Valuing Defence: VFM, RMA & RAB

Ron Smith, Birkbeck College, University of London.

First UWE Annual Public Lecture on Economics and Security
June 26 2003

Ron Smith has been Professor of Applied Economics, Birkbeck College, University of London since 1985 and visiting professor at London Business School and the University of Colorado. He has written 4 books, been an editor of another 3 and published over 150 papers mainly in applied econometrics and defence economics. He is an Associate Fellow the Royal United Service Institution, and has served on Treasury Academic Panel and the Board of the Centre for Defence Studies, Kings College London. He has worked as a consultant for a variety of organisations, including the UK National Audit Office on defence topics.

1. Introduction

I have been doing defence economics for 30 years now. Some things stay much the same. When I started the MoD were saying that the new Downey procedures for weapons acquisition were going to put an end to time and cost over-runs on major projects. Now they are saying Smart Acquisition will put an end to time and cost over-runs. Those of you who come from Abbey Wood will have noted that I have been on the Treasury Academic Panel and done consultancy for the National Audit Office, and will already have me targeted as one of the enemy. I used to say that the Ministry of Defence had three enemies: number one was the Treasury; number two was the French and number three was the Soviet Union. I don't know who number three is now, but they are still fighting numbers one and two. As a little indication of how deep that hostility goes, during a nuclear war the 210 top people in government were going to be spirited by the army to a hideout under Box Hill not far from here, and as Peter Hennessy notes in his book, The Secret State, there was nobody from the Treasury on that list.

This lecture looks at some aspects of the theory of value for defence; it proceeds from the sublime, what do we mean by the value of defence, to the ridiculous, how do we keep track of the assets using the Resource Accounting and Budgeting system. In between it asks how we measure Value for Money in defence choices and in particular, how will the Revolution in Military Affairs change these calculations.

2. The Value of Defence

Economists, like cynics, are accused of knowing the price of everything and the value of nothing. This is not quite true, Economists tend to treat price and value as being the same, something is worth what people are willing to pay for it. On that basis, I would say that the value of defence is the £25 billion or so, two and a half percent of GDP, that the UK is willing to pay for the security the defence budget provides. Many people find that sort of answer unsatisfactory for the reason identified by Adam Smith: water is essential to life but very cheap, diamonds are not essential but very expensive. What determines the price is the marginal utility. Because water

is widely available the marginal utility, the value of the last unit of water you consume is very low; whereas diamonds are rare, so the marginal utility of that extra one is high. Security, like water, may be essential to life, but if you have enough of it already you are willing to pay relatively little for any extra. Of course there are many parts of the world that lack security and the costs of not having it are vast, but the people there are generally too poor to buy the defence they need. If you wanted to look at the total value of defence, the relevant concept would be the total utility of the defence budget, the sum of the value of all the units less their cost. Such total utility is often estimated through cost-benefit analysis, to determine whether a proposed investment, such as a new road or railway, should proceed. Such calculations involve combining monetary costs and benefits with imputed monetary values for non-monetary consequences such pollution generated, time-saved in travelling, lives saved through safer roads etc. It is a complicated and controversial process and requires a counterfactual analysis of hypothetical situations: what would happen if the project proceeds against what would happen if it did not. I am sure that we could spend a lot of time arguing about what might happen if the UK, like Costa Rica, chose to spend nothing on defence. What is central to the problem is measuring the outputs of the defence budgets. We can measure the inputs, soldiers weapons, etc, and to a certain extent the capabilities that they provide; but what is the output those capabilities produce? The usual answer is security, but how do we measure security? A particular problem is that when defence spending is most effective, it appears wasted: nothing happens because the threat to security was deterred by the spending. Imputing monetary values to inputs and outputs, costs and benefits, which do not have any market price is difficult. In particular many projects save or cost lives and choosing the right value for the human lives that appear in many such calculations is particularly controversial. The treatment of the value of a human life in a cost benefit calculation for defence would be fraught with philosophical and moral difficulties.

