States	706	
	Italy	507	
Top second tier (USD 100–500 million)	Germany	452	
	Brazil	382	
	Austria	249	
	Japan	249	Moved up from major first tier
	Switzerland	188	
	Russian Federation	168	
	France	161	Moved up from major second tier
	South Korea	159	
	Belgium	142	
	Spain	101	
Major first tier (USD 50–99 million)	Israel	98	Moved down from top second tier
	Turkey	94	Moved down from top second tier
	Czech Republic	93	
	Canada	87	Moved down from top second tier
	United Kingdom	68	
	Finland	68	
	Croatia	63	Moved up from major second tier
	Norway	61	Moved down from top second tier
Major second tier (USD 10–49 million)	China	46	
	Portugal	45	
	Sweden	38	Moved down from major first tier
	Serbia	35	
	Mexico	31	
	Poland	27	
	Taiwan	21	
	Romania	16	
	India	16	

	Hungary	14	Exported less than USD 10 million in 2008
	Philippines	14	Exported less than USD 10 million in 2008
	Argentina	13	
	Bulgaria	13	Exported less than USD 10 million in 2008
	Cyprus	12	
	Singapore	12	
	Australia	11	Exported less than USD 10 million in 2008
	Netherlands	10	

representatives suggest that procurement of many accessories is modest compared to sights. For example, interest in weapon-mounted laser rangefinders for Carl Gustaf recoilless rifles is growing but the potential global market is estimated at only 1,000 units annually.[58] The same is true for fire control systems for automatic grenade launchers, whose total *potential* global market probably numbers in the thousands of units annually, including units procured from domestic sources, according to one well-placed industry representative.[59]

Finally, the data highlights the rising cost of accessories vis-à-vis the weapons on which they are mounted. As mentioned above, US budget data indicates that the estimated unit value of the M150/M151 mortar FCS was more than twice the cost of the M120 mortar system itself (US Army, 2011). The difference between the unit cost of small arms and some accessories is even starker. The estimated unit cost of the small arms thermal sights budgeted for procurement by the US Army in 2010 was six times the cost of the M4 rifle with which many of the sights were to be used. However, some weapons still cost as much or more per unit than even the most expensive accessories. The M110 semi-automatic sniper system, for example, is comparable in cost to high-end thermal sights for sniper rifles (US Army, 2011). But such examples are increasingly the exception rather than the rule as accessories become more technologically sophisticated, while the weapons themselves remain largely unchanged. If this trend continues, it is possible that, at least in some countries, budgets for accessories will eventually dwarf budgets for the weapons themselves, with significant implications for the international trade in small arms and light weapons.

CONCLUSION

The four-year study of authorized international transfers of small arms, light weapons, their parts, accessories, and ammunition has yielded valuable insights. Among the most notable findings is the highly concentrated nature of the global trade. A handful of countries accounted for most of the documented transfers of small arms and light weapons during the ten-year period covered in the study. Twenty exporting states accounted for more than 80 per cent of transfers of small arms and light weapons from 2000 to 2006, according to customs data (Dreyfus et al., 2009, p. 8). The dominant role of the United States in much of the small arms trade is also highlighted; from 2000 to 2009, it was the top importer of small-calibre ammunition, sporting shotguns, pistols, revolvers, and parts for small arms and light

weapons. While data limitations preclude a definitive accounting of the US role in the trade in light weapons and the other items the project has studied, available data suggests that it was significant.

Another remarkable trend is the absolute growth in the value of international transfers since 2002. This growth was first highlighted in the 2009 *Survey* chapter on the trade in small arms. Subsequent chapters have also found evidence of increases in the trade in small-calibre cartridges and shotgun shells (2010), some light weapons (2011), and now parts. The causes of this increase in world trade need further attention, but there are two probable factors. The first is increased spending by US civilians on small arms and ammunition. The US market accounts for such a large proportion of global sales that an uptick in US demand can have a major effect on exports around the world (Dreyfus et al., 2009, pp. 40, 42; Herron et al., 2010, p. 21). Second, governments made large-scale purchases of military firearms and light weapons for forces involved in fighting in Iraq and Afghanistan; these were intended for both armed forces participating as international forces and for Iraqi and Afghan security forces.[60]

The study also highlights the huge disparity in data on—and public understanding of—transfers to and from the most transparent countries versus transfers between the least transparent countries. As documented throughout the four-year study, transfers to and from Europe and North America are the most thoroughly documented and best understood. This reflects the greater trade transparency of major exporting countries in these regions (TRANSPARENCY). The Survey has also documented transfers in much of South America, filling in some gaps with data obtained through Datamyne and direct requests to government officials. Other key countries for which data was collected include India, Israel, and South Korea—all significant producers of small arms and light weapons.

