L85A1 SA80 rifles in the armoury at the Land
Warfare Centre, Warminster, United Kingdom.
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Military Demand and Supply

PRODUCTS AND PRODUCERS

1

INTRODUCTION

Small arms are a durable good, but like any commodity they are subject to replacement. The global stock of small arms is therefore never static, but in constant flux. Demand for new stock varies according to need, political will, and the availability of finance; the global small arms production rate is consequently never fixed, but fluctuates to meet changes in demand.

This observation is of fundamental importance for any analysis of small arms production. It is not sufficient simply to note that production this year increased in contrast to last year, or the reverse. A demand-side approach explains why production rates change over long periods of time. It can establish trajectories, and hence predictions, of small arms production.

The following analysis estimates procurement and production for a 'global' sample of 151 countries' militaries.[1] It focuses on the acquisition of assault rifles and carbines—the most numerous small arms in military service. These 151 countries were the ones for which stock ages and force levels were available—key factors in the calculation of procurement rates, as will become apparent. By using ratios of each type of weapon stocked by the militaries of 32 countries in the sample for which detailed procurement data was available, it projects assault rifle and carbine procurement data to estimate pistol and light and heavy machine gun acquisition in the 151 states.[2] In so doing, the chapter covers the procurement of the majority of infantry weapons in use today.

From estimates of procurement, the chapter subsequently presents an estimate of global military production to meet this demand. It derives this estimate by gauging the likely ratios of newly produced weapons acquired by states to the transfer and acquisition of surplus weaponry. The approach adopted this year complements production-centred research in past editions of the *Small Arms Survey*. The following are among the chapter's most important conclusions.

- The world's militaries procure around 50 million small arms and light weapons over a 50-year period, or around 1 million units annually.
- Not all of this acquisition is of new stocks.
- Global production of military small arms and light weapons over a 50-year period ranges between 36 and 46 million weapons and averages 0.7–0.9 million annually.
- Production is not constant but cyclical and responds to the demands of the world's wealthier states.
- The world's poorer states often rely on surplus stocks displaced by wealthy state procurement programmes.
- This trade and transfer of surplus stocks to militaries across the globe could number up to 14 million units over a 50-year period.
- Some of the world's largest procurers will launch major procurement programmes in the next 10–15 years.

- Global military production periodically peaks and is projected to do so in the coming 20 years as wealthy states modernize their small arms.
- Unless measures are taken to remove weapons from circulation, this peak is likely to displace yet more surplus stock to the world's poorer states.

MILITARY DEMAND AND SUPPLY

Previous editions of the *Small Arms Survey* note that analysis of production trends necessitates analysis of demand. The 2004 edition, for instance, observes that, while the market for small arms appeared to be in decline during the previous four years, demand had also increased in some areas (Small Arms Survey, 2004, pp. 7–41). In response, the 2005 edition defines particular sectors in the small arms industry, so that variations in demand, and hence production, can be assessed more accurately. It notes that particular sectors respond differently according to the requirements of the consumer groups that purchase the majority of their products (Small Arms Survey, 2005, pp. 39–69).

This chapter focuses on military demand and supply, or 'Sector 5' production, as defined in the *Small Arms Survey 2005*. Sector 5 supplies primarily the armed forces of the world's states. Its products, including assault rifles, carbines, and light and heavy machine guns, are collectively the most numerous small arms and light weapons in military service. They also constitute the group of weapons that are most likely to be of 'main concern' in contemporary armed conflict (Small Arms Survey, 2005, p. 40; UN, 1997, para. 13). Of these military small arms and light weapons, state armed forces, totalling some 20 million active and 33 million reserve forces worldwide (IISS, 2004, p. 358), probably procure the lion's share.

Indian soldiers march during the country's 57th Republic Day parade in New Delhi, January 2006.
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Box 1.1 **Definition of small arms and light weapons**

The Small Arms Survey uses the term `small arms and light weapons´ broadly to cover both military-style small arms and light weapons as well as commercial firearms (handguns and long guns). When possible, it follows the definition used in the United Nations´ Report of the Panel of Governmental Experts on Small Arms (United Nations, 1997):

Small arms: revolvers and self-loading pistols, rifles and carbines, assault rifles, sub-machine guns, and light machine guns.

Light weapons: heavy machine guns, hand-held under-barrel and mounted grenade launchers, portable anti-tank and anti-aircraft guns, recoilless rifles, portable launchers of anti-tank and anti-aircraft missile systems, and mortars of less than 100mm calibre.

The Survey uses the terms `firearm´ and `gun´ to mean hand-held weapons that fire a projectile through a tube by explosive charge. The terms `small arms´ and `light weapons´ are used more comprehensively to refer to all hand-held, man-portable, explosively or chemically propelled or detonated devices. Unless the context dictates otherwise, no distinction is intended between commercial firearms (like hunting rifles) and small arms and light weapons designed for military use (such as assault rifles).

The UN definition was agreed through consensus by government officials. It was negotiated, in other words, to serve practical political goals that differ from the needs of research and analysis. While the UN definition is used in the *Survey* as a baseline, the analysis in this and subsequent chapters is broader, allowing consideration of weapons such as home-made (craft) firearms that might be overlooked using the UN definition. The term small arm is used in this chapter to refer both to small arms and light weapons (i.e. the small arms industry) unless otherwise stated, whereas light weapon refers specifically to light weapons.

In 2002, the Small Arms Survey estimated that military production reached around 815,000 weapons in 2000 (Small Arms Survey, 2002, p. 13). The aim of this chapter is to determine whether this figure is a defensible one when calculated from a different set of data—procurement by the world's militaries. The approach outlined below therefore triangulates with previous approaches, in the hope of reinforcing the validity of our data. By doing so, it aims to generate a better understanding of the current military demand for small arms. Moreover, by investigating past patterns of procurement, it indicates possible future trends in demand and supply. If military demand for small arms can be estimated with some degree of accuracy, then we will have achieved a significant step towards a defensible estimate of global small arms production.

The dynamics of small arms procurement

The world's militaries procure small arms frequently. Each country tries to maintain small arms in sufficient quantities to equip its forces and reserves. A country must therefore repair or replace damaged, lost, or obsolete small arms regularly. However, countries periodically modernize their weapons *en masse,* replacing large numbers of weapons when they believe that their armed forces are in need of modernization.

In terms of the global demand for small arms and light weapons, this equates to two different dynamics; a slow and constant turnover of weapons to replace lost and damaged stocks—an annual low rate—punctuated by major procurement programmes whereby countries replace a large proportion of their existing stocks over a relatively short space of time—a peak procurement rate.

The case of the United States is illustrative (see Figure 1.1). That country began to procure the M16A2 assault rifle in 1982 to replace the M16A1, which it had adopted in 1967. While no data is available for the years 1987–92, or for 1995, the graph displays a distinctive pattern. The M16A2 was adopted in 1982, which prompted initial trials, followed by large-scale procurement. The Gulf War of 1991 provided a final impetus to replace aging stocks of M16A1 rifles

Figure 1.1 **United States procurement of the M16A2 rifle and subsequent derivatives, 1982–2003**

UNITS

YEARS
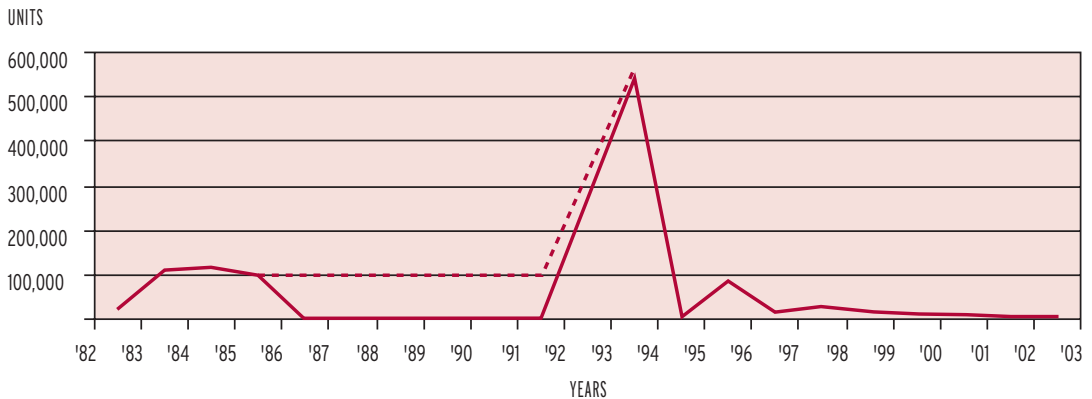
Notes: Online access to US Department of Defense Procurement Programs (P-1) data is only available for 1997 onwards. Data for 1982–86 is from Ness (1995) and Watters (2005). The red dotted line indicates an estimate.

Sources: US DoD (1997; 1998; 1999; 2000a; 2001a; 2002a; 2004; 2005a); Ness (1995); Watters (2005)

with later variants and this is clearly demonstrated by high procurement rates in 1993 and 1994, and is probably true of 1995 also. This was then followed by low-level procurement, fluctuating between 5,000 and 12,000 units per annum, which constitutes the annual low rate of replacement for damaged, destroyed, or lost weapons.

Between 1982 and 2004, the United States procured around 1.9 million M16A2 assault rifles and M4 carbines, totalling around 136 per cent of its active armed forces personnel. That is, 136 weapons were procured for every 100 serving members. The number was similar in 1967, when the M16A1 was introduced. It is also worth noting that the projected procurement of the Objective Individual Combat Weapon (OICW), Increment 1, is of 1.3 million weapons for the Army alone (US DoD, 2005c, p. 11).

Like the United States, most countries periodically review their armed forces' small arms. This may be prompted by an external event, such as a war or a deteriorating security situation, or it may simply be in response to the fact that the negativities of existing weapons begin to add up sufficiently to necessitate a change. It may also be due to countries adopting a different cartridge, for example 5.56 mm instead of 7.62 mm.[3] As Figure 1.2 demonstrates, for a selection of NATO countries, these major procurement programmes have occurred several times in the past 50 years.

