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Risky business

Measuring the costs and benefits of counter-terrorism spending

by Carl Ungerer, Henry Ergas, Scott Hook and Mark Stewart

Introduction and summary

Carl Ungerer

Federal government spending on counter-terrorism has increased substantially since the al-Qaeda terrorist attacks on New York and Washington in September 2001. According to recent estimates, Australia's cumulative spending on terrorism-related measures will exceed \$10 billion by the end of the decade.¹ That spending has been allocated across a broad and diverse range of initiatives including overseas military operations, intelligence collection and analysis, international police deployments and a range of new domestic security functions involving both Commonwealth and state and territory governments. The cost of national security is high and it is growing.

Despite the increased levels of funding there is no systematic way to examine public expenditures on counter-terrorism in Australia. Security and intelligence agencies are now seeking better methods to measure and assess individual national security functions. As yet, however, governments have not settled on a specific formula for assessing the overall success or failure in the 'war on terror'.

Such a task is complicated by the fact that the principal desired outcome, the non-occurrence of a terrorist attack on home

soil, is difficult to attribute to a specific action by one agency or to a government policy. And foiled attacks are rarely made public. The task is also challenging due to the fact that as funding has increased the public has strongly supported government efforts to enhance public safety. So a stricter performance measurement approach to national security spending contains inherent dilemmas for both governments and the public.

But given the centrality of counter-terrorism to national security and foreign policy considerations, an analysis of the benefits (or effectiveness) and costs (expenditure) of counter-terrorism should be an increasingly important component of public sector management. In a period of global financial turmoil, and growing pressure on national budgets, hard choices will need to be made.

Governments will need better metrics to highlight performance measurement issues and to make the sometimes difficult choices between individual security measures or more broadly between national security and other public policy goals. A more rigorous set of assessment tools would provide a stronger evidence-based approach to support national security decision-making. And informed choices can help to allay public concerns if the risk mitigation strategy is seen to be the most efficient and effective use of public money.

Existing frameworks for assessment

Previous attempts to measure the effectiveness of counter-terrorism spending have focused on broad indicators such as the number of terrorist incidents, fatalities or the capture or kill rates of senior terrorist leaders. Where efforts have been made to integrate more rigorous performance measurement indicators, such as in the area of transport security, government spending is often measured according to whether the initiative was completed on time and on budget, rather than a comparative assessment of the various policy options available and which one is the most cost-effective.

The few studies that have been conducted on Australia's counter-terrorism strategy have tended to emphasise macro-level measurement criteria. For example, Andrew O'Neil's assessment of national counter-terrorism policy focused on the degree to which there has been 'observable coherence' (that is, logic, consistency, minimal contradictions and appropriate overlap) between the 'three pillars' of national policy: domestic legislation, intelligence and regional assistance and engagement.² In the absence of specific measurement criteria or data, such an approach is not without merit. O'Neil concludes with the assessment that the underlying coherence of the Australian counter-terrorism strategy remains relatively strong, although he argues that further legislative and foreign policy reforms may be necessary.

At the other end of the measurement spectrum, the Metropolitan Police in London have focused much more closely on measurable actions at the local level in their assessment of counter-terrorism policing in the United Kingdom. This is also reflected in the reorganisation of counter-terrorism policy in the UK since 2005, whereby the

domestic security agency (MI5) has opened regional offices outside London in areas such as the Midlands, West Yorkshire and Glasgow. In the face of both homegrown and transnational terrorist threats, the British have argued that preventive policing also requires a level of multinational cooperation that is difficult to measure. Making judgments about 'effective international cooperation' or the quality of 'intelligence sharing' between national police and overseas intelligence agencies requires both quantitative and qualitative assessments. A terrorist attack against UK interests could be planned in a cave in Pakistan or alternatively in Paris or Leeds. Therefore, counter-terrorism police in the UK have judged that the most effective measurement of police action occurs at the operational level.

Both macro-level judgments about 'coherence' and micro-level measurements of individual policing operations can be useful guides in the analysis of a counter-terrorism function. However, there is an implicit assumption in both approaches that comprehensive and meaningful data exists on which to base and implement policy decisions. Such data is often unavailable, or simply subjective. In the quest to improve Australia's counter-terrorism performance, policy makers and practitioners require a more systematic way to evaluate individual programs and agencies.

A cost-benefit approach

This report examines the utility of cost-benefit methodologies for measuring national counter-terrorism expenditures. Although some cost-benefit analyses have been conducted on counter-terrorism funding in similar jurisdictions overseas such as the United States, there has been limited work done analysing public expenditures in Australia.

