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► **To cite this version:**

Ron Smith, Jacques Fontanel. Weapons Procurement: Domestic Production versus Imports. Bellany & Huxley. New Conventional Weapons and Western Defence, Frank Cass., 1987. hal-02961554

HAL Id: hal-02961554

<https://hal.univ-grenoble-alpes.fr/hal-02961554v1>

Submitted on 8 Oct 2020

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Weapons Procurement: Domestic Production versus Imports

Ron Smith, Jacques Fontanel

New Conventional Weapons and Western Defence (Bellamy & Huxley Eds.)

Frank Cass, London
1987

There is a wide range of acquisition modes, from the purchase of an entirely national weapon to importing it from a friendly country, but sometimes from a state wishing to increase its returns to scale. There are some ambiguities in choosing between import and export, when the products are available in the country at widely divergent prices. The quality of technology, industrial property, weapon components and the independence criteria adopted by the state must be taken into account. There are arguments in favor of national public procurement on military aspects, but national security must be able to have the best military technology at its disposal as part of a policy of deterrence. On the industrial aspects, arms production makes it possible to develop research and development, but it is also a financial risk in the framework of an arms race.

Il existe un large éventail de modes d'acquisition allant de l'achat d'une arme entièrement nationale à l'importation en provenance plutôt d'un pays ami, mais parfois d'un Etat souhaitant augmenter ses rendements d'échelle. Il y a quelques ambiguïtés à choisir entre importation et exportation, lorsque les produits sont disponibles dans le pays, à prix fortement divergents. Il faut tenir compte de la qualité de la technologie, de la propriété industrielle, des composants des armes et des critères d'indépendance retenus par l'Etat. Il y a des arguments en faveur des marchés publics nationaux sur les aspects militaires, mais la sécurité nationale doit pouvoir disposer des meilleurs technologies militaires dans le cadre d'une politique de dissuasion. Sur les aspects industriels, la production d'armement permet de développer la recherche-développement, mais c'est aussi un risque financier dans le cadre d'une course aux armements.

Weapon procurement, armament industry, arms import, arms export
Achat d'armes, industrie d'armement, importations d'armes, exportations d'armes

INTRODUCTION

The contrast in Britain between the import share for defence equipment and for other traded manufactured goods is very striking. Overall 31 per cent of domestic demand for manufactures was met from imports in 1983, up from only 16 per cent in 1970,¹ and in some sectors of the British market, indigenous production has ceased entirely, leaving UK demand to be met completely by imports. In defence only 5 per cent of equipment expenditure goes to imports; 15 per cent goes to the British share of collaborative projects; and 80 per cent goes to national contracts placed with domestic industry.² These shares might be expected to change in the future as the Tornado programme runs down and the projected Trident programme comes on stream; however, the Ministry of Defence (MOD) does not expect the proportion of the equipment budget which is spent in the UK to change dramatically.³

The low import propensity for weapons could be explained by the hypothesis that the British arms industry is much more competitive than other sections of British manufacturing. This hypothesis is examined further below. A more likely explanation is that the industry is protected from foreign competition by the buy-British bias of its major customer, the MOD. A comparable position existed in telecommunications equipment before the privatisation of British Telecom. Since privatisation, BT has abandoned the previous policy of maintaining a protected cartel of domestic equipment suppliers and developed new forms of supply. There are a number of interesting similarities between the defence equipment and telecommunications equipment markets, and many of the same companies are involved.

In general, the present UK government, and most economists, tend to regard sustained protection as a bad thing because of the inefficiency,

distortions of production, welfare loss and lack of competition it can produce. In contrast, free trade is seen as encouraging the international division of labour and the location of production according to comparative advantage. Free trade is not always best; but the present government, and most economists, tend to assume that there is a prima facie case against protection unless compelling arguments can be presented to justify it. The main part of this paper, section 3, examines arguments advanced to justify the protection of the defence industries. In defence procurement, choices are rarely simple, and section 2 provides some background to the issues involved in the choice of domestic or imported weapons by reviewing the alternative modes of procurement and their relative costs. Section 4 examines how the observed choices should be interpreted.