For these countries, the four-year study yielded a fairly complete picture of transfers of small arms, small-calibre ammunition, parts for non-military firearms, and some light weapons, including MANPADS. The trade in other items remains opaque, however. Few countries publish detailed, disaggregated data on transfers of light weapons parts and ammunition or on most accessories for small arms and light weapons, notwithstanding their widespread use by armed groups and their potentially game-changing effects on combat operations and the capabilities of non-state groups.[61]

Despite the Survey's exhaustive data review, the trade in Africa, Asia, and the Middle East also remains opaque. Few countries in these regions routinely report on their transfers of small arms and light weapons to the UN Register or publish detailed national reports on transfers or military procurement of these items. UN Comtrade provides some information on transfers of small-calibre ammunition and certain small arms in these regions, but it offers few details on the trade in machine guns, assault rifles, sniper rifles, light weapons and their parts and ammunition, and most accessories. Other sources utilized for this study—including military procurement notices, direct requests to governments, and commercial aggregators of shipping data (Datamyne)—capture some of these transfers, but huge gaps remain. Of particular concern is the lack of information on possible exports to unstable or abusive regimes from China and the Russian Federation, neither of which releases data on exports of pistols, military firearms, light weapons, or light weapons ammunition (except MANPADS). Arms transfers from Iran and North Korea and re-exports from states with large surplus stockpiles, such as Angola, are also poorly understood.

Filling these data gaps and building on the findings of this study will improve public understanding of the sources and means through which authorized arms transfers fuel the illicit trade. From Afghanistan to Mexico, arms flows can threaten efforts to stabilize countries, enhance security, and combat organized crime (ILLICIT SMALL ARMS and DRUG

VIOLENCE). Yet much of the authorized trade—and in particular those aspects that appear most closely related to the illicit trade—remain shrouded in secrecy. The more we know, the more we need to know.

LIST OF ABBREVIATIONS

ATGW	Anti-tank guided weapon
CBP	United States Customs and Border Protection
FCS	Fire-control system
GDP	Gross domestic product
HS	Harmonized System
MANPADS	Man-portable air defence system
OECD	Organisation for Economic Co-operation and Development
UN Comtrade	United Nations Commodity Trade Database

ANNEXE

Online annexe at <http://www.smallarmssurvey.org/publications/by-type/yearbook/small-arms-survey-2012.html>

Annexe 8.1 Methodology

This annexe provides a detailed summary of the methodology used in this chapter.

ENDNOTES

1 See Purcena et al. (2009) and Herron, Marsh, and Schroeder (2010; 2011) and Annexe 8.1.

2 See Berman and Leff (2008, pp. 8–11). For a definition of 'authorized transfers' and an explanation of the various types of transfers captured in the data used in this study, see Dreyfus et al. (2009, pp. 9–10).

3 Detailed information on numerous light weapons can be found in Jones and Ness (2011).

4 Also included are items attached to other accessories that are fastened to the weapon.

5 See Dreyfus et al. (2009); Herron et al. (2010, pp. 18–20; 2011, pp. 20–21).

6 See Herron et al. (2010, p. 18).

7 See Herron et al. (2011, p. 21).

8 See Lazarevic (2010, pp. 36, 39, 64–65, 116–17).

9 The trade category used is parts of military weapons under HS code 930591.

10 The dataset comprised 201 countries, which is more than the number of UN member states because some autonomous territories report their imports and exports separately to UN Comtrade (such as Greenland, New Caledonia, and French Polynesia); however, the import values of 28 of the countries in the dataset—most of them very small countries—could not be estimated due to a lack of GDP data.

11 The tested variables include: the extent of light weapons production, military expenditure, size of the armed forces, military expenditures per member of the armed forces, GDP, military expenditure as a proportion of GDP, total population, GDP per capita, firearms per capita, total number of guns, OECD membership, NATO membership, EU membership, and the existence of state-owned production.