A cost-benefit analysis measures the costs associated with avoiding risk and allows the policy maker to make an informed decision about whether such a cost is excessive, therefore failing to be a productive use of society's resources, or is in line with informed threat assessments. Another advantage is that a cost-benefit assessment will lead to a better understanding of the individual policy measures and their interactions with other security systems and the wider environment.

In most cases, identifying and then valuing the costs and benefits of a particular program or policy action will involve the analysis of a 'what if' scenario. It will involve a calculation of outcomes with the policy or program in place or if it was removed. Even with large amounts of market information, however, these calculations can be complex, particularly where the indirect benefits of a security measure (such as prevention or deterrence) are likely to be important, but difficult to quantify.

Structure of the report

The report suggests three possible ways of applying cost-benefit analysis in the measurement of Australia's national security effort—at the macro-level (examining the national defence budget as a whole), the meso-level (through the analysis of an individual agency's spending) and at the micro-level (focusing on a specific policy initiative).

The first case study, written by Henry Ergas, examines the evolution of performance measurement in national defence spending. Drawing on the US Defense Department's experience with the Planning, Programming and Budgeting System (PPBS) during the 1950s and 1960s, it discusses the potential application of more rigorous planning controls on domestic security spending. Although acknowledging the inherent difficulties

of applying cost-benefit methods to the provision of a collective public good such as defence, the paper concludes that the analytical rigour of the PPBS still has an important place in national security planning and that when seen as a set of overall capabilities or options rather than individual measures, governments can begin to make more informed decisions about national security spending as a whole.

The second case study by Scott Hook uses the cost-benefit method to analyse the spending of a single government agency—in this case, the Australian Federal Police (AFP). Recognising the inherent problems of attribution and causality, funding of the AFP's eight major counter-terrorism functions is measured against the likely costs of a domestic terrorist incident in Australia. By comparing a 'unit' of agency funding against a 'unit' of terrorist threat, the paper shows that the AFP's current level of expenditure is in line with predicted beneficial outcomes. However, the paper also shows that having invested in a stronger counter-terrorism capability in Australia, increased expenditure would need to be justified on the basis of additional national security benefits.

The final case study, by Mark Stewart, is drawn from his recent comparative research on specific counter-terrorism measures in the US transport industry. This paper provides a risk-informed framework for cost-benefit analysis using airline security as an illustrative example. By using sensitivity analysis to determine the risks and rewards of each policy option, the paper measures the cost effectiveness of the Australian Air Security Officer (ASO) program as a contributor to the overall prevention of terrorism.

Together, the three case studies provide examples of how cost-benefit analysis might be used by Australian decision-makers to examine counter-terrorism expenditures

Copenhagen Consensus 2008 Challenge Paper — Terrorism

A recent study on the macroeconomics of terrorism prepared for the Copenhagen Consensus group argues that counter-terrorism policies can use large resources for little reduction in risk.

The study, led by Professor Todd Sandler from the University of Texas, compares the overall costs and benefits of five different approaches to combating terrorism, based on the United States as a case study:

- (1) business as usual*
- (2) greater international cooperation*
- (3) increased proactive responses*
- (4) augmented defensive measures*
- (5) adopting more sensitive foreign policies.*

By calculating the costs of global terrorist actions according to lives lost and injuries sustained, security expenses and overall loss

of national income in America, the study concludes that only greater international cooperation and more sensitivity in US foreign policy could produce benefits greater than their costs.

There are several problems with this approach. First, there is a strong selection bias in the description of the five counter-terrorism policies. Other policy options were not considered. Second, aggregating costs and benefits at the national level ignores the psychological impact of terrorism on communities and the additional security benefits that accrue to national police and security agencies as a result of counter-terrorism spending. Finally, the assertions regarding the link between US foreign policy and transnational terrorism are speculative and are not supported by historical evidence.

at the national level. Notwithstanding the inherent difficulties of analysing national security risks such as terrorism, these cases demonstrate that a cost-benefit analysis, in conjunction with clear performance indicators, can provide a rigorous framework

for the allocation of public funds. Such rigour will become more critical in the future as additional issues are placed on the national security agenda, and the competition for public funding increases.

Cost-benefit analysis in defence: where it came from, where it might go

Henry Ergas

You cannot make decisions simply by asking yourself whether something would be nice to have. You have to make a judgment on how much is enough.

Robert S McNamara, 20 April, 1963.