The data in Figure 1.2 was derived from numerous sources, but the collection began with extensive searches of the *Jane's Online Reference* database (Jane's Information Group, 2005). Searches were made by type of assault rifle or carbine, for instance, by the Canadian C7, the British SA80, or the Singaporean SAR. These searches revealed various articles referring to the development, sales, and transfers of the weapons concerned and, importantly, government contracts. A judgement was made for each, based on the scale of the order, as to whether or not each contract comprised part of a major procurement initiative. Thus, for instance, the procurement of around 500 M14 rifles in 2002 by the United States does not constitute a major initiative, when gauged against major procurement initiatives beginning in 1967 and 1982, each of more than one million M16 rifles (DoD, 2005a; Ness, 1995; Small Arms Survey, 2004; Watters, 2005).

The research then entailed further searches for previous procurement initiatives. For instance, Canada acquired 94,135 C7 rifles and 2,365 C8 carbines in a procurement programme launched in 1983. The previous initiative had been

Figure 1.2 **Major procurement of assault rifles and carbines by selected NATO countries, 1956–2006**

PROCUREMENT
(UNITS APPROX.)
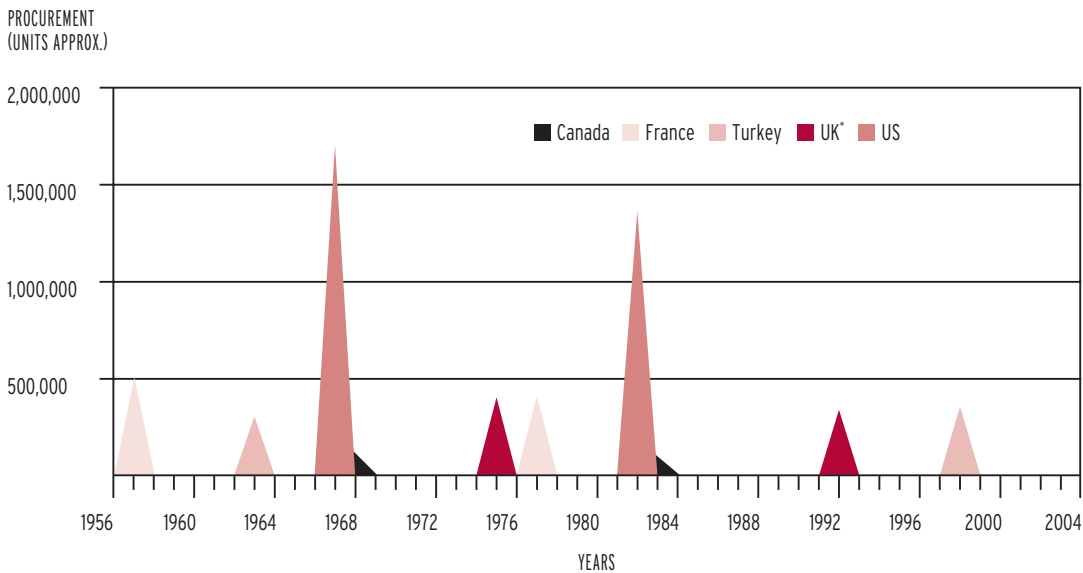
Note: Total units procured are condensed into the year in which the procurement initiative began. The graph must therefore be read as a stylized presentation of procurement trends.

* Information regarding the United Kingdom was provided in a letter from the UK Defence Logistics Organization (UKDLO) to the Small Arms Survey concerning the procurement of the SA80 weapon system, 9 November 2005.

Sources: Canada (2005); *DFASP* (1998); US DoD (1997; 1998; 1999; 2000a; 2001a; 2002a; 2004; 2005a); Forecast International (2005); Heyman (2001); *Jane's Defence Weekly* (1995; 1996); Ness (1995); Sariibrahimoglu (1998); Watters (2005)

in 1968, when Canada adopted the FN FAL (see Figure 1.2); thus there was a 15-year period between major procurement programmes (Heyman, 2001; *Jane's Defence Weekly,* 1996, p. 21). Sources used included the Small Arms Survey's hard copies of news reports on small arms production, historical works on the development of particular weapons, Lexis-Nexis searches of defence industry publications, and government procurement programme reviews.

Derived from this data, Figure 1.2 demonstrates that countries initiate major procurement initiatives quite infrequently, which explains why small arms change very little in design over long periods of time (Small Arms Survey, 2005, p. 58). Countries also appear to replace similar numbers of weapons during every major procurement initiative because, in the last 50 years, there have been few major force reductions or increases, despite the end of the cold war (IISS, all cited).[4] Also, major procurement initiatives happen fairly regularly. Canada, France, the United Kingdom, and the United States, for example, appear to initiate such initiatives every 15–20 years.

However, there are also notable differences among countries in the scale of procurement and in the frequencies of major procurement initiatives. Turkey is a case in point. In contrast to the other four countries in Figure 1.2, the period between Turkey's last two major procurement programmes lasted approximately 30 years. These differences increase markedly when considering states other than NATO members. State armed forces differ in doctrine, in numbers of personnel, and in the resources that each country is willing or able to commit to procuring armaments, including small arms. This poses considerable problems for estimating global procurement.

FILLING IN THE BLANKS

While data on the production of military small arms is sparse, procurement information is relatively accessible for a number of states. This section presents a method of estimating world procurement. It uses data on major procurement initiatives of assault rifles and carbines from 32 countries over the last 50 years. Of the 151 countries in the global sample, these were the only states found to have sufficiently reliable procurement data to project a global rate of procurement.

The countries in the 32-country sample host around 6.5 million active troops, or around one-third of the world's active armed forces. They are arguably a geographically, economically, and politically representative cross section of the world's states.

The method employed calculates major procurement initiatives as a percentage of each country's active armed forces. This yields a rate of procurement with which countries can be ranked and compared. By using a proxy for rates of procurement, in this case the age of stock in each country's arsenal, the analysis extrapolates the procurement rates from the 32 countries to the majority of the world's remaining states.

Calculating procurement rates

Referring back to Figure 1.1, the case of the United States is arguably representative of acquisition dynamics for many states. States intermittently procure large numbers of assault rifles and carbines to replace the primary assault rifle in infantry service at the time. One example is the United Kingdom's replacement of SLR rifles with 332,092 SA80 assault rifles beginning in 1984.[5] Another is Venezuela's decision to replace its stocks of FN FAL rifles with 100,000 Russian AK-103 rifles in 2005 (*Jane's Defence Weekly,* 2005; Kirk, 2005) [TRANSFERS].

These major procurement initiatives constitute peak procurement (Pp); i.e. the largest by volume procurement a state will initiate in a period of, for example, 20 or 30 years. However, states also procure at low volume per annum between periods of peak procurement to replace lost, damaged, or worn weapons—an annual low rate of procurement (Lr).

In this analysis, data on procurement covered only the acquisition of assault rifles and carbines—the standard personal weapons of infantry troops. However, from this data, the ratios developed in Table 1.1 from detailed information supplied by five countries also allow procurement estimates to be made of numbers of pistols and heavy and light machine guns. We can say that for every 84 assault rifles and carbines procured, a country would be expected to procure 11 pistols, 4 light machine guns, and 1 heavy machine gun—in total around 19 per cent of assault rifle and carbine acquisition. This percentage is then added to the figure for assault rifles and carbines to calculate total procurement of small arms and light weapons.

Collectively, the weapons referred to in the previous paragraph are the most numerous infantry small arms and light weapons, whereas other infantry weapons, such as anti-tank guided weapons (ATGW), man-portable air-defence systems (MANPADS), and recoilless rifles, tend to be deployed in far fewer numbers. The weapons listed in Table 1.1 therefore provide the basic complement of weapons for any infantry force.

In the analysis, procurement data was obtained for the 32-country sample, using the same methods used for the five countries in Figure 1.2. Each major procurement initiative was plotted chronologically and by units procured. For all 32 countries, at least two procurement initiatives were recorded, giving an interval between major initiatives (peak procurement) for each country.

Table 1.1 **Ratios of small arms and light weapons in state armed forces in five countries, 2001–03**									
Country	**Assault rifles & carbines**		**Pistols**		**Light machine guns**		**Heavy machine guns**		**Total small arms & light weapons**
Canada[1]	195,803	84%	25,125	11%	11,667	5%	1,354	1%	233,949
Finland[2]	514,600	96%	8,000	1%	7,500	1%	3,523[6]	1%	533,623
Togo[3]	11,020	87%	1,184	9%	360	3%	70	1%	12,634
Switzerland[4]	450,000	83%	70,000	13%	21,469[6]	4%	3,076[6]	1%	544,545
US[5]	1,146,920	75%	232,565	15%	118,582	8%	27,525	2%	1,525,592
Median		**84%**		**11%**		**4%**		**1%**	

Notes: Figures for Canada are from 2000; Switzerland, Togo, and the United States from 2001; and Finland from 2003. US numbers are for the US Army only and exclude other services. The five countries were chosen simply because these are the only ones that made available detailed information on stocks to the Small Arms Survey. Percentages are rounded.

1 Source: Small Arms Survey (2001, p. 74).
2 Source: Letter from Pauli Järvenpää, director general, Finish Ministry of Defence, 21 August 2003.
3 Source: Togo (2001).
4 Source: Small Arms Survey correspondence with the General Staff of the Swiss Armed Forces, 5 and 6 December 2001; 1 February 2002.
5 Source: Small Arms Survey (2002, p. 84).
6 Indicates dummies.

In order to make procurement comparable across countries, the analysis used each country's most recent volume of peak procurement (Pp) and the number of persons serving in its armed forces (S) to develop an up-to-date rate of acquisition for that country. Thus, for example, the acquisition of 150 assault rifles for a force of 100 active troops would equate to a 150 per cent rate of peak procurement (see Table 1.2).[6] This rate of acquisition enables comparisons between how much per capita procurement each country engages in (in the example 1.5:1). Personnel data was derived from the International Institute for Strategic Studies (IISS) *Military Balance* series.