It should be emphasised that this paper is concerned to contrast the present policy of protection with an alternative policy of choosing the most cost-effective system irrespective of where it is produced. The alternative policy being considered is not complete reliance on imports. At a guess, the removal of the present protection might result in an import share of around 25 per cent, rather than 5 per cent, with the effect falling primarily on large projects. The effects of this on the industry would depend on how the companies adjusted, and on the results of exposure to the fresh breeze of competition.

BACKGROUND

There is a spectrum of procurement modes ranging from purchasing a completely domestic product to an off-the-shelf import, with fine gradations in between. There are no sharp boundaries because much domestic production embodies imported components, while imported weapons will typically involve some UK production or at least require some conversion and adjustment to meet British operational requirements. There is also an ambiguity about what distinguishes an import; whether the crucial characteristic is that it is made in Britain, made by a British-owned firm, or made with British technology. These three aspects need not overlap. Speaking purely hypothetically, British Aerospace (BAe) could supply the RAF with a Swiss-developed aircraft, the production of which was sub-contracted to Brazil; while IBM could supply electronic equipment for which both the research and production were done in the UK. In several sectors of manufacturing, the products of foreign-owned companies are more British than the products of British-owned companies. Other government departments, such as the Departments of Trade and Industry, and Health and Social Security, which sponsor industries, encourage foreign-owned companies to set

are overhead costs involved in maintaining teams and facilities in the periods between projects. Finally, development costs are notoriously difficult to control, even in a commercial environment. This becomes even more difficult if there is an external contractor undertaking the development work who is being paid on a cost-plus basis (around two-thirds of the MOD R&D budget is spent with industry). Additional difficulties are created if the specifications are subject to change during the process.

Production

A major influence on the unit cost of weapons is the scale of production, and if a weapon is imported the buyer may gain part of the advantage accruing from the seller's longer production run. The number of units produced influences costs through pure economies of scale, learning curves and process choice. Where long production runs are expected, it is economic to invest heavily in cost-reducing equipment and process-innovation,⁷ but for short production runs there is little return in doing so. The pricing structure will also influence investment choice. BAe's acquisition of a £7.5 m. missile simulator was said to be motivated by the fixed price contract for Alarm.⁸

For aircraft, estimates suggest that doubling the number produced tends to reduce unit costs by about 10 per cent. Unit costs will also be influenced by the pattern of ordering. Disruption of scheduling through speeding up or slowing down in response to budgetary pressures, or the spreading of orders among many contractors, will tend to increase unit costs.⁹ Although scale is emphasised as the major influence on costs, productivity differences between countries will also influence relative costs, as will product design and the extent to which development and production are overlapped.

Operation

Even after the weapon has been delivered, and is in operation, expenditure will be incurred for training, associated infrastructure, spares, and replacements, which can be worth as much again to the supplier as the initial contract.¹⁰ For imported weapons domestic maintenance and repair capacity will be necessary to ensure security and reliability in operation. The Services must also consider running costs. A weapon which is cheap to design and produce might require twice as many people to operate it and twice as much fuel. Of course operating costs depend on deployment and force-posture decisions. For instance, the system that is the cheapest for a country operating a conscript army may not be for one operating volunteer forces, because of the difference in the relative cost of labour.

The sum of costs in the three phases is usually referred to as life-cycle costs. Comparable data on life-cycle costs for different systems are rare. These costs are not incurred all at once but over a long period of time. The interval between initial specification and the withdrawal of the last unit from service can be of the order of 30–40 years. Estimating life-cycle costs over that interval is inevitably hazardous. In addition, the relative costs of importing or collaborating as against domestic provision will differ between types of system. Aircraft, missiles, warships and small arms each have different cost profiles in terms of the size of development cost relative to unit production cost, the minimum efficient scale in terms of number produced, and the trajectory of technological change.