Although cost-benefit analysis has roots in economics that stretch back to the 19th century, it evolved into its current form in the 1950s, reflecting a world-view that emphasised, and sought to promote, rationality in public decision-making. One of the major areas where the search for instruments for rational decision-making was especially pronounced was defence, particularly in the United States, as the pressures of the Cold War, and the uncertainties associated with adjusting to a 'nuclear age', placed qualitatively new demands on defence decision-makers. The result was a flowering of research which led to Charles Hitch and Roland McKean's classic text *The Economics of Defense in the Nuclear Age*, still by far the best work on its subject. On becoming US Secretary of Defense in 1960, Robert S McNamara brought its authors, and their leading collaborators at RAND, into the Pentagon, where they implemented the Planning, Programming, and Budgeting System (PPBS) they had developed, and through a range of important and influential publications, became its most effective advocates.

PPBS covered a range of techniques and methods of economic and financial control, with much of its early emphasis being on improvements to budgeting. Its overall goal, however, was to improve efficiency in defence planning and spending—a goal which is surely of great relevance to Australia

today. In 2008–09, Defence will absorb some 1.8% of GDP; outlays on that scale merit close scrutiny. The importance of an effective defence capability to our future as a country, and the sheer difficulty and complexity of the choices associated with defence, only make all the more compelling the case for using the best techniques we can in shaping our defence budget. Similar considerations apply to domestic security: cumulative public spending on domestic security over the decade from 2001/02 will exceed \$10 billion, to which would need to be added amounts spent by state and territory governments, private corporations and even individuals. Here too, the size of the effort, along with the magnitude of what is at stake, make it important to ensure resources are being used wisely.

Set against that imperative, it is surprising how little attention systematic cost-benefit analysis receives in current defence and national security policy-making. In part, this is because of the history, but it is also because of the many obstacles which lie in the way of applying cost-benefit analysis to these issues. However, before dealing with these, it is important to define a few terms.

The uses of cost-benefit analysis

Cost-benefit analysis is an important tool for moving towards a better use of resources—but it is more than that. In essence, one can distinguish two broad roles that cost-benefit analysis plays. The first, most obvious, role is as a tool for decision-making. This is the resource allocation role, which involves asking whether scarce resources are being used wisely. In this role, cost-benefit analysis complements program evaluation: program evaluation asks what outcomes a program achieves; cost-benefit analysis then asks whether those outcomes are worth achieving.

For example, as part of domestic security responses to terrorism, it has been common

What is cost-benefit analysis?

Cost-benefit analysis is a technique for evaluating collective decisions that hinges on the comparisons of the costs of a proposal to its benefits, where costs and benefits are evaluated in monetary terms. In essence, cost-benefit analysis asks whether the sum of the amounts the individuals who comprise the community at issue would be willing to pay for the project to proceed exceed the costs of that project. Generally, a project enhances wealth—in the sense of the aggregate monetary valuation of the community's resources—if it meets a properly specified cost-benefit test. Projects that fail that test should be looked at very carefully, and found to have other, significant, redeeming features, before they are allowed to proceed. By the same token, if a project has benefits that (evaluated in monetary terms) clearly exceed its costs, it seems reasonable to

presume that absent compelling reasons to the contrary, society would gain were it to proceed.

It is also worth defining efficiency. An outcome is efficient if it maximises the net value of society's resources. This in turn means that given that outcome, society could not be made better off by marginally shifting resources between uses. It follows that if the use of resources in one application derives a benefit that can be valued at \$X, while those same resources, when shifted to some other use, can derive a benefit of more than \$X, then the initial situation cannot be efficient. This is one important reason that cost-benefit analysis is worthwhile: used as a decision tool, it should help us move towards an efficient outcome, in which we get as much as we can out of the limited resources at our disposal. Doing this in defence and in national security is no less important than in other areas of collective provision.

to seek to 'harden' key targets, through means that include enhanced physical protection (such as bollards), electronic surveillance and greater presence of security personnel. A program evaluation would ask what effects that 'hardening' has, taking account, for example, of the risks of simply diverting terrorism to 'softer' targets.

Drawing on such a program evaluation, cost-benefit analysis would then examine whether the benefits of achieving those outcomes exceeded the costs. Given the results of that cost-benefit analysis, policy-makers could then determine whether to continue, expand, contract or terminate the program. This role of cost-benefit analysis as a tool for improving resource allocation is, however, only part of the story. In effect, as well as being a technical tool, cost-benefit analysis is an element in dealing with the

'principal-agent problems' that are inherent in collective decision-making.