The structure of the calculation of the level of military spending -how much is enough- is straightforward in principle, if not in practice. There is a potential threat, military expenditure increases security in the face of that threat but it also has opportunity costs in terms of foregone consumption. The optimal choice is to increase military expenditure to the point where the marginal security benefits of the military expenditure equal the marginal utility costs in terms of foregone consumption. The optimal defence budget will be higher the greater the threat and will be higher the greater the effectiveness of military expenditure in countering the threat. Thus when the Soviet threat was removed at the end of the Cold War, defence spending was reduced. This marginal analysis will not work if there are discontinuities, such as fixed costs, where you get no benefit until you have spent a large amount. In that case it may be that the military expenditure that you can afford is ineffective, since it does not get you over the threshold. Then there is no point in spending on defence and you are in the position of Costa Rica, abolishing the armed forces, or the Danish no-tax party, whose defence policy was an answer machine that said `we surrender' in Russian. What we observe is that countries steadily drop capabilities as the fixed costs become too large for them to play in the game.

Another way to look at defence is as an insurance premium. Historically, in peacetime the UK has been willing to spend about 2% of GDP on defence as a general insurance policy. There is no obvious threat, but it seems prudent to spend something on maintaining a basic military capability and since they are there you may as well

use the armed forces for other purposes, winning an empire in the 19th century or being a good international citizen in the 21st. Although, there are now no obvious threats, British governments seem to feel that military forces are valuable, they certainly continue using them, most recently in Iraq; hence the overstretch our armed forces face. Many in the military feel that the government has been making too many claims on this particular insurance policy. This tension between capabilities and commitments - how much the government wants to spend on defence and how much it wants to do with the limited forces it can afford - has been a constant theme of British defence policy since World War II.

Of course, in time of war, including the Cold War, the UK spent more than the basic insurance policy. In the two World Wars, times of clear and present danger, it was willing to spend over half its GDP on defence. Even in economic terms, ignoring the value of freedom, this is a good investment. If you lose the war, you lose control of the whole of a country's physical and human capital stock, worth many times the value of GDP. Thus investing a large proportion of GDP is good value for money. The defence budget is the price we pay for security and when there are large threats that price may be high, when there is no obvious threat, as now, the price may be rather low, just basic insurance cover.

The value of insurance, be it home insurance or the defence budget is that it buys you security. Be the threat high or low, defence spending itself has no value; it is valuable in that it buys you a military capability which can be used your security objectives be they self-defence or power projection. There are of course alternatives ways to provide security than military power. Social norms can be very effective ways of providing security. In the presence of such a strong norm, if it can be sustained, the value of defence is zero. The value of defence may even be negative if the defence preparations undermine the social norm. After three wars between France and Germany in less than a century, the creators of the European Community were driven by the fear of another one. The French, rather than building another Maginot line, used trade and co-operation to create a social norm of interdependence. This was an effective strategy and the probability of another Franco-German war is now small. If the French went back to defending themselves by, for instance, targeting nuclear missiles at Germany, as they did for many years during the Cold War, those defences would certainly undermine the social norm of trust between France and Germany and reduce French security.

Indirect Consequences.

Returning home, we can note that as well as the security consequences that result from military capability the defence budget has a range of incidental consequences on society and the economy. The economic consequences are for employment, profits, balance of payments, technology, etc. Although I have done a lot of research on economic effects of military spending, I do not think that the answers are particularly relevant here. Their relevance is not to the value of defence but to the fact that the political support for defence often depends on these indirect consequences, particularly the value of defence contracts to vested interests. Pork-barrel arguments play well with defence firms, defence workers and the political representatives of those who directly benefit from the projects. Gaining pork-barrel support is a well-organised industry in the US and is not unknown here. Such considerations, while building support for particular projects may distort decision