12 See Annexe 8.1.

13 For details on the use of mirror data, see Khakee (2004).

14 The figures for the different weapon categories do not add up to 100 per cent due to rounding.

15 Many of the contract award notices identify the procured items simply as 'night vision devices' without identifying the model or intended platform. Since night vision technology is used on a variety of platforms, many of which are outside the scope of this chapter, data from these notices is of little use for the purposes of this study.

16 Data submitted to UN Comtrade is not sufficiently detailed to distinguish the value of the sight from the value of the weapon with which it is exported.

17 Other items reported under HS code 901310 include telescopes, periscopes, and optical devices used for industrial purposes.

18 Datamyne (n.d.); GTIS (n.d.); UN Comtrade (n.d.); USCB (n.d.). The estimates reflect sights imported separately from the weapon with which they are to be used. The value of sights imported with weapons is recorded in the same customs category as the weapon itself.

19 This HS category reflects data on weapon sights shipped separately from the weapon for which they were intended. Weapon sights imported with the weapon are included in the same commodity category as the weapon itself.

20 Interestingly, observers find that 'greater openness to trade and Foreign Direct Investment (FDI) lowers small arms imports per capita' (de Soysa, Jackson, and Ormhaug, 2009). Their finding underlines the points made in this chapter regarding the fact that the major importers and exporters involved in production chains differ from those trading in finished weapons.

21 Author communication with an industry representative, 27 October 2011.

22 The acronym COTS can also refer to 'components off the shelf', which has a similar meaning.

23 The Small Arms Survey includes international movement of arms for repair and maintenance in transfers studied as part of the four-year project to assess the trade (Dreyfus et al., 2009, p. 9).

24 Author interview with an industry representative, 4–5 October 2011.

25 Author interview with an industry representative, 4–5 October 2011.

26 Author communication with analyst Jurgen Brauer, who compiled statistics on Sturm, Ruger & Co., 16 December 2011.

27 For more information on UN Comtrade, see Dreyfus et al. (2009, pp. 10–11).

28 Glock has a plant in Smyrna, Georgia, while Beretta has one in Accokeek, Maryland.

29 Parts are described as being 'military' by the state reporting the transfer. This designation is based upon the nature of the finished weapon (such as being fully automatic) rather than the identity of the intended recipient.

30 For more information, see Herron et al. (2011) and Gander and Cutshaw (1999, p. 382).

31 An example is the MK19 Capability Upgrade Package from Rheinmetall (Rheinmetall Defence, n.d.a).

32 Author telephone interview with a defence industry representative, 26 September 2011.

33 The onus is on the vendor to demonstrate that the operational benefits of a given piece of equipment exceed the opportunity cost of the equipment it displaces. As articulated by a British official interviewed by Jane's Information Group, '1 kg of extra capability must exceed the value of one litre of water or two rifle magazines' (Pengelley, 2009b).

34 Weapon sights are often referred to as 'optics' or 'scopes'.

35 An example is the optical sight in Singapore Technology Kinetic's SAR 21 rifle (Jones and Ness, 2007, p. 209).

36 The RPG-2 rocket-propelled grenade launcher is an example. According to Jane's Information Group, '[t]here is no provision for the fitting of an optical sight' on the RPG-2 (Jones and Ness, 2007, p. 476).

37 Since iron sights come standard on most small arms and are widely viewed as essential for the basic, intended use of these weapons, iron sights are considered 'parts' for the purposes of this study. Exceptions include emergency sights for use when primary sights are damaged or lost and specialized sights for target shooting.

38 The US Defense Department defines a reflex sight as an 'optical or computing sight that reflects a reticle image (or images) onto a combining glass for superimposition on the target' (USDoD, 2009).

39 These countries are Austria, Belgium, Canada, China, Croatia, the Czech Republic, Finland, France, Germany, Greece, India, Israel, Italy, the Netherlands, Norway, Pakistan, Poland, Romania, the Russian Federation, Serbia, South Africa, South Korea, Spain, Turkey, the United Kingdom, and the United States.

40 A small number of sights for light weapons, including the BILL 2 ATGW, feature cooled imagers (Jones and Ness, 2011, p. 666).