As Table 1.2 illustrates for a selection of the 32 countries, most appear to launch major procurement initiatives every 15–30 years. Certainly, no states for which data was available did so more frequently than every 15 years (see Appendix 4). A large number did so every 25–30 years. It is likely, however, that many of the world's poorer states

Table 1.2 **Rates of per capita procurement (%) for 6 of the 32-country sample**				
Country	**Current active forces**	**Last major procurement (units)**	**Frequency of major procurement (years)**	**Major procurement per capita (Pp/S)**
Canada	52,300	96,500	15	185%
France	259,050	435,000	30	168%
Spain	150,700	120,000	30	80%
Taiwan	290,000	130,000	25	45%
Venezuela	82,300	100,000	30	122%

simply do not engage in major procurement initiatives. This may be due to lack of funds or trade restrictions. In contrast to wealthier states, they replace stocks on an ad hoc basis, according to need and ability—a potentially low rate, but high frequency.

Age of stock as a proxy variable for procurement

While reasonably good data was available for the 32-country sample, this was not the case for the remainder of the world's countries. The analysis therefore necessitated using a proxy variable to project the procurement rates of the 32 countries to the states of the rest of the world.

However, despite some ostensibly plausible proxies, such as military expenditure and gross domestic product (GDP), there were too many intervening variables that prevented defence and economic indicators from being used to determine small arms procurement (see Appendix 1). Such variables include expenditure on larger items of military hardware such as artillery or ballistic missiles; variations in armed force type, composition, and doctrine; or the impact of corruption on reducing direct expenditure on equipment. Or, like Iceland, a state may not even field an army, but channel its GDP into non-military expenses (IISS, 2004, p. 277).

These observations suggest the need for a proxy variable that represents a state's direct commitment to the procurement of small arms and light weapons, rather than other military costs.

One such proxy—age of stock—was hypothesized to be a good gauge of a state's commitment to procuring small arms and light weapons, potentially revealing important information about the scale and frequency of its procurement.

Countries that procure small arms frequently and in large numbers should, on average, have relatively young stocks of weapons. In contrast, those that procure infrequently or in fewer numbers should stock older weapons. In mathematical terms, the rate of procurement (Pp/S) should be a function of the inverse age of the stock (A):[7]

$$Pp/S = f(A^{-1})$$

Using this proxy necessitated logging the age of a selection of a particular state's small arms and light weapons. However, for reasons of data availability, weapon ages were not recorded by date of manufacture, but by the date at which the design first became available on the world market for military weapons. This is not strictly, therefore, the age of a weapon, but the age of a design. Some weapons are newer than recorded in this analysis, having been produced after the date at which the type first entered service. However, age of stock arguably remains a good indicator of the modernity of a state's weapons.

One example illustrates this. A single rocket launcher developed in 1950 and still in service with a state's armed forces may tell us little about procurement. However, when all of a state's weapons are of that vintage, we can say with some surety that the state expends little on procurement. By contrast, states that stock numbers of the latest guided missile launchers and similar weapons clearly procure more frequently and at greater expense. Thus, while this method does not yield the 'real' age of a country's arsenal, when the same method is applied to all countries, it produces a comparable relative age.

In this analysis, infantry support weapons (including anti-tank, anti-bunker, and multi-purpose rocket launchers) and MANPADS—both of which fall under the UN definition of small arms and light weapons (UN, 1997)—were used to produce a combined age that was representative of a country's small arms and light weapons stocks. In contrast to assault rifles and carbines, there are fewer similarities among types of infantry support weapons and MANPADS, which makes them far easier to differentiate by age.[8] They are a valid indicator of age of stock because, in countries

Figure 1.3 **Average age of weapons stocked and procurement rates in major procurement initiatives for 32 countries**

Pp/S: PERCENTAGE OF WEAPONS PROCURED PER ACTIVE MEMBER OF ARMED FORCES

AVERAGE AGE OF WEAPONS STOCKED (YEARS)
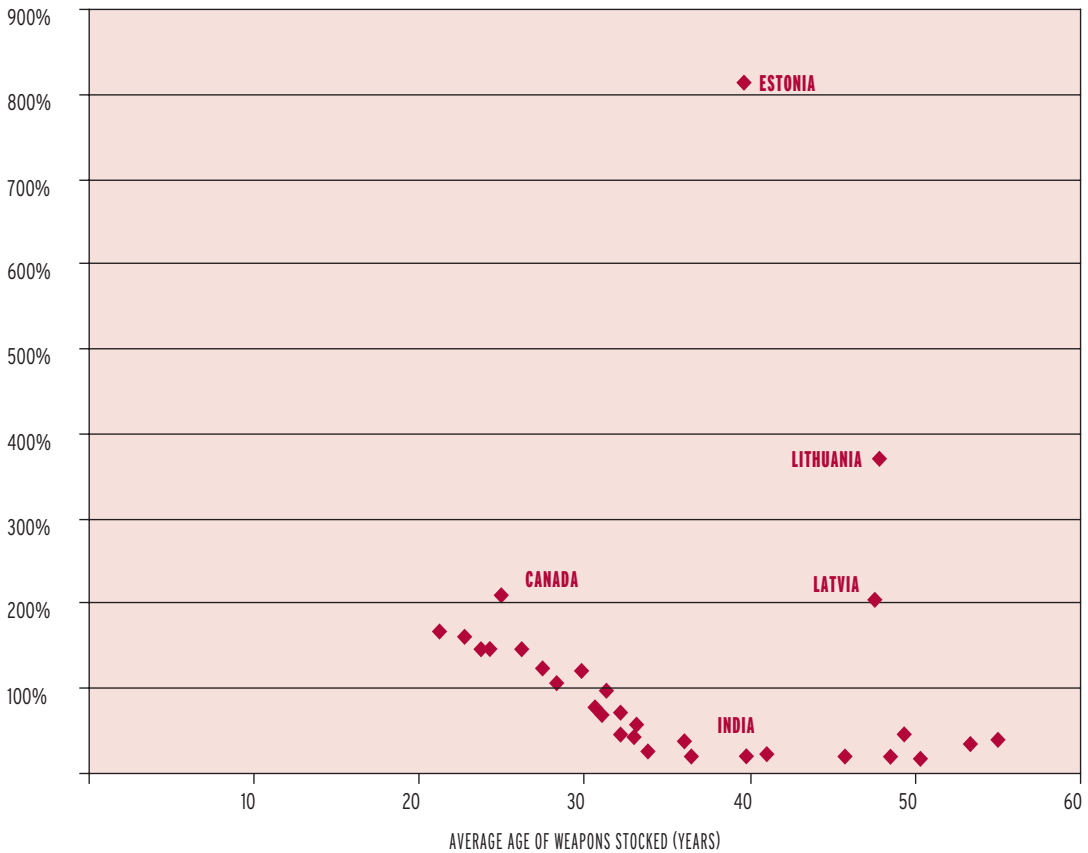
ranging from the United States, to Turkey, to Uganda, their ages mirror those of other infantry weapons, including assault rifles and carbines.

Data from *Jane's Infantry Weapons,* the IISS *Military Balance* series, and the *Small Arms Survey 2004* was used to determine the age of these weapons, and for the 151 countries, to produce a single average age for each state's arsenal (IISS, 2004, pp. 14–249; Jones and Cutshaw, 2004, pp. 409–71; Small Arms Survey, 2004, p. 82). A portion of this data was then plotted against the known procurement rates for the 32-country sample, to determine whether age of stock was a reliable proxy for procurement (see Figure 1.3).

Figure 1.4 reproduces Figure 1.3, but without the outliers of the three Baltic states, to make the pattern clearer.

What age of stock tells us about procurement

The world's wealthier states appear to procure newly produced weapons at regular intervals. By contrast, the world's poorer states procure on an ad hoc basis. Discounting transfers of surplus stocks to states in conflict or those recovering from conflict, these states probably procure more frequently, but they acquire fewer weapons in any one initiative. Poorer state acquisitions are very often of older surplus weapons and this is one further reason why these states have far higher stock ages than their richer counterparts.

Figure 1.4 **Average age of weapons stocked and procurement rates in major initiatives for 29 countries**