Cost control raises a number of distinct, though related issues. First, there is the potential sourcing – what range of companies are allowed to tender and on what terms. Second, there is the method of pricing, from cost-plus through various incentivised contracts to fixed price, each with their associated forms of risk-sharing. Third, there is the process of monitoring progress and attributing responsibility between MOD, prime contractors and sub-contractors. Increased competition has different implications for each of these issues. Designing appropriate forms of contract and tender also plays an important role.

When the equipment is imported a further uncertainty is added to the costing: fluctuations in the exchange rate. Commercial firms have a variety of methods of hedging longer-term contracts against exchange rate risk. The agreed price could have a sterling as well as a dollar component, or an oil component as in the case of Saudi Arabia with the purchase of Tornado and Hawk aircraft. Insurance in the financial market can be obtained through forward cover or back-to-back loans. These types of arrangement share the risk (of both gain and loss) from exchange rate movements, and they are something to be negotiated by the MOD with the Bank of England or the Treasury, who have overall responsibility for the procedures used for investment appraisal and for trade-finance within the public sector.

Alternative Procurement Modes

Costs in the different phases are affected differently by the various procurement modes. Domestic purchase is straightforward: all the costs are incurred domestically in domestic currency. The distribution of costs in collaborative projects varies depending on the exact arrangements. With weapons collaboration, the typical pattern is that development costs are shared between the partners, cutting the costs to each. Production is done on a national basis, though there may be some saving if each country specialises in particular components and some loss if compromise designs are more expensive to produce. Collaboration itself

adds a cost penalty arising from co-ordination expenses and transport needs. There are often complicated, politically negotiated, work sharing and compensation arrangements, which can be sensitive to exchange rate variations and other factors. Operations costs on a collaborative project are probably similar to those for domestic production for a similar design, though the design may be less efficient if there are expensive compromises between partners. Design integrity will influence export potential, which then feeds back on costs.

Experience with collaboration seems to indicate that cost savings are much smaller than the theoretical maximum which would be suggested by splitting development costs and increasing production runs. Nonetheless there are some savings, and in many cases collaboration is the only way to get a 'piece of the action', since a purely national venture would be impractical. Press reports during the European Fighter Aircraft (EFA) negotiations suggested that collaboration might involve a 10 per cent saving over a purely British venture.

Licensed production usually involves the UK paying a royalty which is typically small relative to development costs, and producing the foreign-designed system in Britain.¹¹ The size of the royalty will depend on demand and supply conditions, which are discussed below with respect to imports. Development costs are thus saved by licensed production, a system of known capability is acquired and there may be some technology transfer; but there is a production cost penalty relative to importing. Official figures cite a saving of 35 per cent on estimated price from the competition for the new RAF basic trainer.¹² However, no figures are available on what it would have cost had it been produced in Brazil by Embraer, the firm whose design won the competition, rather than in the UK by Short Brothers.

Arms import contracts tend to be complicated, involving offset deals, credit terms, counter-trade, and various other elements of a complete package.¹³ Thus estimating the true price can be difficult. In the negotiation of the import price the bargaining strengths of buyer and seller will depend on the extent of the competition. If the supplier is the only source and the equipment is essential to the recipient, the price may be high. If there are many potential sources of similar if not identical equipment and the buyer has scope to substitute, the price will be forced down.

Currently, the arms export market is very competitive. On the supply side, many governments have subsidised the development of indigenous arms industries for strategic and political reasons. This creates strong pressure to export, even if this is done at a loss to the exporting country, whose government subsidises the sale. Prices thus get forced down towards marginal production cost which is much less than average cost.

In addition, incentives like cheap credit make imports more attractive. On the demand side, the Third World debt overhang and the weakness in oil prices have caused the market to contract. In these circumstances, buyers can force very good deals on many items. In the past, exporting arms was seen as a way of gaining political leverage over other countries. Now, importing arms from them may be a more effective way of gaining leverage.