making in terms of military effectiveness. Many arguments made for the value of defence are of this sort, the jobs created or the contracts won for influential political actors. I remember presenting to a Labour Party Parliamentary Defence Committee in the 1980s and arguing that there could be efficiency gains from importing weapons. The left-wing Old Labour MP who was Chair said: `I don't want any of these Bloody Useless Weapons, but if we're going to have them they are going to British Bloody Useless Weapons'. More recently, I heard a retired Colonel on the Today Programme describe most defence procurement as disguised job creation schemes with little military relevance. It is interesting what retirement does to people's views. I think many including the Treasury would agree; but just try switching money from the expensive black holes that eat the procurement budget to reducing overstretch and watch the response from the lobbies.

The indirect benefits of defence spending are often used as arguments for the defence budget. Job creation, export promotion and technological innovation are often cited as values produced by defence. But if those were the objectives, they could be usually more efficiently achieved by programs directly targeted at those objectives, e.g. labour market reform or R&D support. The defence budget should be targeted at military objectives; trying to hit two targets with a single missile is a recipe for disaster.

To conclude this part of the lecture, I said that the value of defence is the £25 billion or so, two and a half percent of GDP that the UK is willing to pay for what it provides. Those two numbers have very different implications for forecasts, if it is £25 billion it stays constant in real terms, if it is 2.5% of GDP it grows with GDP.

3. Value for Money and the RMA

There now exists a fairly sophisticated system based on long experience for judging value for money in defence: determining the appropriate capabilities and force structure to meet the UK security needs. This is not to say that system always produces the right answer, or that the system is always followed or that resources are never wasted; but there is a system. For instance there is a sort of cost-benefit analysis used in MOD to measure the `bang for the buck' you get from individual weapons systems. It is done through a process called COEIA: Combined Operational Effectiveness and Investment Appraisal, which is used to select from alternative equipment options the most cost-effective way of meeting an operational requirement. This is done not in absolute terms, but relative to another weapon system that might provide similar military capability. At a higher level, the cost-effectiveness of the whole programme is reviewed, to determine the optimal force mix, the numbers of each type of capability required to meet UK defence objectives, given the available budget. This is a more qualitative assessment than investment appraisal and again is not in terms of some absolute value, but relative to alternative options.

From past mistakes a series of rules to ensure VFM have been learned. We learned from Downey that, it is essential to spend 10-15% on R&D and technology demonstrators before proceeding with a major project. Though even now it is often not done. From the Nimrod AEW disaster, where responsibility was split between BAE and GEC, we learned the importance of having a single responsible prime contractor. I wish BAE and Thales good luck with the aircraft carriers.

However, I am concerned that this system with all those techniques may not work so well if there are massive changes associated with the Revolution in Military Affairs. To think about this issue, I want to compare the putative New Economy of Defence, the RMA with the New Economy in Civilian life, where changes in technology transformed production and distribution. In the process it made dominant incumbents, like IBM, vulnerable to attack by initially small competitors, like Intel and Microsoft, who followed different strategies; the commercial equivalent of asymmetric warfare. In the new economy literature it is common to distinguish incremental and disruptive technological change. With incremental change competition proceeds down well established product and process technological trajectories and there is considerable inertia. With disruptive change the industry and market is completely transformed. The RMA is potentially the latest of a sequence of technological changes that have transformed the military. Such revolutions usually change the balance of power, as one group or country adopts the new technology faster than their antagonists and use it to change the way war is fought. The technological changes can involve new products, like the tank, or new processes, forms of organisation, like Blitzkreig, that make better use of existing products. In the military, process innovation tends to be much slower than product innovation, particularly in peacetime. In general, new technologies have been most effective when used in ways that are unexpected by the enemy and have often been associated with the rise of new revisionist powers e.g. the Japanese defeat of the Russians in 1905, through the use of the latest technology and a more effective strategy. Some military revolutions concentrate power, because the equipment is so expensive and specialised that only an elite can afford it; the rise of the armoured knight in their siege-proof castles, for instance. Other revolutions disperse power as they put cheap capability into mass hands; the guns that displaced the knights and castles.