As a community, we don't worry about whether we will make the right number of pencils, top hats, or numerically controlled machine tools. Nor do we worry about whether we should be reallocating some resources from making pencils to the manufacture of top hats or the design of numerically controlled machine tools. Those issues are taken care of by the price system, which signals to producers both the value consumers place on each of those items and the opportunity cost of the resources devoted to their production. If the value consumers place on pencils falls below the opportunity cost of their production, while the value consumers place on top hats rises above the opportunity cost of their production, then one or more producer of pencils will incur

a loss on the marginal pencil supplied and reduce output, while one or more producer of top hats will gain greater profits on the marginal top hat supplied and hence increase output. Of course, this is not to say that these processes work perfectly: they certainly do not work instantaneously or without some costs of their own; but the prosperity of market economies suggests that usually and on balance, they do an extremely good job.

However, markets cannot similarly determine the supply of collective goods, such as defence and national security. These are goods for which output is broadly non-rivalrous, in the sense that an increase in our defence capability benefits all Australians, and the fact that one person derives some of that benefit does not reduce the quantum of the benefit that is available for other Australians to enjoy. As a result, the opportunity cost of an individual benefit is effectively zero and that is the efficient price of the ‘usage’ of those services. At the same time, the benefits produced by defence and national security are largely non-excludable, in that there is no sensible way in which anyone can be prevented from deriving those benefits for so long as they remain in Australia. As a result, any voluntary system, in which citizens agree to pay for those services, is sure to fail, as individuals will have incentives to ‘free ride’. Under those circumstances, decentralised, market-based, allocation cannot work.

This makes it inevitable that the community, acting through the political system, will need to contract for those services collectively—which is what our defence and national security budget does. In that sense, the institutions that provide defence and national security are the ‘agents’ for the community which—in its roles as citizens, voters and taxpayers—is the ‘principal’. However, the implied contract between the principal and the agent is inherently imperfect: it is marred by the fact that these

parties will have somewhat different interests (as the agent will have interests of its own) and that the principal lacks the information and other tools and resources needed to perfectly monitor the agent’s behaviour. Those imperfections translate into what economists refer to as ‘agency costs’, which are broadly the sum of the resources devoted by the principal to controlling the agent’s behaviour, the resources devoted by the agent to avoiding or undermining those controls, and the residual losses in output that follow from the remaining misalignment in interests and incentives.

Cost-benefit analysis is one instrument that the principals in public sector governance can use to improve the decisions taken by their agents, and to enhance their supervision of those agents. In particular, the requirement to carefully assess, and report, the costs and benefits of decisions can reduce the information asymmetry between the principal and the agent. More specifically it can:

- help reduce the risk of ‘capture’, in which the agent’s decisions, rather than reflecting the interests of the principal, come to be determined either by the agenda of self-interested third parties (such as vendors of weapons systems) or by the agent’s own interests and aspirations
- help correct ‘policy bias’, which is a situation in which those working in an agency have policy commitments that differ from (and may undermine) those of the public, as can occur when service loyalties or traditions impede the reallocation of resources between competing defence uses
- help overcome ‘shirking’, in which agents do not exercise as much effort and care in taking and implementing decisions as would be warranted

- help disclose and correct the cognitive biases that affect decision-making, including the tendency to confuse the unfamiliar with the improbable, and more generally to under-estimate the risks of a course of action when its benefits seem large, and under-estimate the benefits of a course of action when its risks seem large
- increase consistency in decision-making, both by standardising the information base on which decisions are taken and by highlighting anomalies, such as differences between project appraisals in the valuation of common elements
- improve accountability, by providing a standardised ex ante statement of key expected values for costs and benefits, thus allowing readier ex post identification of variances from those expected values and encouraging analysis of the causes of those variances, which can facilitate learning.

Ultimately, all of these effects mean that cost-benefit analysis is never merely an analytical tool. Rather, as Aaron Wildavsky emphasised many years ago, it is inevitably an instrument in shaping bureaucratic structure and process, both within each public sector body and between that body, the other elements of the public sector with which it interacts and the wider political system.³ These impacts are especially salient in defence, where principal-agent problems are intertwined with the inherent complexities of civil-military relationships, the importance of service loyalties and inter-service rivalries and the political difficulty of seeming to deny ‘the best’ to young men and women who are putting their lives at risk for their country.

The history

As with all innovations in governance, the introduction of PPBS, and the initial application of efficiency analysis, to defence

was driven by a mix of considerations, including wider political and economic imperatives, bureaucratic politics and the genuine search for better ways of addressing society’s problems.

The wider imperatives came from the incoming Kennedy administration’s criticism of the cap the Eisenhower administration had set on defence expenditures; having criticised that cap, the new administration had to find an alternative way of constraining defence outlays. As Robert McNamara famously put it, faced with defence budgets that seemed set to inexorably expand, there had to be some way of determining ‘how much is enough’: PPBS and the techniques associated with it were seen as the key to providing that discipline.