Pp/S: PERCENTAGE OF WEAPONS PROCURED
PER CAPITA ACTIVE MEMBER OF ARMED FORCES

AVERAGE AGE OF WEAPONS STOCKED (YEARS)
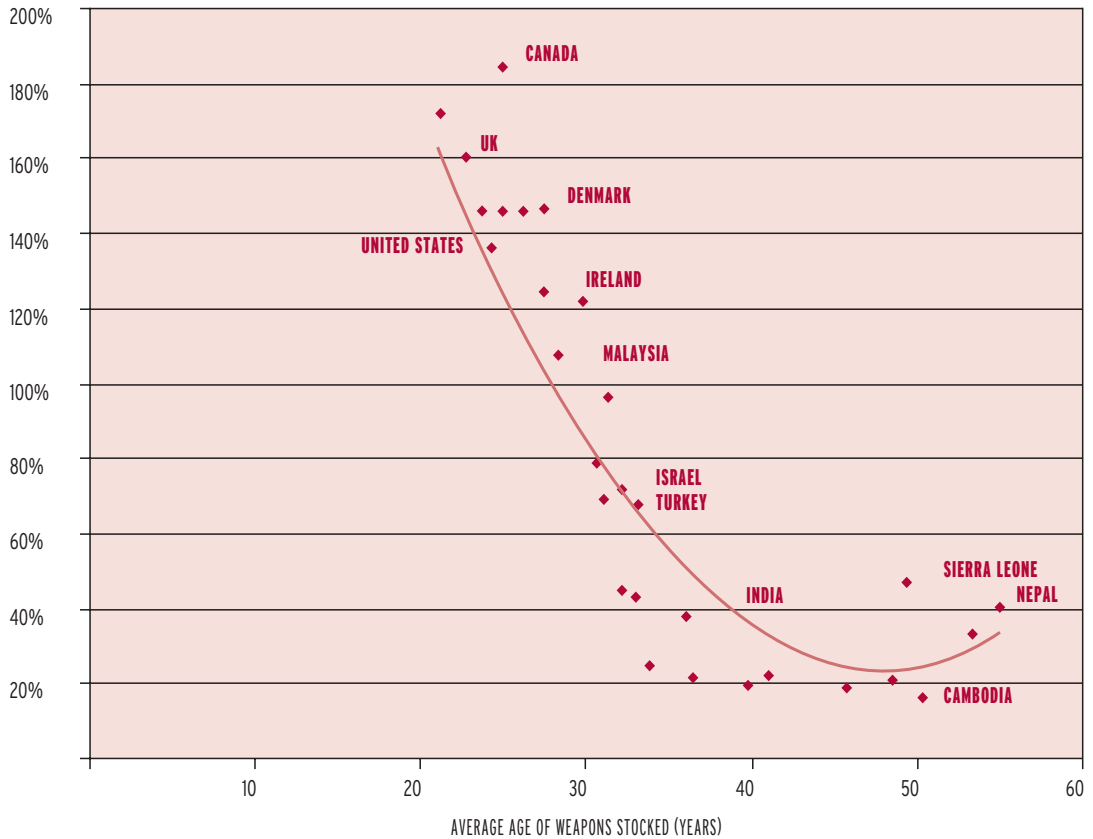
For the largely wealthy countries with average stock age of less than 40 years (to the left of Figures 1.3 and 1.4), the relationship to procurement rates appears to be a close one. These countries procure increasingly in proportion to declining average ages of stocked weapons. Their arsenals are newer because they replace large numbers of weapons with newly produced stock. Thus, for instance, when Canada wanted to replace its stocks of FN FAL rifles, it replaced nearly all of them with new Diemaco C7s and C8s (Heyman, 2001; *Jane's Defence Weekly,* 1996; Canada, 2005).

States with an average age of stock in excess of 40 years (to the right of Figures 1.3 and 1.4) are unable to replace stocks on such a scale. They retain older varieties of infantry weapons and their procurement of assault rifles and carbines reflects this. A number of these countries procure entirely from surplus stocks. In India's case, acquisition of the Indian-developed INSAS assault rifle has been delayed by financial and technological setbacks, which has meant that only a fraction of the number of INSAS rifles desired have entered service. The Indian Army continues to rely on older designs of weapons, and relatively small numbers of weapons procured from overseas in the interim (Bedi, 2001; *Jane's Defence Weekly,* 1997).[9]

PROJECTING A GLOBAL ESTIMATE OF PROCUREMENT

The section above has demonstrated that, for the 32 sample countries, average age of stock is a valid indicator of procurement rates. Subtracting the three outlying Baltic states from the sample leaves 29 states. The procurement rates of these states can be projected, with the caveats expressed below, to yield procurement rates for the remaining 122 states in the 151-state study.

The projection is not without problems. As Figure 1.5 demonstrates, introducing a dummy variable for the 74 countries with stocks in excess of 40 years of age (to the right of the graph) illustrates how projections made from the 7 countries that fall into the 40+ year grouping (an admittedly small number, marked in black) out of the 32-country sample are invalid.[10] Excluding outliers such as the three Baltic states (see Figure 1.3), most countries in this part of the sample procure at rates below 50 per cent. In fact, in the admittedly very small sample of seven countries, the average rate of procurement was around 28 per cent. However, the projections for countries with stocks younger than 40 years of age are, by contrast, relatively strong (see Appendix 2 for regression statistics).

Method and results

In order to estimate the number of units procured by each country, state armed force numbers were multiplied by the projected rate of procurement (Pp/S) (see Table 1.3). In the absence of a strong correlation (see Figure 1.5), for

Figure 1.5 **Projected and known procurement for 151 countries (sample split into countries with stock aged above and below 40 years)**

Pp/S: PERCENTAGE OF WEAPONS PROCURED
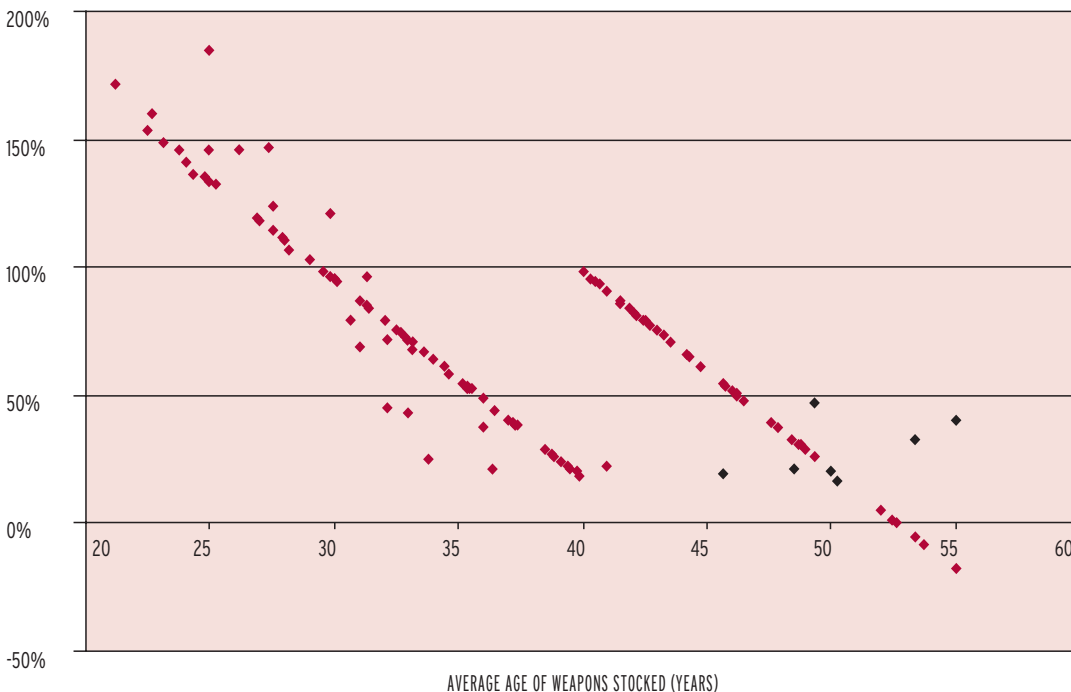PER CAPITA ACTIVE MEMBER OF ARMED FORCES

AVERAGE AGE OF WEAPONS STOCKED (YEARS)

Table 1.3 **Projecting assault rifle and carbine procurement rates: a selection of the 151 states studied**					
Country	**Average age of stocks**	**Major procurement rate (Pp/S)**	**Number of active troops (S)**	**Projected assault rifles and carbines procured (major initiative)**	**Annual low-rate procurement (Lr/S = 1%)**
China	30	98%	2,225,000	2,211,655	22,500
Gabon	46	28%	4,750	1,330	48
Philippines	49	28%	108,500	30,380	1,085
Qatar	28	110%	7,500	8,286	75
Sweden	23	153%	27,600	42,268	276
US	24	136%	1,433,600	1,948,421	14,336

Note: Projected assault rifles and carbines procured are subject to standard deviation of the Pp/S of 0.287 for countries with stock below 40 years of age (see Appendix 2). In this selection of states, Gabon and the Philippines have stock aged over 40 years and are therefore allocated a fixed Pp/S of 28 per cent.

the 74 countries whose average age of stocks was over 40 years, the average rate of procurement for the seven countries discussed above of 28 per cent was allocated.

The potential impact of using this fixed 28 per cent, in terms of distorting world procurement data, is attenuated by the fact that these 74 countries, whilst hosting around 50 per cent of the world's active armed forces, almost certainly comprise the lowest procuring states. By contrast, the bulk of the world's procurement of assault rifles and carbines is by countries whose weapons average less than 40 years of age. The procurement rates for these latter countries were calculated using the regression equation (see Appendix 2 for regression statistics).

For all countries, the major procurement rate (Pp/S) was then combined with an annual low rate (Lr/S) of procurement (see Appendix 3 for a complete mathematical representation). As Figure 1.1 illustrated for the case of the United States, this low rate replaces lost or damaged stock and does not constitute a major replacement initiative. In the United States, it is around 1 per cent of troop levels per year and is assumed, for want of conflicting data, to be the same for all states.

Having developed projected procurement rates for each of the 151 countries for which stock ages and force levels were available, the analysis then combined these country totals to produce a global figure. The findings suggest that, if every country were to initiate a major procurement initiative at the same time, they would in total acquire approximately 17.5 million assault rifles and carbines.[11]

Using the ratios developed for rifles, pistols, and light and heavy machine guns in Table 1.1, this figure rises to around 21 million when these categories of weapon are included. While this does not include any other category of small arms, including MANPADS, ATGWs, recoilless rifles, sniper rifles, anti-material rifles, mortars under 100 mm in calibre, or shotguns, the figure does encompass the most numerous types of infantry small arms.

Procurement in the long term

Despite the potential for a maximum rate of procurement of 21 million units, states launch procurement initiatives at different times. World procurement therefore never peaks at 21 million. Instead, this number is distributed over a number of years.

In the 50-year period for which data was available, none of the 32-country sample were found to have launched major procurement initiatives more frequently than at 15-year intervals. Many procured every 20 or 30 years. Many of the world's poorest states—which are under-represented in this sample—procure little in volume, but do so frequently.

With these observations in mind, estimates of procurement in a 50-year period were based on the shortest procurement cycles of around 15 years for the 74 countries with stock aged over 40 years. For the 77 countries whose stock was younger than 40 years, the average procurement cycle length of 24 years was used (see Appendix 4). The results of this method suggest that the countries of the world procure an estimated 50 million assault rifles, carbines, pistols, and light and heavy machine guns over a 50-year period, or around 1 million units per annum (see Appendix 3).[12]

FROM PROCUREMENT TO ESTIMATING PRODUCTION

This section projects world military demand of newly produced and surplus weapons. It does so by estimating the proportion of surplus to new acquisition and applying these ratios to the procurement estimates generated in the previous section.