Old economy military technology was very centralising; rapid cost growth between generations of weapons means that almost nobody, not even the US, can afford it. Most military equipment is obsolete in commercial terms before it enters service, because it takes on average seven years to develop and deliver it. Eurofighter, not yet in service, is based on early 1980s designs; and when it enters service, it will do so without its main missile, Meteor, which is mired in collaborative politics. Current fighting power is very much old economy, and much of it like the B52s is very old.

The question is whether this will change and what a new economy military might look like. It is worth comparing the new military and civilian economies in terms of some core characteristics. New-economy industries tend to have high fixed costs but low marginal production costs. Software is expensive to develop but cheap to produce in quantity. They tend to have network effects, the more people who use the product the more effective it is. Innovation tends to be a series of winner-take-all races. At any moment in time a single firm, which produced the killer application, tends to dominate the market; but when innovation is rapid their dominance is precarious: as Netscape fell to Microsoft and Yahoo fell to Google. Most weapons production does not show these characteristics. Although they do have high development costs, they are also so costly to produce that they are limited to small batches with long gaps between generations. In consequence innovation is slow, inertia dominates, the defence industry is fragmented and the market leaders are the same old firms who have been producing weapons for decades. The arms industry is still waiting for the killer applications that displace most of the competition, typical of

the new economy.

There are some new economy elements. The Global Positioning System, GPS, is a system of military satellites that has spawned a myriad of commercial applications. The system was expensive, but receivers are cheap. GPS was crucial in the 1991 Gulf War. For the first time in desert warfare, commanders could rely on soldiers knowing where they were. The wide availability of GPS allowed the allied commanders to use tactics that would have been impossible without it. Nearly all the friendly fire incidents involved vehicles without GPS. GPS was widely available because there was a commercial industry from which the military could quickly buy the GPS receivers that they needed to equip their vehicles. Such symbiosis between the commercial and the military will be central to any new economy armaments, but will raise issues as to who has control of the technology.

A recurring theme in military procurement reform is the attempt to learn from the commercial world, where new technology generates low production costs and high volumes; rather than as in the military where new technology generates high production costs and low volumes. However, because military time-horizons are so long, much of the equipment is old before it is introduced. Thus there are major problems of obsolescence, since commercial markets, particularly in electronics, do not support systems and devices designed to last for decades. Nobody makes those old chips that keep your bit of kit going. The US Department of Defense had to set up a special programme DMEA (Defense Microelectronics Activity) for the manufacture of replacement parts no longer supported by the commercial market.

During the 1991 Gulf War 9% of the ordinance dropped consisted of ‘smart’ (precision-guided) munitions. In Kosovo in 1999, the figure had risen to 29%, but cloud cover hindered employment of the laser guided types. In Afghanistan it was between 60 and 70%, with a large proportion of these being standard dumb bombs, with strap-on guidance kits, that allowed high accuracy from safe bombing heights. In the 2003 Iraq war it was over 90%. The main strap-on kit, JDAM (the GPS guided Joint Direct Attack Munitions) was cheap in military terms because it used more commercial development programmes and commercial components. It had been estimated that under traditional acquisition programmes JDAM would cost $68,000 each, which given the numbers required was not affordable even to the US. A new system, mandating a maximum price, was used and the final cost was about $18,000 each (see Lorel et al., 2000). Subsequently with volume production, competition and dual sourcing the price fell to about $12,000.

Of course JDAM is only useful if you already have the legacy systems: B52s and dumb bombs. But imagine if there was a cheap, stand-alone military killer application which could be produced with commercial components and whose technology was transformed every 18 months; could our traditional procurement process could handle it? How would you judge VFM? How would you value the assets? That leads me to my third strand, RAB.