Specifically, the intention was that PPBS would involve three key elements:

- The planning process, which would identify the contingencies that needed to be faced and the broad parameters within which decisions were to be taken.
- The programming process, which, in turn, had two crucial sub-elements:
 - the definition of outputs, which were coherent sets of services provided by groups of inputs that could be considered separately from other inputs. The crucial feature of such a set of outputs, i.e. of a program, was that the interdependencies between the various activities grouped within the program and generating its outputs were greater than those between individual activities within the program and those in other programs
 - optimisation within each such set of outputs or program, in the sense of identifying the most efficient way of providing those outputs, either by taking the level of outputs as given and minimising the costs involved, or

by taking resource use as given and maximising the outputs.

- Budgeting, which would translate the outcomes of the programming process into coherent and balanced resource requirements across the defence effort as a whole, and then into a costed five year rolling forward budget.

While it was apparent that this process could not determine the ultimate issue of ‘guns versus butter’, it was aimed at five goals. First, forcing more explicit identification of the objectives being pursued in each area of defence resource use. Second, promoting consideration of alternative ways of meeting those objectives, and doing so using a common, consistent, and hence more readily testable, analytical framework. Third, spotting areas of imbalance, such as troops without airlift, and identifying and avoiding further expansion in program areas that were on the ‘flat part’ of the cost effectiveness curve. Fourth, facilitating post-mortems on decisions and performance, by comparing out-turns to expectations. And fifth, assisting decision-makers to evaluate whether the current and likely future aggregate level of resources could provide more defence output and/or whether the current and required future aggregate level of defence output could be provided using fewer resources.

This required adopting ‘a way of looking at problems’ that centred not on calculation per se, but rather on ‘the comparison of all the relevant alternatives from the point of view of the objectives each can accomplish and the costs which it involves; and the selection of the best (or a ‘good’) alternative through the use of appropriate economic criteria’.

This objective—of better controlling spending, and doing so in a way that was more consistent than were arbitrary budget caps with efficient use of resources—also meshed with the imperatives of bureaucratic

politics. There was, in effect, a natural intersection between McNamara’s desire to assert the primacy of the Secretary of Defense’s role and PPBS.

In effect, PPBS had an inherent centralising tendency in that it decomposed the defence budget into programs which contained inter-related items that either complemented one another or were close substitutes for each other. Under PPBS, the proportion of the program package which would be dedicated to, say, aircraft versus submarines versus land based missiles would depend upon which weapon system could achieve the program’s objective (in this case, deterrence and assured second strike capability) in the most cost-effective manner. Hence, the Navy’s strategic systems did not compete against other Navy programs such as antisubmarine warfare as they had in the past; rather, they competed against the Air Forces’ strategic systems. Because decision-making was based on comparisons which spanned traditional service lines, the final budget could only be put together by the Secretary of Defense. As a result, PPBS enhanced the Secretary’s role in the decision-making process relative to the service chiefs—a factor that was also hugely relevant to Sir Arthur Tange’s attempts to introduce PPBS in Australia.

The apparent success, in the Cuban missile crisis of 1962, of the approaches to decision-making developed at RAND during the 1950s enhanced the status of the RAND-originated PPBS techniques and strengthened the belief that a ‘managerialist’ approach could put defence decision-making on a genuinely scientific basis. In that light, PPBS was viewed as offering the potential to bring the governance of defence into a ‘nuclear age’, as compared to previous approaches based on service traditions, loyalties and rivalries formed over many decades and pre-modern in spirit. Moreover, the scope to use computers—for example,

for cost evaluation, and for testing cost-effectiveness under alternative conflict scenarios—made the entire enterprise of PPBS appear naturally consistent with the opportunities that exciting new technology offered to change not only the way wars were fought, but also the way in which they were planned and resourced.

What happened to PPBS?

The implementation of PPBS was a significant advance on previous approaches. It brought far greater focus on the systematic assessment of the costs of alternatives relative to the objectives being pursued, and introduced the notion that the alternatives to be considered had to be assessed across traditional service boundaries. It also brought far greater order than had previously prevailed to defence budgeting processes, and the approach of grouping outputs into coherent programs, within which alternatives can be explored, remains important in public budgeting internationally. Indeed, the budgeting aspect of PPBS has very largely remained intact, including at the US Department of Defense.

However, it would be fair to say that the promise of PPBS in defence was never fulfilled, certainly in terms of its grander ambitions. In part, this was the result of PPBS being in the wrong place at the wrong time. Thus, PPBS' aura was one of the many victims of the tragedy of the Vietnam war. No doubt, the managerialism of PPBS, and the logic of economic decision analysis, was apparent in many aspects of decision-making in Vietnam. Combined with the management of the war by means of quantitative targets, most famously the 'body count', PPBS and its tools came to be seen as underpinning decisions that ultimately led to defeat.