As we saw, when countries procure stocks of small arms and light weapons, the wealthiest states procure new equipment, whether from abroad or from domestic suppliers. Less wealthy states often have to procure a mixture of new and used stocks because of financial constraints. The poorest countries, and those in the most urgent need of small arms, often re-equip with sales or gifts of surplus stock.

Developing an estimate of global small arms and light weapons production from procurement data is therefore hampered by the fact that the transfer of old stocks distorts projections. Unfortunately, there is no precise way of alleviating this problem. The only sure way to do this would be to assess every state's procurement on a case-by-case basis and, from there, to develop some country-specific ratio of new-to-old weapons procured. The fact that only 32 countries were found to have sufficiently reliable procurement data to develop the projections used in this chapter is evidence that this method is, at present, unfeasible.

A rough means of assessing production is therefore to develop a series of thresholds, from the 32 cases, at which countries procure varying ratios of new-to-old stock. This approach stands the risk of considerable arbitrariness, but this is alleviated by the fact that the world's highest procurers are, for the most part, the wealthiest. Put simply, the largest part of world production appears to supply the wealthiest countries and, as Figures 1.3, 1.4, and 1.5 demonstrate, these comprise the countries for which the most reliable data is available.

The countries of the world procure about 1 million military small arms per year

Such observations suggest that age of stocks should again be used, in this case to determine the likelihood that a country will procure old or new stocks, or a mixture of the two. As was clearly demonstrated in Figure 1.3 in the case of the Baltic states, high average ages of stocks appear to correlate strongly with high volumes of surplus stock procurement.

Countries with the oldest stocks: Of the nine countries in the 32-country sample (including the Baltic States) that have stocks of an average age of more than 40 years, none was found to have procured new assault rifles and carbines in a recent major procurement initiative. This does not mean, however, that they did not recently acquire new weapons, but rather that they did not do so in large quantities. For these countries, and in fact for most, very little data is available on low-level procurement.

Countries with the youngest stocks: For countries with stock aged 30 years and below, the 11 countries of the 32-country sample that fell into this category all procured 100 per cent newly produced weapons. This figure was distributed evenly throughout the sample; from countries with the newest stocks, to those with stocks approaching 30 years of age. On this basis, all countries with stocks younger than 30 years of age were deemed to procure 100 per cent new weapons in major procurement initiatives (see Table 1.4).

Countries with mid-age stocks: For countries with stocks of an average age of between 30 and 40 years, there were considerable differences. The ratio of new-to-old procurement did not closely relate to variations in age of weapons stocked by this group. For instance, Israel, with an average age of weapons of 32 years, procured around 60 per cent new equipment (Ben-David, 2003; NISAT, 2005; Pineo and Lumpe, 1996). In contrast, Thailand, whose stocks averaged 36 years, procured 100 per cent new stocks in its last major procurement initiative (*Bangkok Post,* 2005; Haug et al., 2002; Thai Press Reports, 2005). The rate of new procurement in the 12 countries of the 32-country sample that fell into this category averaged 81 per cent. However, the sample was arguably skewed towards the acquisition of new weapons.

Eight out of the 12 states in this category, for instance, each acquired 100 per cent new equipment in their last major initiative, but it is highly plausible that this number over-represents acquirers of new equipment. This is simply because of the newsworthiness of contracts with major small arms producing firms, in contrast to the transfer of excess defence articles or used equipment.

With this in mind, developing a range—rather than a single figure—of new–old procurement appears more appropriate. The lowest rate of procurement for this set of 12 countries was found to be 30 per cent acquisition of new stock. The maximum was 100 per cent, but due to the fact that the sample was probably skewed, the sample average—80 per cent—was used as a conservative estimate of maximum new stock acquisition.

Table 1.4 extrapolates the figures for procurement given above regarding the 32-country sample onto the remainder of the 151 countries for which information about force size and stock age is available and reflects figures for the entire 151-state sample.

Applying these figures to the projected procurement rates of each country gave an estimated range of assault rifles and carbines produced to meet major procurement initiatives each year. Conversely, it also generated a rate of procurement for surplus or used weapons. An amount of 19 per cent was again added to the figures to encompass production and surplus transfer of pistols and light and heavy machine guns.

The results plotted in Figures 1.6 and 1.7 suggest that within a given 50 years, world production of assault rifles, carbines, pistols, and light and heavy machine guns ranges between 36 million and 46 million units. Average

Table 1.4 **Age of stock and the proportion of new to surplus stocks procured by 151 states**				
Group of states	**Number of states in group**	**Average age of stock**	**% new weapons procured**	**% surplus weapons procured**
Youngest stocks	29	21–30	100	0
Mid-age stocks	57	31–40	30–80	20–70
Oldest stocks	65	41+	0–30	70–100
Total	**151**			

Figure 1.6 **Numbers of weapons produced (low estimate) or transferred from surplus (high estimate) to meet the annual procurement needs of 151 states**
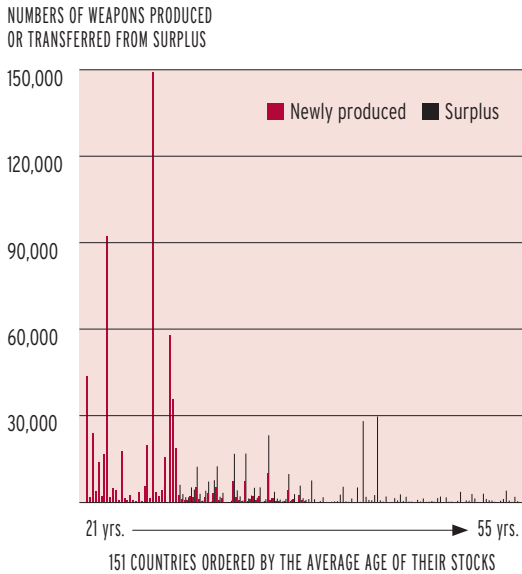
NUMBERS OF WEAPONS PRODUCED
OR TRANSFERRED FROM SURPLUS

151 COUNTRIES ORDERED BY THE AVERAGE AGE OF THEIR STOCKS

Note: The method used to produce the data assumes countries with stock aged 31–40 years procure 30 per cent new small arms and light weapons and 70 per cent surplus, and countries with stocked aged over 40 years procure only surplus weapons. See accompanying text for details.

Figure 1.7 **Numbers of weapons produced (high estimate) or transferred from surplus (low estimate) to meet the annual procurement needs of 151 states**
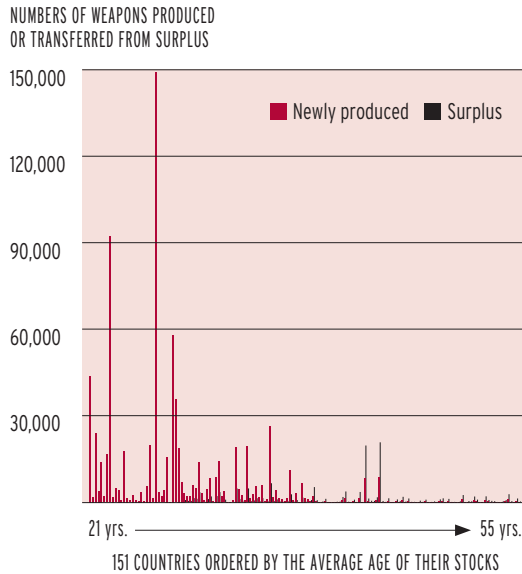
NUMBERS OF WEAPONS PRODUCED
OR TRANSFERRED FROM SURPLUS

151 COUNTRIES ORDERED BY THE AVERAGE AGE OF THEIR STOCKS

Note: The method used to produce the data assumes countries with stock aged 31–40 years procure 80 per cent new small arms and light weapons and 20 per cent surplus, and countries with stocked aged over 40 years procure 30 per cent new weapons and 70 per cent surplus. See accompanying text for details.

annual production ranges from 0.7 million (Figure 1.6) to 0.9 million (Figure 1.7) weapons. It is nonetheless important to stress that, because this estimate is derived from the procurement projection, for each parameter, the same standard deviation of 0.287 applies (see Appendix 2).

WHERE THE MODEL MEETS REALITY

The projected demand of 36–46 million units produced for the world's militaries in a 50-year period is likely to be a reasonable approximation of the true level. However, a yearly production rate of 0.7–0.9 million units is unlikely to hold for any given year. Projections over long periods (in this case 50 years) mask short-term fluctuations in periods such as five or ten years. Countries' procurement cycles may be unsynchronized, or they may be clustered into short periods of time, creating peaks in world procurement.

In reality, global procurement does follow some broad trends and there are clear reasons why certain groups of states procure at approximately the same time. In short, some countries' procurement cycles *are* synchronized and this has important consequences for the evolution of future world procurement and production levels.

1) Political alliances and changes of calibre: Change of calibre is an important push factor in procurement and can be a collective one. Being a member of a military alliance frequently necessitates interoperability of weapons and ammunition among member state armed forces. Thus, for the case of new North Atlantic Treaty Organization (NATO) members, this requirement has, and will, push them to procure weapons that utilize the NATO 5.56 x 45 mm and 7.62 x 51 mm cartridges, rather than the 7.62 x 39 mm Warsaw Pact calibre (NATO, 2001; Atlantic Council, 2001, p. 24).

2) Wars and insurgencies: States experiencing war and armed opposition procure at rates that differ from 'normal' procurement. For example, Nepal procured around 30,000 assault rifles from India, Israel, the United Kingdom, and the United States in a ten-year period. This was not part of a concerted effort to change Nepal's primary infantry weapon. The weapons procured were of varying calibres, from 5.56 mm and 7.62 mm NATO to 5.56 mm Indian-produced weapons (Bedi, 2005a; Davis, 2005a; Heyman, 2001; Hill, 2004; Press Trust of India, 2002). Patterns of procurement such as this, with states accepting grants of weapons when finances are scarce, suggest that quantity takes priority over quality or the demands for within-military interoperability. States in conflict therefore tend to procure more than and often differently to those at peace.