4. Resource Accounting and Budgeting

Resource Accounting and Budgeting is the new system used for government accounts. Essentially it replaces the old cash based budgets with more commercial budgets, which also have balance sheets, that count the assets and liabilities. This

introduces depreciation, revaluation of assets, cost of capital etc as charges. This is not a big deal for most government departments, because they do not have many assets. It is a very big deal for the MoD, which has £90 billion or so of assets, from Salisbury Plain to fighter aircraft.

I want to make some general remarks about the role of accounting and then some comments on RAB. I shall try to keep the discussion very simple. Partly that is because I am an economist not an accountant, and as you may know economists are people who are good with numbers but not creative enough to be accountants. Partly it is because I think the simple obvious issues are the most fundamental and often get forgotten in the complexities. Obviously, the operation of RAB depends on a whole range of technical accounting details, about what, when and how you measure things, but that is not my area of expertise.

Modern accounting probably dates from late 13th century Italy, with the invention of double entry book-keeping, from there it diffused all over the world, though not yet, I gather, to the European Commission. The first description of the system was published in Venice in 1494 in Luca Pacioli's Summa de Arithmetica Geometria Proportioni et Proportionalita. About the same time Italian financiers also discovered the number e, from continuously compounding interest payments, but that is a digression. Initially, accounting was used by merchants and firms to keep track of how they were doing, i.e. essentially management accounts to aid the running of the business. There is a separate function, present in the accounts of Kings from the beginning: to monitor the stewardship of their agents. Published company accounts now also have that role in allowing the owners, the shareholders, to monitor the performance of their agents, the managers who run the company. In economics this is called a principal-agent problem, and typically the agent (the managers, the civil servants) will have far more information than the principal (the shareholders or taxpayers). Independent auditing, in the case of the public sector by Treasury and NAO, is designed to reduce that disparity of information. Of course, as Arthur Andersen and Enron or PwC and Tyco reminded us, there is then the issue of who audits the auditors? While I would not compare Her Majesty's Treasury to Arthur Andersen, as auditors, some of the ways they both have kept liabilities off the books are very similar.

Accounts also get used for other functions, such as to determine the tax liability of a company to or to compare the performance of different enterprises or the performance of the same enterprise over time. Changes in accounting procedures, like the change in the way military pensions were treated or RAB, make it more difficult for analysts like me to track what is happening to the military budget. Changes in the published numbers also have a political significance, even when the reality has not changed. During the 1970s the CIA doubled its estimate of Soviet military expenditure as a share of GNP. This was generally interpreted as indicating that the Soviets were a more formidable military power than had been thought before. In fact the estimates of Soviet forces had not changed. The CIA had decided that Soviet Industry was half as efficient as they had previously thought, so they had to spend twice as much to field those forces; but this is not how the numbers were perceived. I am sure that there will be similar issues of interpretation with the RAB numbers.

I think there are two general lessons. Firstly, accounts are a tool and you need different tools for different purposes, so there will be different systems of accounts for

different purposes and many companies will have multiple sets. There is not one true way of doing the accounts, just a variety of useful conventions: generally accepted accounting principles. Conventions that are adequate in one set of circumstances may not be so in others. For instance, historic cost depreciation is usually adequate, but fails badly during the times of high inflation such as the 1970s, when it does not provide enough to replace capital, so measured profits (and consequently taxes) are too high. But we stick with historic cost accounting rather than current cost accounting because it is simpler and periods of high inflation are rare. In time we will discover how robust the RAB conventions are to changes in the environment.