Whether PPBS received a 'fair rap' in this respect is questionable. Any close reading of

the material shows that the various forms of quantitative analysis were at least as often used by analysts to question, as they were to support, the assessments and choices being made in the course of the war. Even with the performance or situation indicators (such as the body count or the net attrition rate), the issue lay less in the use of those indicators, than in the indicators chosen and the interpretations placed upon them. Moreover, although the causes of defeat in Vietnam are still highly controversial, it is difficult to find scholarly assessments that lay blame on the analytical tools that were used, though it may be that those tools helped define and perpetuate a way of seeing the world that gave too little weight to realities 'on the ground'.

All of that notwithstanding, the ultimate failure seemed to doom the project of bringing the tools of 'rational' decision-making into defence. This is not to say those tools disappeared, for plainly they did not—for instance, cost-effectiveness analysis is widely used in defence projects. However, much as Wildavsky had predicted, they survived as one element in a decision strategy of incremental 'muddling through', as against an overall scheme aimed at rationalising resource use across the wide range of defence applications. And its aura so severely tarnished, PPBS, and the application of cost-benefit analysis to defence, virtually disappeared as an area of research, relegated to specialised studies, often heavily engineering-based, of choices among weapons systems.

What role could cost-benefit analysis play?

That PPBS' grand vision failed cannot be put down solely to bad luck or poor judgement by decision-makers. Rather, it also reflects some inherent limitations on, and difficulties in, the application of many elements of cost-benefit

analysis in defence. These difficulties are partly technical in character. Even the simplest forms of cost-effectiveness analysis require some capacity to define the outcomes being sought and then array by some index of effectiveness alternative approaches to pursuing those outcomes. There must, in other words, be an underlying production function of some kind that systematically and predictably relates inputs to desired outputs and then allows the efficient choice of combinations of inputs and outputs. While there are defence contexts in which these concepts have a ready meaning, there are others where they prove extremely difficult to apply.

The classic situation that lends itself to analysis is that of nuclear conflict. This situation is a game with a limited number of moves, where each player has clearly definable choices and where the combination of those choices across players maps into readily identified outcomes. Moreover, those outcomes can be ranked, using metrics such as loss of life or expected recovery time, allowing strategies (in the sense of combinations of actions) to themselves be ranked. The fact that nuclear war is by definition total war, in which the survival of the nation is at stake, makes the ranking of outcomes that much easier. In turn, playing out this game allows decisions to be made about issues such as the composition of the nuclear force, its siting and requisite logistics. The classic study by Albert Wohlstetter and his colleagues of the optimal location of military bases in the perspective of assuring a second-strike capability is an outstanding example of this kind of analysis. Drawing on studies of this kind, it is possible to optimise across an entire program category, as the McNamara administration did through rationalisation of the strategic nuclear force.

However, there are other areas of defence capability where the relationship between

inputs and outputs is far more complex. The general purpose forces, that would bear the brunt of the fighting in a conventional war, illustrate the point. Conventional wars are typically lengthy, and involve not two or three key decision points (as would be relevant in a nuclear conflict) but many millions of individual moves and decisions. While inputs—such as aggregate firepower—are doubtless of great significance, their value in any particular conflict depends on many factors of detail, including the specifics and size of the terrain, the nature of the adversary, the cooperativeness of the population, the extent and precise nature of constraints on the use of force, and the specific type of outcome being sought. As a result, it is not possible to identify any meaningful general relationship even between factors such as technological superiority on the input side and indicators such as the casualty exchange ratio on the output side. It follows that assessing the effect of marginal changes in inputs on likely relevant outputs is inherently problematic. While many detailed decisions are capable of optimisation—and indeed are routinely analysed using the instruments of operational research—the scope for wider optimisation is limited.

Put slightly differently, what the defence force provides are options—options to make graduated use of force in circumstances where the application of force, or the threat of its application, are of utility. At times, none of those options will be ‘in the money’, i.e. efficiently exercised; at other times, some or even all of those options will be, or will be close to so being. Even so, the mere fact of having those options is of value in a world where developing the required capabilities takes time and experience and where the absence of those options when they would be of value could inflict great loss. Precisely how great that value is depends on the range of relevant contingencies, the costs

and benefits each of those contingencies involves, and the cost that developing and retaining the capabilities dealing with those contingencies requires.