Press reports on the EFA negotiations suggested that Spain would find it 30 per cent cheaper to buy from the US than to collaborate, and this is similar to figures given elsewhere.¹⁴ A discount of about 30 per cent would be consistent with the aircraft selling at around marginal production cost in the export market, the development costs being subsidised by the supplier government, and there being some scale advantages in production. Extra costs would be incurred by the importer because some domestic capacity has to be installed to repair, maintain and ensure the reliable operation of the system. This capacity would already exist with domestic development or licensed production. It is also said that spares, etc. are more expensive from US than from domestic sources, but there are few published figures for this.

The extreme example of the saving from importing is nuclear delivery systems. Britain acquired the Polaris and is promised the Trident missiles at a fraction of the costs the French incurred for independent development. For Trident a fixed total contribution of \$116m. at fiscal 1982 prices is paid to R&D costs, with payment spread over ten years, and the UK pays the same production costs as does the USA.¹⁵ Whatever is believed about the desirability or operating independence of these weapons, there is no doubt that it is cheaper to import than to develop and build them in the UK. The Chevaline programme illustrated vividly the cost of domestic development of UK nuclear systems.

ARGUMENTS FOR DOMESTIC PROCUREMENT

The arguments used to justify buying British are familiar. On the military side, it is said that although foreign weapons may be cheaper, British weapons are better, tailored exactly to the needs of UK forces; and that even were the cheaper foreign weapons procured, the money saved would not go to providing more systems but would be lost from the defence budget. On the industrial side it is argued that a domestic defence industrial base, with its associated design capacity, is essential for strategic independence and that 'infant industry' and 'unfair trade' arguments justify protection. On the economic side it is argued that domestic procurement of weapons creates employment, boosts tax revenue, helps the balance of payments and produces technological spin-off for civilian production.

These arguments are very difficult to evaluate, which is perhaps why they are so popular. There is undoubtedly some truth in all of them in particular cases, but they cannot be accepted as general principles which always justify buying British. The issue is whether in each particular case the putative benefits outweigh the costs. Unfortunately, estimates of the magnitudes of the elements involved in this balance are rarely available, and almost never uncontentious. In addition, the types of economic argument used to justify this class of protection would not be accepted by the current Conservative government in any sphere but defence. Even in the defence sphere, the arguments seem ad hoc, because the other policies, such as larger inventories, which would be implied were these arguments believed to be true, are not implemented; thus casting doubt on their force. Below, the military, industrial and economic aspects of these arguments are examined in turn.

Military Aspects

The argument that British weapons are better is difficult to disprove because no two weapons systems are exactly comparable, except in combat. There is not a choice between a British AEW Nimrod and an imported AEW Nimrod; the US alternatives, such as AWACS, differ in certain important respects. Thus any extra costs, however large, can be said to be worthwhile to pay for the differences in specification from the nearest alternative. Those who have the expertise to make an assessment of the importance of the differences, in the Services and MOD Procurement Executive also have close links and loyalties to British firms, making it difficult to guarantee an impartial assessment. Even if a system is cancelled and never sees service, it can always be said that with a little more perseverance and a little more money a world-beater would have been produced; TSR2 still has its defenders.

Many indirect arguments would suggest that British weapons are not always best. Given the cost disadvantages that arise from scale and development overheads, British firms would need to make products that are qualitatively superior by orders of magnitude to provide better value weapons. There are the familiar cases where the British systems proved expensive, late and unable to meet their performance targets, Nimrod AEW & the Torpedo Programme being recent examples. Nor does world market evaluation suggest that British weapons are better value for money. The French, from a comparable base, sell perhaps twice as many as the UK. In the 1985 US communications competition the British system Ptarmigan cost 70 per cent more than the French system RITA. Foreign sales are the outcome of many factors, but export performance does suggest that foreign buyers are not convinced of the superior price and quality mix of British systems.