Secondly, by their monitoring function, accounts are designed to change people's behaviour, at a minimum to try and keep the agent honest. Thus accounting systems have incentive effects and changing the accounting system changes the incentives the agent faces. Changes can have perverse incentive effects. For instance, they have incentives to cook the books: manipulate the figures, within accepted conventions if possible, to make themselves look good. People will run the enterprise differently or report what they are doing differently under different accounting systems. This is particularly the case when a measure becomes a target, hospital waiting lists are a case in point. Goodhart's law comes into play once you target. Charles Goodhart, then an economist at the Bank of England, pointed out that any well established statistical regularity immediately breaks down once you target it for policy purposes.

Thus there is a constant two-way feedback between accounting procedures and organisational behaviour. I am sure that as the civil service gets to understand RAB, they will find the loopholes. I went to a conference on RAB in defence and all the civil servants were there to find the wheezes.

The accounts of commercial firms have for long contained a variety of accounts. There is a cash account, which tells them how much money they have, and this is how public expenditure accounts operated. This is then adjusted to give a profit and loss account, which adjusts for the vagaries in the timing of cash payments and includes depreciation to ensure that enough is put aside to replace the capital used up in the normal course of business. There is a sources and uses of funds which shows where the money generated in the business goes: back to the owners or to reinvestment in the business. And finally, there is a balance sheet, which records the assets and liabilities of the firm. I think there is a fundamental issue in whether it is meaningful to think of the MoD as having a profit and loss account, because of the difficulty of defining outputs, but I think the main issue in RAB is explicitly including a cost for the assets that are used.

For capitalist firms trying to maximise the return on their invested assets, the balance sheet is crucial. For governments, whose main focus was on financing cash expenditure, it was less salient if not completely ignored. There is a saying: if you don't count it you don't manage it. I do not think this is really true, but the invisibility of government assets did mean that one could not be sure that they were wisely managed. A major objective of RAB is to provide balance sheet information that will enable the government to manage its assets better. In principle this is a good thing, but I think it is important to be clear that, even without a formal balance sheet, MoD did manage the assets in its force structure in order to provide particular military

capabilities. Whether it managed its military assets as well as it could is a matter of debate, but it is a military debate not an accounting debate. There is a danger that if inaccurate numbers are given too much weight in the calculation, one may get wrong military decisions. In the early days of the use of Discounted Cash Flow in industry this happened. Investment decisions were being made by ignorant people in the finance department; on the basis of highly unreliable forecasts being fed them by people in the sales and production departments.

Balance sheets have both assets and liabilities, and managing the liabilities can be as important as managing the assets. For the MoD the most important liabilities are contingent liabilities, responsibility for compensation in the event of an inadvertent nuclear explosion at AWE for instance. Like this example many of these are in the balance sheet as unquantifiable. Some of them are already there, liability to dispose of nuclear submarines, but again we do not have good estimates of the cost. How one values such liabilities in investment appraisal, e.g. in a through-life-costing to decide whether to procure a new SSN, is an interesting question. The significance of such disposal costs is very sensitive to the discount rate used, and there is substantial dispute about what is the appropriate discount rate to use.

The introduction of RAB raises two issues, how you value the assets and how you manage them. Let us begin with how you might value a commercial asset, say a public house. There are three main ways. Firstly the historical cost of the asset to you adjusted for depreciation and improvements. This is the way assets usually are recorded in the books and although the idea is quite simple, in practice there are complications which introduce uncertainties. Secondly, the value of the asset to you on a going-concern basis. This is the present-value, the sum of discounted future profits i.e. the surplus of the value of its output, i.e. its revenue, over its costs, discounted by the interest rate you could get investing elsewhere, e.g. government securities, plus some risk premium. Again the estimation of future profits and choice of discount rate introduce uncertainties into such discounted cash flow calculations. Thirdly, there is the market value, the net proceeds of sale: what someone would pay you for it. For assets where there are liquid markets, e.g. equities or private houses, this is easy to measure though it may change from day to day; for other assets it would depend on what buyer you could find, what they might do with the asset, etc. and these are uncertain. My point here is that even in a commercial setting these three valuations are likely to differ.