There are ways of seeking to value those options and to use those valuations to guide defence decision-making. Moreover, considerable effort is currently being devoted to developing the relevant techniques and applying them to issues such as the choice of R&D programs and the selection and design of future weapons systems. This is the 'real options' approach which has received a great deal of attention in the economic literature over the course of the last decade. But for most defence applications, the 'real options' approach is still more of a useful analogy that can help structure the analysis, than a practical tool for decision-making. The extreme difficulties involved in seeking to 'monetize' benefits in a defence context make it all the more difficult to give this analogy concrete application. Given continued development, it may help better align choices with possible future needs—which would certainly be of great value—but it will fall well short of being able to tell us 'how much is enough'.

Conclusions

Planning is inherent in national security and has been an integral feature of how defence forces operate since at least the 19th century. The high and ever rising capital intensity of defence in advanced societies, the long lead times and lifetimes of key parts of the defence capital stock, the career nature of defence service and the inherent organisational unity and continuity of the defence establishment are all factors that make for a long-term perspective.

At the same time, and somewhat paradoxically, the defence environment is almost uniquely resistant to the methods

and disciplines of efficient resource allocation. There are some good reasons for this, including the formidable technical problems, discussed above, that are involved in applying cost-benefit analysis, even in the form of cost-effectiveness analysis, to defence, at least once one goes beyond the most granular types of operations research. As well as these good reasons, however, there are substantial obstacles that arise from the entrenched culture of defence, including the long tradition of thinking along service lines and of viewing resourcing issues through the prism of 'military requirements'. Unsurprisingly, defence organisations have a natural tendency to revert to service-based approaches: it is striking, for example, that the most recent revisions to the budgeting framework for Australian defence outlays have moved back to what amounts to a service-by-service approach to defining defence outputs.

Thus, as far as Australian defence budgeting is concerned, the McNamara vision of programs that span the various services and comprise 'integrated combinations of men, equipment, and installations whose effectiveness could be related to our national security objectives' has been completely abandoned. This makes it extremely difficult, if not impossible, to sensibly gauge the efficiency with which resources are being used. As Mark Thomson observes, while Defence has been subjected to periodic efficiency drives, it lacks 'any mechanism to measure, manage or reward efficiency. If Defence is somehow efficient, it is a remarkable coincidence'.⁴

Addressing these issues requires renewed attention both to the detailed lessons of PPBS and to the contribution that can be made by the techniques developed since PPBS' heyday. In particular, it is essential to recognise that the output of defence is not a stream of services as such, but rather a set of capabilities and options, whose value changes

in line with domestic and international circumstances. Learning how to properly value those options, and how to relate that value to defence resource allocation decisions, offers the best hope of at least helping defence to avoid the worst decisions. As Wildavsky noted in reviewing America's experience with PPBS, 'avoiding the worst where one can't get the best is no small accomplishment'.

Assessing expenditure in individual agencies: the case of the Australian Federal Police

Scott Hook

Introduction

Counter-terrorism policing remains the Australian Federal Police's (AFP) 'highest priority'. However, the AFP has also acknowledged that it is entering 'a critical phase of consolidating a range of specific initiatives, and looks forward to the ongoing benefits these initiatives will deliver in the future'.⁵ Despite recent efforts by the AFP and other national security agencies to more clearly define performance management indicators, however, there is little, if any, baseline criteria for measuring the success or otherwise of individual agencies operating as part of a national counter-terrorism system. Moreover, there has been limited comparative analysis of counter-terrorism strategies and policies across national boundaries.

This paper seeks to analyse the benefits that arise from particular aspects of the counter-terrorism initiatives undertaken by the AFP. Using a cost-benefit approach, focused on a single agency, the paper seeks to provide policy makers with a framework for assessing the overall functions of the AFP's counter-terrorism command.

The counter-terrorism function

Terrorism is qualitatively different from other crimes, as it is an attempt to send a political message and/or to change existing policies. In this way, counter-terrorism is a means of preventing a certain form of criminal violence that is excessively costly to the community affected by it. So can counter-terrorism be evaluated like other police work? This analysis follows the same principles used in any analysis of the cost and benefits associated with the delivery of services in other areas of police work, such as drugs, fraud or personal protection. However, the post-event nature of most policing evaluation means that the data requirements are different from the mostly pre-emptive nature of counter-terrorism policing.