Whether or not British firms have a competitive advantage in the international defence market, in some cases it may be sensible for the MOD to buy British. Operational requirements differ between countries, as do procurement schedules; thus, on occasion, a suitable system may not be available on the international market, and foreign companies may be unwilling to tender for the development contract. However, most of the controversial choices between domestic and imported systems are controversial just because there are competing systems.

In three recent cases, Airborne Early Warning (AEW), Torpedos and the Multiple Launch Rocket System (MLRS), the choice of national procurement rather than the available US alternative, involved not only higher costs for Britain but also the lack of an adequate system in-service when needed. In these cases, it appears that buying British was given a higher priority than having a system available to meet the assessed Soviet threat.

In 1977 the US offered the AWAC system to NATO. The British share of the cost would have been about £460m. in 1985 prices and AWACS would now be operational, compatible with the rest of the NATO system. AWACS would also have generated considerable employment in the UK through offsets and the possible basing of the NATO force in the UK. Instead the domestic alternative, the AEW Nimrod, was ordered, on which £1 bn had been spent by 1986 and the total cost is likely to be over £1.5 bn. The system is still not operating effectively because of problems with the avionics.¹⁶ Without Nimrod, AEW is being provided for Britain by ancient Shackletons. In late 1986 the government eventually chose to buy AWACS. The Torpedo programme (Mark 24 Tigerfish, Sting Ray and Spearfish) costing over £5 bn at 1984 prices has run into repeated problems and represents bad value for money.¹⁷ The Minister of Defence rejected military advice to buy MLRS off-the-shelf from the US, and by doing so incurred a cost-penalty and a slippage in the in-service date.¹⁸

Clearly, there are benefits from having equipment exactly tailored to the preferences of British forces, and domestic suppliers may be more willing to customise products in this way. But there are also benefits from standardised equipment, compatible and inter-operable with allies. In practice it is difficult to determine whether the claimed advantages of customised equipment will be realised, and decisions have to be made on the basis of promises about what might be delivered in the future. Even if the advantages are realised, it is not clear whether they will be worth the extra cost and delay, which are also unknown in advance.

It should also be noted that the argument for customised weapons conflicts with the argument for export potential, since weapons optimised to British requirements are less likely to sell well abroad. To maximise

the export potential requires designing the equipment in the light of world market needs, as the French are reputed to do.

Industrial Aspects

There are clearly some areas where a military case can be made for domestic production or conversion capability, irrespective of cost, for strategic reasons. But these cases seem rare and need to be justified individually on the basis of consistent priorities. For the most part, production lead-times are so long that in short conflicts, which is what current UK policy is geared towards, supply depends on inventories, domestic or foreign, rather than production capacity. The government concluded that the Falklands Campaign 'demonstrated the value of a broadly based national defence industry, and the benefits of an in-house research capability'.¹⁹ However, the report neither spells out which aspects of capacity were crucial nor mentions, in the discussion of procurement, the decisive role of US supply, particularly of the Sidewinder AIM 9L for the Harrier.

If a defence-industrial base is required, then there should be a defence-industrial policy which specifies what is needed, and the best way that it can be acquired. The optimal strategy is likely to involve importing a range of systems. The money saved by doing this can be used to finance more effective ways of maintaining the capability required. The MOD could subsidise some strategic research for future eventualities; acquire essential technologies by licensed production of foreign designs; and maintain adequate inventories of materials likely to be needed in conflict.

There is a more general argument for independence, that does not rest on narrow military considerations, but on the more general economic and political freedom of action that indigenous weapons production, and the like, provides to a nation. This is the French position, but as the Westland and Land Rover disputes demonstrated, many British politicians become embarrassed about being quite so explicit about the need for the UK to resist the yoke of US hegemony. In any case, in both countries the argument is often more about symbolism than economics, and centres on prestige items (aircraft or nuclear reactors, space launchers or mainframe computers) rather than the more prosaic products which have proved central to international competitiveness. The countries which have prospered in international trade, like West Germany and Japan, have not diverted their scarce development resources to high profile small market projects of this sort.