41 The AN/PAS-13(D)3 heavy sight is also mounted on squad leaders' assault rifles (DRS Technologies, 2010).

42 Author interview with a defence industry representative, Washington, DC, 11–12 October 2011.

43 The terms 'laser sight', 'aiming laser', and 'aiming light' are used interchangeably.

44 This definition is based on the US military's definition of 'integrated fire control system', which is a 'system that performs the functions of target acquisition, tracking, data computation, and engagement control, primarily using electronic means and assisted by electromechanical devices' (USDoD, 2009).

45 Author telephone interview with a defence industry representative, 23 June 2011.

46 This dataset differs from the data used to generate the annual estimate for the value of transfers of weapon sights in that the data on military procurement was not used in the global estimate because of concerns about double-counting.

47 While the intended end user is often unclear, the commodity descriptions suggest that most of the sights are intended for hunting or sporting rifles and air guns.

48 Note that data on items with an average per-unit cost of less than USD 1 was excluded based on the assumption that they may be parts for sights (incorrectly categorized) rather than complete sights.

49 While the relevant HS commodity category under which these transfers were recorded is for complete sights, it is possible that some shipments of parts were declared in this category.

50 Data on transfers to Peru is excluded from the table since it does not identify the country of export.

51 While the relevant HS commodity category under which these transfers were recorded is for complete sights, it is possible that some shipments of parts were declared in this category.

52 This data reflects imports of rifle sights that are sold separately from small arms.

53 As articulated by analysts Brown and Wasserbly, 'the main theme evident in sights developments and acquisitions over the last five years is the democratization of access to thermal sights' (Brown and Wasserbly, 2009).

54 Brown and Wasserbly (2009); Gething (2008; 2011); Jones and Ness (2011); White (2009).

55 The data provided by the UK Ministry of Defence includes the following caveat: 'The country of origin is based on the supplier we purchased from, as although some items are imported the delivery to MOD is through a UK supplier' (UKMoD, 2011). The information was supplied in response to a Freedom of Information Act request by the Small Arms Survey.

56 Author telephone interview with a defence industry representative, 26 September 2011.

57 The one exception is the Swedish military.

58 Author telephone interview with an industry representative, 26 September 2011, and author interviews with industry representatives, Washington, DC, 11–12 October 2011.

59 Author correspondence with an industry representative, 7 November 2011.

60 Dreyfus et al. (2009, pp. 17, 32, 37, 54); Herron et al. (2010, pp. 22, 31; 2011, pp. 9, 23–24, 27–28, 31–33, 35).

61 For an example of the significant tactical advantages provided by latest-generation accessories, see the section titled 'Small arms and light weapons accessories and the modern battlefield', above. For a discussion of the potential consequences of acquisition and use of latest-generation light weapons by armed groups, see Bonomo (2007, pp. 71–75).

BIBLIOGRAPHY

BAE Systems. 2011. 'BAE Systems Hits Delivery Milestone for Thermal Weapon Sight.' 23 August.

Baily, Mike. 2009. 'Bushnell's Latest Golf Course Laser Rangefinder—the Pro 1600 Slope Edition—Hits the Mark.' *WorldGolf*. April. <http://www.worldgolf.com/golf-equipment/bushnell-pro-1600-slope-edition-laser-rangefinder-10063.htm>

Beretta. n.d. 'ARX160 and GLX160: Unrivaled Soldier's Defender.' <http://www.berettadefence.com/index.aspx?m=53&did=145>

Berman, Eric G. and Jonah Leff. 2008. 'Light Weapons: Products, Producers, and Proliferation.' In Small Arms Survey. *Small Arms Survey 2008: Risk and Resilience*. Cambridge: Cambridge University Press, pp. 6–41.

Bonomo, James, et al. 2007. *Stealing the Sword: Limiting Terrorist Use of Advanced Conventional Weapons*. Santa Monica: RAND Corporation.

Bosch. n.d. 'Laser Rangefinder DLE 50 Professional.' <http://www.bosch-pt.com/productspecials/professional/dle50/uk/en/start/index.htm>

Brauer, Jurgen and Paul Dunne, eds. 2004. *Arms Trade and Economic Development: Theory, Policy, and Cases in Arms Trade Offsets*. London: Routledge.