3) Independence and domestic political change: The experiences of Afghanistan, East Timor, Iraq, and Sierra Leone suggest that foreign support for reconstructing a state's security sector also distorts procurement rates. In effect, these countries start from scratch, having lost their state arsenals into the hands of insurgents, rebel groups, or the general civilian population. Sierra Leone, for instance, received some 2,520 surplus British SLR rifles in 2000 (London Press Association, 2000; UK, 2000). Similarly, Iraq has received surplus weapons from Eastern Europe to replace stocks lost with the disbandment of the Iraqi Army following the 2003 invasion by coalition forces (Holdanowicz, 2005). In both cases, procurement exceeds numbers that a state in peacetime would normally be expected to procure.

4) Competitive and cooperative modernization: Criticism has been levelled at decisions to replace stocks of assault rifles with new designs, given the degree to which rifles can be improved by relatively minor alterations (Steadman, 1994). However, the fact remains that the world's wealthier nations frequently procure newly developed rifles. Analysis demonstrates that this does not necessarily occur on a random basis, but in response to developments in other countries, particularly those with a similar level of investment in infantry weapons. As is the case with selecting calibres, some of these programmes take place within a framework designed to ensure interoperability among alliance members. In NATO, for instance, small arms programmes are under way in Belgium, Canada, Denmark, France, Germany, Italy, the Netherlands, Norway, the United Kingdom, and the United States and are regulated by the NATO Army Armaments Group. Similar initiatives are under way in Australia, Singapore, South Africa, and Sweden (Gourley, Janssen, and Pengelley, 2002; *Jane's International Defence Review,* 2005).

Annual world production of military small arms is around 0.7–0.9 million weapons.

These are just four brief examples of why events can produce some patterning to global procurement rates. At any one time, a number of similar—connected or unconnected—events, such as wars, participation in alliances, or regime changes, can make groups of states increase procurement above 'normal' or average rates. Projecting future trends in procurement and production therefore necessitates knowing where we are in respect of these potentially global procurement cycles.

## Current trends and projected demand in the near future

What can the findings in this chapter tell us about the future? The most important observation is that procurement is never static and fixed at one rate. Consequently, neither is production, nor the growth of and trade in surplus stock.

While it is not within the capacity of this short chapter to explore these trends in great detail, a number of recent events suggest that, for some states, major procurement initiatives will occur in the coming few years. This will certainly increase global production and will also have the potential to increase the world's transfers of surplus stocks.

Major increases in global procurement follow the acquisition policies of the world's wealthiest states—the highest volume procurers of newly produced small arms and light weapons. At least 13 states are currently developing or evaluating new infantry rifles, the majority of them NATO members (Gourley, Janssen, and Pengelley, 2002). As

Figure 1.8 **Duration of development of personal weapons in the United Kingdom, France, and the United States: past, present, and projected**
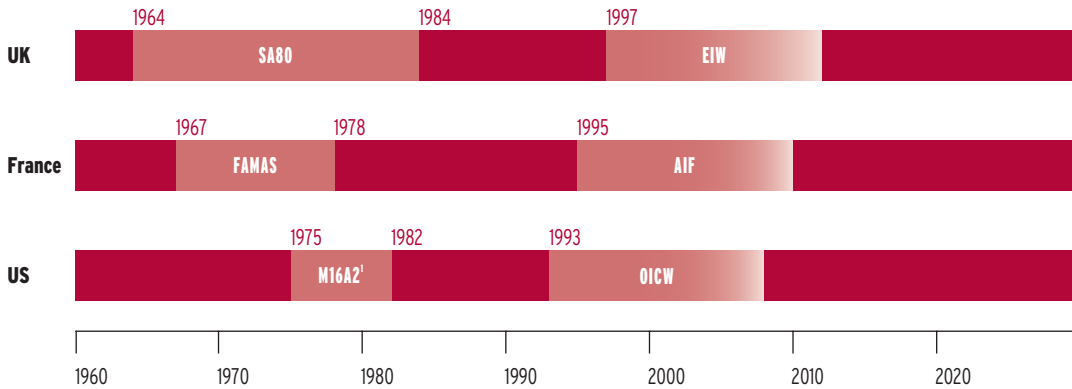
**Note:** Date markers indicate known start and end of development phases.

1 The M16A2, in contrast to the SA80 and FAMAS, was a revised version of the M16A1. Its development phase was consequently shorter.

Sources: Cutshaw and Pengelley (2000); *Jane's International Defence Review* (1995); Jones and Cutshaw (2004)

Figure 1.8 illustrates, based on the duration of past development and procurement initiatives, weapons currently under development in NATO countries are likely to enter service in the next 5–10 years. As in past initiatives, procurement is unlikely to be condensed into a single year, but phased over a long period. This trend is best represented by US procurement of M16A2 rifles, charted previously in Figure 1.1.

Procurement by these 13 states is also likely to spur procurement by states seeking to maintain infantry parity with them. Since 1945, Russian and Chinese adoption of new assault rifles and carbines has mirrored US procurement cycles, usually following by around 5–10 years and 10–15 years, respectively. Assuming a similar pattern emerges in the next round of procurement, we should expect to see a collective period of procurement for the world's wealthier states beginning in around 2010–15, and ending in 2030–35. Based on the projections developed in this study, this

Figure 1.9 **Projected demand for new production from countries currently undertaking modernization programmes, other wealthy states, and Russia and China**
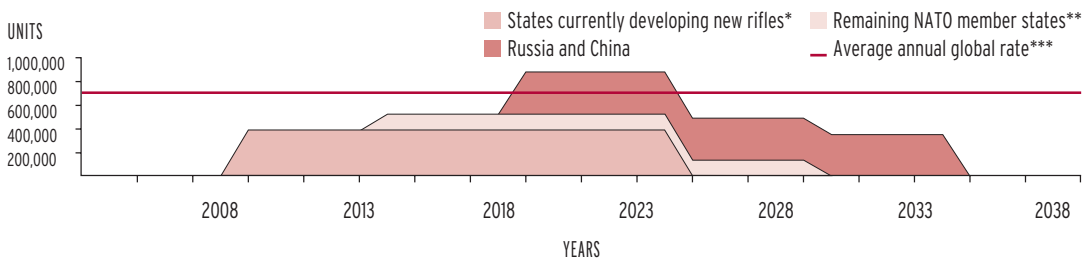
Note: The x-axis shows the estimated period in which the states concerned begin to procure weapons (but does not include the development period). The y-axis indicates expected average annual procurement.

* Includes Australia, Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Singapore, South Africa, Sweden, the United Kingdom, and the United States.

** Includes Canada, Ireland, Greece, Portugal, and Spain.

*** Lower estimate (700,000).

Box 1.2   Lengthy developments: the Objective Individual Combat Weapon

The development of the OICW is illustrative of the lengthy development stages of small arms. The costs and decision-making involved indicate why states launch major procurement initiatives only infrequently.

The OICW requirements were first approved in December 1993, in response to a US Army requirement for an infantry weapon 'to engage primary targets, such as personnel protected with body armor or in improvised fortifications and tactical vehicles, and secondary targets, such as light armor and slow moving aircraft' (US DoD, 2005c, pp. 1–4). In February 2002, the 'Objective Individual Combat Weapon Operational Requirements Document' (OICW ORD or ORD) outlined the specifications of 'a dual-weapon system that [would] combine high explosive air bursting munitions and kinetic energy munitions' (US DoD, 2005c, p. 37). The OICW was envisaged as a weapon that could fire munitions akin to spin-stabilized grenades fused to explode above a target in addition to conventional cartridge-based munitions common to contemporary assault rifles.

However, by 2005, the programme had not been able to meet the requirements of ORD. In fact, the most developed stage of the weapon, known as 'Increment I' or the XM8, does not feature an air bursting capability, but is simply a new type of carbine, designed to fire the same NATO 5.56 mm ammunition as the current M16 variants used by the United States. The XM8 programme has become separated from the original OICW programme. The latter, slower-moving programme now comprises the XM25 stand-alone air bursting weapon and the original specification integrated air bursting and kinetic energy weapon specified in ORD (Kucera and Gourley, 2005). The XM8 programme, by contrast, consists of a family of four weapons–carbine, special compact, designated marksman, and light machine gun–which have been designed for the US Army alone (Kucera, 2005a). By 2004, the programme had cost around USD 122 million (see Table 1.5), with the XM8 (Increment I) expected to replace an estimated 1.3 million weapons in the US Army (US DoD, 2005c, p. 11).

Table 1.5   Cost (USD '000) of the OICW development programme, 2000–04

Year	Cost
2000	10,319
2001	25,273
2002	29,860
2003	26,898
2004	29,906
Total	**122,256**

Sources: US DoD (2000b; 2001b; 2002b; 2003b; 2004; 2005b)

However, the development phase has been mired in controversy. The army has been accused by competitors of favouring the XM8's developers, Heckler & Koch (USA) (Kucera and Gourley, 2005). In addition, the considerable differences between the OICW, as originally envisaged in ORD, and the XM8 have incurred much criticism. As the army deputy general counsel (acquisition) noted in September 2004, the XM8 differs so greatly from the OICW that it constitutes 'a materially different [new] requirement . . . More specifically, the OICW ORD does not appear to support the XM8 development to date' (US DoD, 2005c, p. 37). In addition, rather than being a successor to the widely deployed M16 series, the XM8 was being developed for the US Army alone, rather than for the other branches of the armed services as well, and without the input of the latter.

In response to these criticisms, the US Army announced in July 2005 that it was suspending the competition for the next generation of infantry weapons in favour of a programme for all US services, including the Marine Corps, navy, and air force (Gourley, 2005). Furthermore, in November 2005, the army announced that the programme had been suspended to allow the army and other services time to integrate lessons learned from Iraq and Afghanistan into the specifications for the new family of weapons (Kucera, 2005b).