It can be argued that the cheapness of imported weapons arises from unfair trade, since other governments subsidise their arms exports and pay the development costs. Thus the argument suggests that to maintain

fairness between defence contractors the British government must also incur heavy costs duplicating the development work of others and selling weapons to foreigners at below average cost. This simply seems to be a waste of money which can be justified only for the limited areas specified as essential by a defence-industrial policy, or where there is a danger of one supplier obtaining a monopoly. This is not the case for most of the systems under consideration. Rather than a problem of monopoly there is a problem of overcapacity in the arms market. Complete monopoly is also difficult to maintain, since once the technology has been developed it can usually be copied at a cost.

The argument that one becomes locked in to foreign suppliers, becoming completely dependent on them, does not seem compelling because one becomes even more strongly locked in to a domestic supplier. It is much easier to cancel an import order if the weapon does not live up to promises than it is to cancel a domestic or collaborative order. There is also the danger of becoming locked into old technologies. If the capacity and experience is established in the UK to produce traditional weapons, it establishes a bias against new approaches which might threaten that investment.

The 'infant industry' argument is that domestic products are currently high in cost because of lack of scale, and that protection will enable the scale of production needed to compete internationally to be reached. The argument is weak in this sector, because existing protection has failed to provide this scale advantage. The argument is leading every country to protect its arms firms, resulting in a world industry with too many producers almost none of whom can reach minimum costs because the size of the total market is inadequate to support them all. For instance, it seems unlikely that the European helicopter market and likely export sales will be sufficient to maintain four European producers.

Economic Aspects

A range of indirect economic effects on taxes, jobs, technology and exports is used to justify procurement of domestic rather than foreign weapons. This type of justification raises two questions. One is empirical: how large are these benefits? One is theoretical: can these benefits justify the costs of protection?

On the empirical question, despite the frequency with which the contrary is claimed, most published research indicates that military projects are a very ineffective form of economic intervention;²⁰ rather, following this policy has damaged UK economic performance in the past. If state intervention to achieve such economic objectives is appropriate then there are more efficient methods available. Relative to other types of government expenditure military projects create

comparatively few jobs per billion spent, because of the skill and development intensity of the process. There is also little evidence of much commercially successful technological spin-off from the half of the public R&D budget which is devoted to defence in Britain. Given the size and volatility of the market, the entry of many new competitors, and the poor demand prospects, the likely return from arms exports is not great. There may be a case for subsidising and protecting some industries because of growth prospects, employment potential and economic linkages they provide. But the evidence suggests that these objectives would be better served by directing the scarce financial and scientific resources at civilian not military industries.

The theoretical question is more difficult because there are such a variety of economic theories. Socialist–Keynesian governments, like that in power in France until March 1986, have an interventionist philosophy and argue that protection, subsidies and government contracts have an essential role in the maintenance and re-structuring of domestic industry. But Conservative–Monetarist governments, like that currently in power in the UK, have an enterprise philosophy and argue that market forces decide such things better than bureaucrats. These bureaucrats should confine themselves to their expertise, choosing the best weapons, and not indulge in economic forecasting, picking commercial winners and interfering with the market. Moreover, this philosophy asserts that markets work efficiently and that any incidental benefits that can be predicted will already be reflected in relative prices. Thus adding in extras for tax revenue and employment would involve double counting.

The UK government's stated policy on defence procurement reflects this philosophy.

It is not Government practice to take account of tax and national insurance flowbacks in comparing tenders from United Kingdom and overseas contractors because the Government consider that the acceptance of United Kingdom tenders which are internationally uncompetitive does not lead to a sustainable increase in employment in the economy as a whole. It is accepted that there may be short term employment benefits, in particular sectors of the defence industry, but the adverse effects of uncompetitive purchases on the economy through higher public sector borrowing, interest rates, rate of inflation, or the exchange rate, lead to increases in unemployment in other areas which negate the assumed flowback benefits.