Brown, Nick. 2011. 'First Sighting of Pointer Networked Target Indication System.' *Jane's International Defence Review*. 22 February.

— and Daniel Wasserbly. 2009. 'Piercing the Fog of Battle: Forces Set Sights on Thermal Technology.' *Jane's International Defence Review*. 14 April.

Browning. n.d.a. 'BAR Rifles, Firearms.' Accessed 4 November 2011. <http://www.browning.com/products/catalog/family.asp?webflag_=002B>

—. n.d.b. 'Question: Where are Browning Firearms Manufactured?' Accessed 4 November 2011. <http://www.browning.com/customerservice/qna/detail.asp?id=90>

CBP (United States Customs and Border Protection). 1996. 'Country of Origin Marking for Barelled Actions from Belgium.' HQ 558849. 2 February. <http://rulings.cbp.gov/index.asp?ru=559392&qu=HQ+559392&vw=detail>

—. 2001. 'Country of Origin Marking of Unfinished Shotgun Barrels.' HQ 561919. 31 May. <http://rulings.cbp.gov/index.asp?ru=561919&qu=HQ+561919&vw=detail>

—. 2010. 'Internal Advice: Classification of Kongsberg Remote Weapons System (RWS).' HQ H080595. 5 August. <http://rulings.cbp.gov/index.asp?ru=h080595&qu=H080595&vw=detail>

Cox, Matthew. 2007. 'Army Buys 6,500 Remote Turret Controls.' *Army Times*. 23 August. <http://www.armytimes.com/news/2007/08/army_crows_070823w/>

CSS (Connecticut Spring & Stamping). n.d. Company website. Accessed 4 November 2011. <http://www.ctspring.com/>

Datamyne. n.d. Datamyne Database. Accessed September 2011. <http://www.datamyne.com/index.html>

Dimitrov, Dimitar and Peter Hall. 2012. 'Small Arms and Light Weapons Production as Part of a National and Global Defence Industry.' In Owen Greene and Nicholas Marsh, eds. *Small Arms, Crime and Conflict: Global Governance and the Threat of Armed Violence*. London: Routledge.

Dove, Bill. 2010. 'Applications for Infrared Thermal Imagers.' *Air Conditioning, Heating & Refrigeration News*. 14 June.

Dreyfus, Pablo, et al. 2009. 'Sifting the Sources: Authorized Small Arms Transfers.' In Small Arms Survey. *Small Arms Survey 2009: Shadows of War*. Cambridge: Cambridge University Press, pp. 7–59.

DRS Technologies. 2010. 'Thermal Weapon Sight (TWS) II.' <http://www.drs.com/Products/RSTA/PDF/TWSII.pdf>

DXT (Dandong Xunlei Technology Co., Ltd.). n.d. Company website. Accessed 4 November 2011. <http://ddlaser.en.alibaba.com/>

Electrophysics. n.d. 'How Night Vision Works.' <http://www.electrophysics.com/nl/HNVW/index.html>

Firearm Blog. 2011. 'ATN ThOR 3 Thermal Weapon Sight: $13,000 of Fun.' 22 July. <http://www.thefirearmblog.com/blog/2011/07/22/atn-thor-3-thermal-weapon-sight-13000-of-fun/>

Gabelnick, Tamar, Maria Haug, and Lora Lumpe. 2006. *A Guide to the US Small Arms Market, Industry, and Exports, 1998–2004*. Occasional Paper 19. Geneva: Small Arms Survey.

Gander, Terry and Charles Cutshaw, eds. 1999. *Jane's Infantry Weapons: 1999–2000*. Coulsdon: Jane's Information Group.

Gelfand, Lauren. 2011. 'Streetwise: Fighting in Built-up Areas.' *Jane's Defence Weekly*. 28 April.

Gething, Michael. 2008. 'Lighting the Way: Armed Forces Seek Greater Thermal Imaging Capabilities.' *Jane's International Defence Review*. 11 September.

—. 2010. 'The Perfect Shot: Military and Industry Partners Look to Develop Effective Target Suppression Measures.' *Jane's Defence Weekly*. 7 June.

—. 2011. 'India.' *Jane's World Armies*. 15 July.