Management of the assets will take account of the differences between the valuations: if market value is greater than going concern value, you should sell the asset; somebody else can make better use of it and you can use the money raised from the sale to invest elsewhere at a better return.

Now let us think about managing and valuing public assets such as Salisbury Plain or a new Eurofighter. With Eurofighter we can get a historic cost estimate fairly easily (though there are issues in the treatment of R&D and Intellectual Property Rights which constitute intangible assets), with Salisbury Plain the historic cost figure makes no sense. There are potentially market prices, what others would pay for them, but they have large uncertainties attached. In both cases the uncertainty arises from questions about how the buyer would be allowed to use the asset. With Salisbury Plain the use issue is what sort of planning permission would be provided, with

Eurofighter the use issue arises because those who would be willing to pay the most for it are exactly those we would not want to sell to. Some of the methods used to value the assets were quite imaginative.

Given the limitations of historic cost and market price valuations in the case of many defence assets, we would want to value them on a going-concern basis. In the commercial calculation, the going-concern value was the present discounted value of expected profits. In the defence calculation, we would want to do that in the same way using the present discounted value of the surplus of the value of its outputs over its costs, which comes from the use of the asset. Thus if we are really going to manage our public sector balance sheet we need to be able to value the outputs they produce. But as I discussed above valuing the outputs raises almost insoluble problems. With the present system we are certainly going to get perverse effects and incentives. When the Sea Harriers were withdrawn, because the MoD could not afford to run them, under RAB they had to write them off, this causes a capital charge which causes them to overspend on RAB accounts. Like all employers, MoD say their biggest asset is their employees, but RAB does not include them in the balance sheet.

I think it is useful if we have rough estimates of the value of the assets that the MoD has, it gives them more salience and prompts the question could they be better used elsewhere; similarly lists of liabilities are a useful reminder. Charging for depreciation and capital gains is also sensible, to an economist, but may be difficult to explain to MPs. I think that there will be definite benefits in areas such as inventory control and management of spare parts, etc. which has traditionally been a problem for MoD. I think focusing on certain sorts of capability measure can be useful: e.g. the potential capability to deploy an infantry battalion in Afghanistan. But because I am sceptical about valuing military outputs, I think commercial type balance sheet management could be counter-productive in some instances, because they send the wrong signals. They also have a direct cost, since the accounts are expensive to calculate; and we have to decide the optimal mix of soldiers and accountants in the UK force structure.

5. Conclusions

Having discussed some aspects of how we measure and value defence from an economic perspective, I should emphasise one qualification; military efficiency and economic efficiency can be very different concepts. Defence is different, certainly we are spending money on it and the money should be well spent, but often we are buying values and outcomes which are not well described in monetary terms. I have great sympathy with the diatribe Edward Luttwak made against economists and micro-managers in defence, in his delightfully titled paper "Why we need more waste, fraud and mismanagement in the Department of Defence". He says: “The trouble is that the outputs that count in war are very particular and very different from the outputs that count in peacetime, and when civilian notions of efficiency are applied, the difference is routinely overlooked.” Although economics can be useful in military matters, it is important to be clear that military optimality and economic optimality are quite different concepts. Economists tend to think in terms of a production function: material inputs, labour, capital, etc., go in and output comes out. But as Luttwak says “when it comes to military power, the relationship between material

inputs and desired outputs is not proportional; it is in fact very loose, because the making of military strength is dominated by nonmaterial, quite intangible human factors, from the quality of military strategy to the fighting morale of individual servicemen." We have to value those things as well as the things we can count.

Acknowledgements

Section 2 draws on a paper I prepared for a MoD seminar on the "The Value of Defence", 18 January 2001. Section 3 draws on work in a forthcoming "The Economics of the Revolution in Military Affairs" with Dunne, Garcia-Alonso and Levine. Section 4 draws on a paper I prepared for a Royal Aeronautical Society conference on RAB in the MoD, 13 November 2002.