However, the next sentence rapidly retreats from this firm, principled stand. 'Defence procurement decisions are nevertheless taken in the light

of associated defence, technological, industrial and other factors.¹⁴ It is not explained how these other factors are assessed if the flowbacks are not taken into account. Despite considerable effort, the House of Commons Defence Committee failed to get MOD to clarify the procedure.

The French Socialist government, with its scepticism about market solutions, applied its interventionist philosophy to the defence industries consistently with its endeavours in other areas. The British Conservative government, with its enterprise philosophy, has endeavoured to apply market solutions to other industries like coal, steel and cars. Both governments have had their successes and failures and have not always lived up to their ideals. However, in UK defence procurement, despite a declaratory policy of the need for more competition, little attempt has been made to apply market principles when they might harm British contractors.

The enterprise-interventionist dispute has many ramifications. The interventionist would argue that lack of protection would lead to the irreplaceable loss of the flagships of British industry with their experience, design teams and technology. The enterprise answer would be that it has been protection and support of these arthritic giants which has resulted in poor British economic performance, and that their state supported shadow has smothered the small firms and venture capitalists who could have contributed to growth. Exposing the conglomerates to the winds of foreign competition could revitalise them and create the space for new British entrants to flourish.

This theoretical argument is in many respects academic because the current UK defence procurement policy consists of neither a coherent interventionist philosophy with an articulated defence-industrial policy; nor a consistent enterprise policy, willing to rely on the beneficial effects of international market forces. The policy which is being implemented is not only contradictory but also unsustainable. Eventually escalating costs and budget constraints will force some change.

CONCLUSION

Economists rely heavily on a single approach, taught to them by Adam Smith: interpret economic processes as the outcome of rational self-interest. This approach can be used in two ways. One way involves taking the objective of interest declared by the agents involved (profits, security, etc) and the constraints to which they are subject (available budget for instance), and then trying to derive the optimum actions. The optimum actions can then be compared with the actions actually taken. In the defence sphere the large deviations between the optimum and observed

actions then have to be explained in terms of non-economic factors such as political-market processes, the military-industrial complex, generalised failure to act rationally and the like.

The other way of using the approach is to assume that actions speak louder than words, especially where money is concerned. Therefore, one should regard the observed actions as being optimal for some real objective, which may be different from that declared by the agent involved. Then the analysis involves trying to infer from the observed actions what the real objectives are. Interpreting the choices in this way reveals multiple conflicting objectives each with different weights. Concern with the Soviet threat is one of these objectives; but in many decisions, like AEW, it seems to come a long way down the list, subordinate to national prestige and the support of British firms. Thus, it is not surprising that the peace movement should discount government warnings of pressing security danger, when government procurement choices also seem to discount such dangers.

NOTES

We are grateful for support under an ESRC/CNRS financed collaborative study of the British and French defence efforts. Very similar issues to those discussed in this paper are addressed by K. Hartley, *NATO Arms Co-operation: A Study in Economics and Politics*, Allen and Unwin, London, 1983, on which this paper draws heavily. We are also grateful to Keith Hartley, Linda Hesselman, Hugh Davies and Huw Dixon for comments.