These events, however, are not unusual in the development stages of small arms and light weapons. The programme's suspension is unlikely to be made permanent. The OICW/XM8 programme has not been scrapped, but its development is likely to be longer than first expected. The programme will now be open to other competitors for the design and production of the weapon and is also notably likely to include FN Herstal, which is reportedly planning to bid for the OICW Increment 1 (Kucrea, 2005b).

would herald procurement of around 10 million new weapons over approximately 20 years (see Figure 1.9). This would push procurement for these states alone above the average global rate of procurement in a 50-year period, creating a peak in world procurement.

If this prediction is accurate, global production of small arms will increase significantly as the world's largest procurers re-equip with new stock. However, because procurement of new weapons is likely to displace current stocks from active service, this could have important implications for the trade in surplus stock.

Procurement and the cascade of surplus weapons

Large procurement initiatives in wealthy states can have a major impact on the trade in surplus weapons. Unless major procuring states adopt a systematic policy of destroying surplus stocks, or only agree to supply surplus weapons with the proviso that the recipients' existing stocks are destroyed on a one-to-one basis, the kind of overlapping procurement initiatives displayed in Figure 1.9 can generate a cascade of surplus weapons.

This dynamic occurs because major procurement initiatives by wealthy states replace existing stocks with newly produced weapons. If not destroyed, these weapons are held in reserve. Subsequently they may be redistributed, whether through sales at second-hand rates to poorer countries, or as grants to aid countries with few resources with

Box 1.3 The temptation to transfer surplus stocks

The impact of new procurement initiatives on generating surplus stock is clearly evidenced by past events. The decades following the end of the cold war demonstrate some notable examples of major transfers from states that had either downsized their armed forces or begun to re-equip with more modern small arms and light weapons. Because of the duration of small arms development and procurement cycles, some of this readjustment is still in progress.

In 2001, for instance, Bulgaria's largest small arms producer, Arsenal:

> proposed that the Ministry of Defence provide the company with its outdated weapons, which Arsenal subsequently intended to sell on international markets. The revenues of the transactions would have been used to produce new, NATO-standard weaponry for the national armed forces (Kiss, 2004, p. 35).

Although this offer was reportedly never taken up by the Bulgarian government, it is a good example of how countries seeking to modernize may be easily tempted to offset the cost of modernization by exporting surplus stocks. Tacitly recognizing this tendency, the *OSCE Document on Small Arms and Light Weapons* notes that 'any small arms identified as surplus to national requirement should, by preference, be destroyed' (OSCE, 2000, IV Introduction; IV C1).

Today, the temptation for states to engage in large-scale surplus transfers is still very real. Prospective NATO member states, for instance, working under the PfP, are switching to NATO standard weapons because of the demands for weapon interoperability within the alliance (NATO, 2001). Unfortunately, and despite NATO aid to help manage and destroy stockpiles, the economic attractiveness of selling weapons to offset the cost of re-equipping has nonetheless been strong. Fears over such transfers led the advocacy organization Human Rights Watch to address its concerns directly to NATO, stating:

Yuri Orlov (Nicolas Cage), illicit arms dealer, beside his most recent acquisition: a vast arsenal of surplus Kalashnikov assault rifles, depicted in the film *Lord of War*. © TK (Lions Gate Films?)

> While new PfP programs regarding disposal of surplus small arms are optional, we feel that PfP countries should be actively encouraged to take advantage of all programs that will help address the proliferation of these weapons. In addition, where appropriate, NATO member states should arrange exchanges, by which the transfer of newer military equipment to PfP or new NATO states would be contingent on the recipient country's responsible disposal of quantities of surplus weapons. Such arrangements could do much to prevent weapons from ending up in the hands of abusive military forces (HRW, 2000).

Unfortunately, there are now many producers of NATO standard weapons other than current NATO member states, and unless there is some mechanism to ensure one-to-one replacement and destruction, states–whether prospective NATO entrants or not–are likely to be attracted by the prospect of part-financing new procurement by selling old stocks.

which to re-equip. According to the estimates generated in this chapter, such surplus trade and transfer could total some 14 million units in a 50-year period, or around 280,000 units per annum (see Figures 1.6 and 1.7).

Importantly, the countries that procure surplus stocks are generally the poorest and consequently more likely to be states that suffer armed conflict. The links between procurement of new stock and the displacement of old stock illustrate a critical dynamic—unless destroyed, the arsenals of today's wealthier states are likely to become those of poorer states tomorrow. If the projection in Figure 1.9 proves to be an accurate one, then acquisition of new stock by the world's richer states could potentially displace a further ten million units of surplus stock into the global market place in the coming decades.

The impact of large numbers of surplus weapons was clear in the transfers from Eastern Europe to the world's conflict zones in the 1990s (Faltas and Chrobok, 2004; HRW, 2002; Lumpe, 1999). The poorest states of the world clearly demand weapons above their purchasing power, to say nothing of non-state actors. Rising supply of surplus stocks in the coming years could meet this demand at rates that ensure even larger military small arms transfers. In real terms, this will signify yet more stocks leaving the arsenals of the world's richer and politically robust states, to reside in arsenals where stocks are far less secure.

CONCLUSION

The figures presented and patterns described in this chapter point to one major trend of concern: wealthy states (NATO members, Australia, Japan) will initiate new procurement initiatives in the coming 5–10 years. This will have a number of consequences.

- Global military production will rise to meet the demands of modernizing militaries.
- These initiatives will lead to other countries seeking to maintain parity in weapon quality and numbers (China, Russia).
- Together, these factors could boost world consumption by around 10 million units in the next 25 years.
- This will in turn make large amounts of surplus small arms and light weapons available in the arsenals of these modernizing nations.

Global surplus trade and transfers average around 280,000 military small arms per year.

Past experience suggests that many of these weapons will not be destroyed, but will be transferred to the poorer regions of the world, where stockpiles are less secure, whose militaries are more prone to disintegration, and in which intra-state armed conflict is more common. Without efforts to destroy surplus weapons, the global stock of small arms will continue to grow year by year.

The models presented in this chapter are far from complete. A sample of 32 countries is admittedly a small one and there are critical problems with projecting data from these countries to those for which data is scarce. Nevertheless, for the world's wealthier states, procurement data is relatively good. For these states, the relationship between average age of stock and procurement appears to be a powerful tool for understanding both demand and supply.

With these findings, we are further advanced in understanding global demand and supply for small arms and light weapons. In 2002, the Small Arms Survey estimated that production of weapons for the civilian market in the year 2000 was around seven million units. Military production was estimated to total around 815,000 for the same year (Small Arms Survey, 2002, p. 13). The estimates of military production presented in this year's edition of the *Small Arms Survey,* which are importantly derived by different means, support the 2002 estimate of military production.

The fact remains, however, that military production probably remains a small component of overall production in any given year. Understanding non-state actor demand for weapons is the next big challenge. ◢

APPENDIX 1: PROBLEMS WITH PROXY VARIABLES

State procurement appears to be conditioned by financial constraints. It is therefore plausible that GDP and military expenditure could provide some indication of (a) a country's financial ability to procure frequently and (b) its investment in defence, and hence in the procurement of small arms. In broad terms, this appears to be true (see Figure 1.10). In a ranked sample of the 32-country sample, the highest (by volume per capita) procurers were the states of Western Europe and North America. Middle-ranking countries included the larger South American countries and wealthier South-East Asian nations, such as Thailand and India. The lowest-ranking countries were states such as Cambodia, Sierra Leone, and Sri Lanka.

Unfortunately, however, this trend was not found to be sufficiently regular across the 32 countries to be used as a proxy. In the case of GDP, for instance, countries such as Iceland have a high GDP but no armed forces, while the similar GDPs of Canada and the United Kingdom cannot account for the disparity in the numbers of weapons each procures (see Appendix 4). In the latter cases, Canada procured 96,500 assault rifles from 1998 for a force of 52,300 active troops, giving a per capita procurement rate of 185 per cent (Canada, 2005). In contrast, the United Kingdom acquired only 332,092 assault rifles and carbines for a force of 207,630, which gives a lower per capita procurement rate of 160 per cent (UK, 2005). The same disparities are true of military expenditure, as the cases of Nepal and Uruguay demonstrate (see Table 1.6). The approximate relationship between GDP and military expenditure, on the one hand, and procurement, on the other, suggests that, for the majority of states, modernizing weapons is conditioned, *but not determined,* by financial considerations.

As Figure 1.10 illustrates, one problem with using GDP per capita as a proxy is that the relationship is weak for the wealthier states. Because these states are the largest procurers, using GDP as a proxy stands a greater risk of distorting a world procurement projection than using age of stock.

| Table 1.6 **Cross section of selected countries from the 32-country sample for which procurement data was available ranked by rates of procurement**				
Country	**Major procurement per capita (active troops)**	**GDP per capita (USD)**	**Current active armed forces**	**Military expenditure (USD millions)**	**Military expenditure per capita (USD)**
France	168%	29,410	259,050	45,695	765
Turkey	68%	3,399	514,850	11,649	165
Iceland	–	36,377	–	–	–
Nepal	41%	237	69,000	110	21
Uruguay	19%	3,308	24,000	103	30

Note: Iceland does not have a standing army. Its 'security budget' is listed as USD 2.6 bn in IISS (2004, p. 277) and described as 'mainly for Coast Guard'.
Sources: IISS (2004, pp. 353–7); UNDP (2005, pp. 266–9)

It is also plausible that states with large armed forces procure more small arms. This could be argued from the perspective that a large armed force indicates a commitment to maintaining an effective military capability, which should reflect in the scale of procurement. However, numbers of troops appear to be no gauge of the 'quality' of a state's armed forces, or of its willingness or capacity to modernize or improve them through small arms procurement. For the 32-country sample, there appeared to be no correlation between size of armed forces and volume of procurement. The disparity between France and Turkey (Table 1.6) is just one example.