Gimelli Sulashvili, Barbara. 2007. 'Multiplying the Sources: Licensed and Unlicensed Military Production.' In Small Arms Survey. *Small Arms Survey 2007: Guns and the City*. Cambridge: Cambridge University Press, pp. 7–37.

GTIS (Global Trade Information Services). n.d. 'Global Trade Atlas.' Accessed September 2011. <http://www.gtis.com/english/>

Herron, Patrick, Nic Marsh, and Matthew Schroeder. 2010. 'Annexe 1.3: Methodology.' June. <http://www.smallarmssurvey.org/fileadmin/docs/A-Yearbook/2010/en/Small-Arms-Survey-2010-Chapter-01-Annexes-1-3-Methodology.pdf>

—. 2011. 'Annexe 1.3: Methodology.' June. <http://www.smallarmssurvey.org/fileadmin/docs/A-Yearbook/2011/en/Small-Arms-Survey-2011-Chapter-01-Annexe-1.3-EN.pdf>

Herron, Patrick, et al. 2010. 'Emerging from Obscurity: The Global Ammunition Trade.' In Small Arms Survey. *Small Arms Survey 2010: Gangs, Groups, and Guns*. Cambridge: Cambridge University Press, pp. 6–39.

—. 2011. 'Larger but Less Known: Authorized Light Weapons Transfers.' In Small Arms Survey. *Small Arms Survey 2011: States of Security*. Cambridge: Cambridge University Press, pp. 9–41.

IQPC (International Quality & Productivity Center). 2010. 'IF Technologies: Examples of Equipment that Use Image Fusion Technology.' November.

Jones, Richard and Leland Ness. 2007. *Jane's Infantry Weapons 2007–2008*. Coulsdon: Jane's Information Group.

—. 2011. *Jane's Infantry Weapons 2010–2011*. Coulsdon: Jane's Information Group.

Khakee, Anna. 2004. 'Back to the Sources: International Small Arms Transfers.' In Small Arms Survey. *Small Arms Survey 2004: Rights at Risk*. Oxford: Oxford University Press.

Khan, J. A. 2004. *Air Power and Challenges to IAF*. New Delhi: APH Publishing.

L3 Communications. n.d. *EOTech HOLOgraphic Weapon Sights: 2010 Complete Catalogue for Holographic Weapon Sights, and Night Vision Products*.

Laser Devices. 2010. *Laser Devices, Inc.: 2010 Product Catalogue*.

Lazarevic, Jasna. 2010. *Transparency Counts: Assessing State Reporting on Small Arms Transfers, 2001–2008*. Geneva: Small Arms Survey. June.

Lothar Walther. n.d. Company website. Accessed 4 November 2011. <http://www.lothar-walther.de/3.php>

Mohanty, Deba. 2004. *Changing Times? India's Defence Industry in the 21st Century*. Bonn: Bonn International Center for Conversion.

Opticsplanet.com. n.d.a. 'Firefield Mini Red Laser Sight.' Accessed 1 November 2011. <http://www.opticsplanet.net/firefield-mini-red-laser-sight.html>

—. n.d.b. 'Insight Technology CNVD-T2 Clip-on Thermal Imaging Sight with Laser Pointer.' Accessed 1 November 2011. <http://www.opticsplanet.net/insight-technology-cnvd-t2-clip-on-thermal-device-with-laser-pointer-cqt-001-a12.html>

Pengelley, Rupert. 2008. 'Moving towards a Digitised Future: France Steals a March with FELIN.' *Jane's International Defence Review*. 8 May.

—. 2009a. 'Vingmate Receives Baptism of Fire on Operations.' *Jane's International Defence Review*. 6 March.

—. 2009b. 'Soldiers Look to Infantry C4I Aids for Tempo without Torment.' *Jane's International Defence Review*. 9 July.

—. 2011. 'Mortar Fire Control in the Modern Battlespace Mix.' *Jane's International Defence Review*. 14 February.