1. Economic Progress Report, No. 178, June-July 1985, HM Treasury.
2. Prof. Sir Ronald Mason, 'Defence Research and Development and Western Industrial Policy: Part I' in 'New Technology and Western Security', *Adelphi Papers* 199, IISS, London, 1985. Part II, by Henri Matre gives a French perspective. The import and collaborative shares in France are of a similar magnitude.
3. Evidence by Sir Clive Whitmore, 'Defence Commitments and Resources', Third Report from House of Commons Defence Committee, Session 1984-85, HC37-I, II and III (HDCD hereafter).
4. M. Brech and Margaret Sharp, *Inward Investment*, Chatham House Papers No. 21, Routledge & Kegan Paul, London, 1984.
5. The D/P ratios for Tornado and Harrier GR5 come from HCDC II pp. 143-6 and 157, which gives development costs of £333 m. and production costs of £853 m. for 60 GR5. Tornado figures are production costs of £6.5 bn. for 385 units and development costs of £2.5 bn. The other R&D figures come from *Statement on Defence Estimates*, 1985, Cmnd 9430 I + II, HMSO, London, Table 3.1 (hereafter SDE).
6. The average D/P ratio of 38 per cent is equivalent to an R&D to sales ratio of 27.5 per cent. If one added company-financed R&D to the numerator and exports to the denominator, it might fall to just under 25 per cent. *Business Week* 8/7/1985, R&D Scoreboard gives details of company-sponsored R&D expenses (i.e. excluding R&D performed under contract to others such as the US Government) as a percentage of sales for the US in 1984. These data are reported to the SEC on form 10-K. Comparable data are not available for the UK. For all industries the average R&D to sales ratio is 2.9 per cent. Of the 32 industries considered only eight spend over 5 per cent of sales on R&D, the highest being semiconductors at 8.2 per cent, followed by computers 7.4 per cent, peripherals 7.3 per cent and drugs at 7.1 per cent. Aerospace is 4.8 per cent.

7. The differences between US and European cost-curves that result from these influences are explained in Hartley, *op. cit.* It should also be noted that the US DOD has also invested heavily in process technology, e.g. numerically controlled machine tools.
8. Air-Launched Anti-Radiation Missile. *Financial Times* 5/8. 85 reports on the purchase and use of the missile simulator.
9. The government incurred a classified amount of extra costs as a result of the slowdown in Tornado deliveries and by spreading orders between yards paid an extra £7m. for Type 22 Frigates, HCDC I, pp. xxxv and xxix.
10. The sale of 8 Tornados to Oman, the first export contract obtained for the aircraft, was said to be worth over £250 m. At £17 m. a copy, this would be 54 per cent for the aircraft and the remainder for the associated costs. The costing of the subsequent £5 bn. deal to sell Tornados and Hawks to Saudi Arabia is less transparent. In particular, the true return on the sale will depend on the terms of the oil arrangement. The fall in the oil price has also raised questions about whether these sales will go through.
11. In other areas, e.g. parts of civilian electronics, the reverse pattern is prevalent. Design and development are done in Britain and production is licensed or sub-contracted abroad to Korea, Taiwan or other low labour cost areas, and the products re-imported.
12. SDE, p. 37.
13. Offset deals involve the seller agreeing to buy specified amounts of other goods from the buyer. Dassault has undertaken to offset about 60 per cent of the cost of the sale of 40 Mirage 2000 aircraft to Greece (*Financial Times*, 26 July 1985). Most large sales are associated with corresponding loans at subsidised rates made by the seller. These credit terms, handled in the UK by the ECGD, which are the subject of both an international agreement, the 'Consensus' and considerable dispute, are very costly to exporting governments. ECGD cover was important on the sale of Tornado to Oman. Counter-trade is a form of barter where, for instance, Saudi Arabia exchanges oil for planes.
14. Hartley, *op. cit.*
15. HCDC, pp. 266, 269, 272.
16. *The Listener*, 21 Feb. 1985.
17. *Report by the Comptroller and Auditor General*, HC 291, 21 March 1985.
18. HCDC III, p. 61, evidence by Mr. Heseltine, then Secretary of State for Defence, on M.L.R.S.
19. *The Falklands Campaign: The Lessons* (Cmnd 8758 pp. 24-5), HMSO. The more general issues involved are discussed in Hartley, Hussain and Smith, 'The UK Defence Industrial Base', unpublished.
20. There is a large literature on the economic effects of military expenditure and some of the references can be found in J. P. Dunne & R. P. Smith, 'The Economic Consequences of Reduced UK Military Expenditure', *Cambridge Journal of Economics*, Vol. 8, Sept. 1984, pp. 297, 310.
21. HCDC III-17, quoting a writer, answer by the Parliamentary Under-Secretary of State for Defence Procurement to a Parliamentary Question.

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