Figure 1.10 **Procurement in relation to GDP per capita**

PROCUREMENT RATE

GDP PER CAPITA (USD)
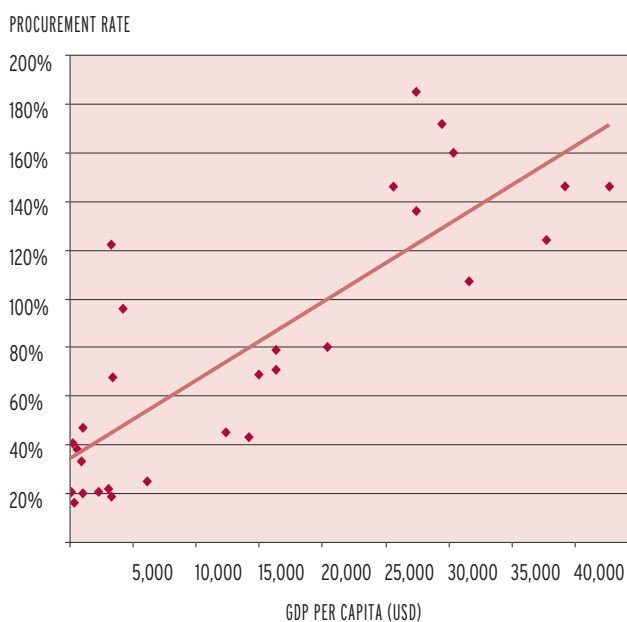
APPENDIX 2: REGRESSION STATISTICS FOR 29 COUNTRIES FROM THE 32-COUNTRY SAMPLE (FIGURE 1.5)

Multiple correlation coefficient	0.86506527
Coefficient of determination R^2	0.74833792
R^2 adjusted	0.72897929
Standard deviation	0.28737293
Observations	29
F-statistic	38.65656981
P-value of the t-statistic for the variable average age of stocks (A)	3.49745E-07

APPENDIX 3: MATHEMATICAL PRESENTATION OF GLOBAL PROCUREMENT CALCULATION, AND SUBSEQUENTLY PRODUCTION AND SURPLUS TRANSFER

1) For each country (i), the ratio of peak procurement (Pp) divided by the number of active personnel (S) is a function of the inverse of the average age of the weapons it stocks (A):

$$Pp/S = f(A_i^{-1})$$

2) This relationship can be estimated for the 32 countries for which data is available and is positive and linear above the threshold where stock is an average age of 40 years. For stock above 40 years, Pp/S is conservatively estimated at a fixed 28 per cent.

3) These numbers allow an estimate of each country's annual procurement over a long—in this case 50-year—period (t). The number of times that peak procurement occurs (m) for each country (i) is equal to the long period (t), divided by the length of the procurement cycle (a):

$$m_i = t/a_i$$

4) Annual procurement is equal to peak procurement (Pp), multiplied by the number of times (m) it occurs (in this case in cycles of 15 and 24 years) over the long period (t), plus the annual low rate of procurement.

$$Pa_i = (Pp_i \times m_i/t) + (Lr_i)$$

5) This can be calculated for each country for which Pp has been estimated and the length of procurement cycle (a) is known/estimated.

6) Global procurement (Pg) for all countries (i, with i running from 1 to n) is therefore:

$$Pg = \Sigma Pa_i$$

7) Each country potentially procures both newly produced weapons (N) and used, surplus stock (U):

$$Pa_i = (Na_i + Ua_i)$$

8) The numbers of newly produced small arms and light weapons procured (N) is a function of the inverse of the number of used, or surplus, small arms and light weapons procured (U):

$$Na_i = (Ua_i^{-1}) \text{ or } Ua_i = (Na_i^{-1})$$

10) Global production (Ng) for all countries (i, with i running from 1 to n) is therefore:

$$Ng = (\Sigma Pa_i - \Sigma Ua_i)$$

APPENDIX 4: DATA FOR THE 32 COUNTRIES USED TO GENERATE GLOBAL PROJECTIONS OF PROCUREMENT AND PRODUCTION

Country	Average age of stock (years) (A)	Current active personnel (S)	Peak procurement (Pp)	Procurement ratio (Pp/S)	Procurement cycle (years)
France	21	259,050	435,000	168%	30
UK	23	207,630	332,092	160%	16
Switzerland	24	205,400	300,000	146%	29
US	24	1,433,600	1,950,000	136%	20

Australia	25	51,800	75,674	146%	30
Canada	25	52,300	96,500	185%	15
Spain	26	150,700	120,000	80%	30
Denmark	27	21,180	31,000	146%	20
Ireland	28	10,460	13,000	124%	28
Netherlands	28	53,130	57,000	107%	33
Venezuela	30	82,300	100,000	122%	30
Greece	31	170,800	134,870	79%	30
Portugal	31	44,900	31,000	69%	30
Malaysia	31	110,000	106,000	96%	20
Israel	32	168,000	119,909	71%	20
Taiwan	32	290,000	130,000	45%	25
Brunei	33	7,000	3,000	43%	20
Turkey	33	514,850	350,000	68%	35
Mexico	34	192,770	48,178	25%	30
India	36	1,325,000	499,500	38%	30
Thailand	36	306,600	65,000	21%	15
Indonesia	40	302,000	60,000	20%	20
Estonia	40	4,980	40,500	813%	30
Belize	41	1,050	230	22%	30
Uruguay	46	24,000	4,562	19%	30
Latvia	48	4,880	10,000	205%	30
Lithuania	48	13,510	50,000	370%	30
Sierra Leone	49	12,000	2,520	21%	15
Philippines	49	106,000	50,000	47%	15
Cambodia	50	124,300	20,000	16%	15
Sri Lanka	53	151,000	50,000	33%	15
Nepal	55	69,000	28,500	41%	15
Average **Total**	**35** –	– **6,470,190**	– **5,324,035**	**82%*** –	**24** –

* Sample Pp/S calculated using the sample totals of S and Pp: thus, 5,324,035/6,470,190. By contrast, an average of country Pp/S would yield 115%.

LIST OF ABBREVIATIONS

ATGW	Anti-tank guided weapon	**OICW**	Objective Individual Combat Weapon
GDP	Gross domestic product	**ORD**	Operational Requirements Document
IISS	International Institute for Strategic Studies		(for OICW)
MANPADS	Man-portable air-defence system	**PfP**	Partnership for Peace (NATO)
NATO	North Atlantic Treaty Organization	**UKDLO**	UK Defence Logistics Organization

ENDNOTES

1   A number of countries did not appear in the sample either because of insufficient data on small arms stocks, problematic personnel data, or problems with procurement figures. These include Antigua & Barbuda, Bahamas, Barbados, Bhutan, Costa Rica, Equatorial Guinea, Fiji, the Gambia, Iceland, Iraq, Jamaica, Panama, Papua New Guinea, and the Solomon Islands.

2   See Appendix 4 for a list of these 32 countries.

3   Other factors may also intervene in decisions to procure weapons, such as business or politico–military–industrial interests. Like any industry, arms production can create and sustain employment. Sometimes, therefore, procurement programmes are perceived to have a social welfare function. Obvious examples of this phenomenon were the arms production policies of Eastern European states in the 1990s (Kiss, 2004).

4   There are some exceptions, of which the most notable is probably China, whose military has decreased in numbers by around 800,000 personnel since 1991 (IISS, all cited).

5   Letter from the UKDLO to the Small Arms Survey, 9 November 2005.

6   Only active personnel levels were used for two important reasons. Firstly, there are variations in how reserve forces are calculated. For example, in some cases paramilitary forces are included in reserve figures, while in others they are not. Secondly, it is unclear whether the majority of some reserve forces are in fact armed, particularly in states that are known to experience small arms shortages. Whether or not this is the case for all states, the rationale is that a state's front line of defence—its active troops—are more likely to be armed than its reserves.

7   For a complete mathematical model of the approach used to estimate procurement in this chapter, please refer to Appendix 3.

8   Using assault rifles and carbines to calculate age of stocks is difficult because of the ubiquity of certain varieties, such as the Kalashnikov and M16 series. This ubiquity makes it harder to differentiate among the ages of various countries' arsenals because of the degree of uniformity in stocks. Gauging age of stock is made even more problematic because assault rifles and carbines are frequently referred to in generic terms. For example, types of Kalashnikov vary considerably in age of design, ranging from the AK-47 of 1947 vintage, to the AK-74 of 1974, to the latest AK-100 series. In many reports, however, all of these weapons are simply referred to as AK-47s.

9   In the case of the three Baltic states (the outliers in Figure 1.3), between 1995 and 1998, they received surplus M14 rifles from US excess defence articles stocks (Lumpe, 1997). Because the three states effectively started from zero small arms stocks upon independence, the volume of weapons transferred—100,500 rifles for the three—was clearly beyond their expected purchasing power at the time. Moreover, the sheer number of old weapons received, in this case, suggests that age of stock is a good predictor of a state's dependence on surplus transfers. The case of Sierra Leone—another outlier—is similar to that of the Baltic states. In 2000, the British government supplied Sierra Leone with surplus 2,520 SLR rifles as part of a training programme for the country's armed forces, which had disintegrated during the war (*DFASP,* 1999; London Press Association, 2000; UK, 2000). Similarly, Nepal received assistance from the United States and India between 2003 and 2004 for its operations against Maoist insurgents (Bedi, 2005a; Heyman, 2001; Hill, 2004). As was the case with the Baltic states, the transfers to Sierra Leone and Nepal have been of surplus weapons from foreign supporting nations.

10   These countries are Belize, Uruguay, Sierra Leone, Philippines, Cambodia, Sri Lanka, and Nepal.

11   With standard deviation of 0.287, the estimate is more accurately a range—between 13 million and 22 million. It is important to note that this standard deviation only applies to the 77 countries whose stocks were younger than 40 years and whose procurement rates (Pp/S) were calculated from the regression equation. For the remaining 74 countries, a fixed rate of procurement of 28 per cent was used to project numbers of weapons procured. The range of 13–22 million assault rifles and carbines thus reflects the range 11.5–20.5 million for the 77 countries, combined with a fixed value of 1.5 million for the remaining 74 states. The same method is used to calculate all further figures presented in the chapter.

12   Figure includes 1 per cent annual low rate of acquisition. Note that with standard deviation, the range over a 50-year period could be some to 37–61 million weapons, with annual procurement rates accordingly of around 0.8–1.2 million weapons.

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