Purcena, Júlio Cesar, et al. 2009. 'Annexe 1.3: Methodology.' <http://www.smallarmssurvey.org/fileadmin/docs/A-Yearbook/2009/en/Small-Arms-Survey-2009-Chapter-01-Annexe-3-EN.pdf>

QinetiQ. n.d. 'Pointer Advanced Targeting Technology.'
<http://www.qinetiq.com/what/capabilities/land/Documents/Pointer-Advanced-Targeting-Technology.pdf>
Rheinmetall Defence. n.d.a. 'MK19 Capability Upgrade.' Product spec sheet.
—. n.d.b. 'Vingmate: Advanced Sight and Fire Control System for Heavy Machine Guns and Grenade Launchers.' Product spec sheet.
Ring Sights. 1998. 'Sights for the Modern Military Rifle.' 20 February. <http://www.ringsights.com/Tech%20Papers/13733.PDF>
Saletan, William. 2009. 'Heat Check.' *Slate Magazine*. 28 April.
Shideler, Dan and Derrek Sigler. 2008. *The Gun Digest Book of Tactical Gear*. Iola, WI: Krause Publications.
de Soysa, Indra, Thomas Jackson, and Christin Ormhaug. 2009. 'Does Globalization Profit the Small Arms Bazaar?' *International Interactions*, Vol. 35, No. 1, pp. 86–105.
Stoeger. n.d. Company website. Accessed 4 November 2011. <http://www.vursan.com.tr/index_en.htm>
Sweeney, Patrick. 2008. *The Gun Digest Book of the Glock*, 2nd edn. Iola, WI: Gun Digest Books.
Tai, Anthony, et al. 1996. 'United States Patent: Compact Holographic Sight.' Patent No. 5,483,362. 9 January.
<http://www.google.com/patents/about/5483362_Compact_holographic_sight.html?id=M0MdAAAAEBAJ>
Thompson, Leroy. 2011. *The Beretta M9 Pistol*. Oxford: Osprey Publishing.
UKMoD (United Kingdom Ministry of Defence). 2011. '20110920_FOI_Schroeder_Enclosure_Data-U.' 22 September.
UN (United Nations). 2011. 'Why Traces Fail: Challenges Involved in Issuing and Responding to Tracing Requests.' Summary Report of Side Event for the Open-ended Meeting of Governmental Experts, New York. 10 May. http://www.poa-iss.org/mge/sideevents.html
UN Comtrade (United Nations Commodity Trade Database). n.d. 'United Nations Commodity Trade Statistics Database.' <http://comtrade.un.org/db/>
UNGA (United Nations General Assembly). 1997. *Report of the Panel of Governmental Experts on Small Arms*. A/52/298 of 27 August. New York: UNGA.
US Army (United States Army). 2009. *Committee Staff Procurement Backup Book*. May.
<http://www.asafm.army.mil/offices/BU/BudgetMat.aspx?OfficeCode=1200>
—. 2010. *Committee Staff Procurement Backup Book*. February. <http://www.asafm.army.mil/offices/BU/BudgetMat.aspx?OfficeCode=1200>
—. 2011. *Committee Staff Procurement Backup Book*. February. <http://www.asafm.army.mil/offices/BU/BudgetMat.aspx?OfficeCode=1200>
USCB (United States Census Bureau). n.d. 'USA Trade Online.' Accessed September 2011. <https://www.usatradeonline.gov/>
USDoD (United States Department of Defense). 2009. *Department of Defense Dictionary of Military and Associated Terms*. Amended 31 October.
USMC (United States Marine Corps). 2004. *Marine Corps Concepts and Programs 2004*.
<http://www.marines.mil/unit/pandr/Documents/Concepts/2004/TOC1.HTM>
Vayu. 2010. 'The Missile Powerhouse: Visiting MBDA in France.' Iss. 3, pp. 92–97.
White, Andrew. 2009. 'Romania Unleashes Assault Rifle Requirement.' *Jane's International Defence Review*. 17 December.
—. 2010. 'CQB Technologies Help Forces Grapple with Short-range Front Line.' *Jane's International Defence Review*. 11 February.
Wikipedia. n.d. 'Iron Sight.' <http://en.wikipedia.org/wiki/Iron_sight>
Williamson, Oliver. 1981. 'The Economics of Organization: The Transaction Cost Approach.' *American Journal of Sociology*, Vol. 87, No 3, pp. 548–77.

ACKNOWLEDGEMENTS

Principal authors

Janis Grzybowski, Nicholas Marsh, Matt Schroeder

Contributor

Giacomo Persi Paoli