The ability to deter an individual or group from a certain course of action relies on the assumption that the group is acting rationally and that those groups or individuals have transitive preferences so that they set goals and act systematically to achieve them. In this regard, a terrorist group can act rationally—even if the aim is to bring down a government or to prevent a society from exercising its democratic rights to freedom of expression or religion. Accordingly, a terrorist group will allocate their resources to maximise the impact of their political message. For example, the attacks on September 11 in the United States (World Trade Centre and Pentagon), bombings in London in 2005 (in the financial heart of London) and Madrid in 2004 (prior to a national election) all seemingly fit these models. Such groups will not engage in random acts of terror but will focus on the most effective means to advance their aims. Hence, it is important to assume that the AFP's manpower and resources (in conjunction with other agencies) are focused to maximise the impact of the protection of intended targets. This is reflected in the following list of the different tasks that were

identified in the 2006–07 Annual Report; they have been divided into domestic and international activities:

Domestic

- Joint Counter Terrorism Teams
- the Family Investigative Liaison Officer Program
- control orders
- multi-jurisdictional exercises.

International

- international counter terrorism advisors and capacity building with particular agencies in the region
- counter terrorism offshore rapid response
- providing a support role in multilateral operations in Indonesia and the Philippines
- Jakarta Centre for Law Enforcement Cooperation.

These particular activities have taken time to develop. For example, statements by the Howard government on counter-terrorism expenditures suggested that the bulk of the counter-terrorism funding in Australia since 2001 has been directed towards capacity building. Capacity building includes such things as the acquisition of new equipment, additional training for police officers, joint exercises and increased protective security at key locations, including airports. In this way, the capacity building focus of the AFP's counter-terrorism effort can be seen as a fixed cost. Once spending has been allocated and committed, the ongoing costs of maintaining readiness will be borne by the agency regardless of whether there is a terrorist attack or not.

However, across the main areas of counter-terrorism effort for the AFP, it is difficult to attribute a specific outcome to one of these eight functions. For example, the prevention of a terrorist attack against

Australian interests in Southeast Asia could be the result of a range of factors from the decision-making processes of the terrorist group itself through to the opportunity cost of choosing one target over another. Moreover, the broader strategic objective of reducing the scope and networking of terrorist organisations at the international level is unlikely to be attributable to the actions of a single agency within one country.

Lastly, we should not ignore the symbolic aspect of deterrence arising from developing counter-terrorism capabilities that is demanded by the public. This reflects public concern with terrorist outcomes rather than actual risk. For example, ASIO's own risk assessment would rank the actual threat to the Australian homeland as medium although public perceptions of this risk are much higher. The threat to Australia from domestic and international terrorism remains multifaceted and real. Australians or Australian interests overseas have been the target of a planned, conducted or aborted terrorist attack each year since 2000.

Comparing the costs and benefits of the AFP's counter-terrorism effort

The economic damage from a terrorist attack would be substantial. To assess the costs and benefits of counter-terrorism involves the application of valuation principles to current preventive actions and also to the terrorist actions themselves. However, this type of analysis presents problems for the estimation of terrorism because of the extreme uncertainty of the costs and benefits. Consequently, the following represents a simplified analysis of 'event' versus 'no event'. There is no estimate of the effect of counter-terrorism policing on risk or the effect that these policies might have in reducing the effectiveness of other AFP programs. Using a limited time period appears reasonable as the

effects are usually concentrated in the initial period and the following twelve months.

In terms of economic assessment, the value of counter-terrorism also requires an estimation of the value of deterrence and the prevention of terrorist actions. However, the outcome of a terrorist act requires substantial amounts of post-event data—much of which from the attacker's side will remain unknown and is thus often underestimated.

In seeking to judge the potential benefits of a counter-terrorism policy, the concept of a 'unit' of terrorism is easier to define. According to a RAND report, the most useful way to approach this problem is to think of 'units' of terrorism in terms of 'bombing equivalents'.⁶ Unlike places such as Israel or the UK, however, Australia does not have a history of terrorist bombings that could be used for comparative analysis. However, natural disasters provide a useful benchmark.

In some respects, a terrorist attack displays similar characteristics to extreme events such as natural disasters. In particular, it can be characterised by non-linear responses, low probabilities, high consequences and the potential that may lead to catastrophic losses. As a result, there is some utility in comparing natural disasters and their effect on Australian communities. Like terrorist events they can occur with little warning and are often unpredictable in the location of damage. Similarly, such events have short and medium term economic and social effects that require substantial efforts by emergency services, each level of government and the community to cope with the initial impact and the rebuilding phase that follows. For example, following *Cyclone Larry* that struck parts of northern Queensland in 2006 there were insured losses of around \$369 million and wider economic losses of around \$1 billion from the destruction of around 90% of the banana crop.

From evidence presented at recent terrorism trials and from our understanding of the costs associated with natural disasters, the most common 'unit' of terrorism in Australia would likely involve a conventional chemically-based explosive against an iconic building, a defence establishment, a diplomatic post or transport infrastructure. Assuming that the event was of a similar scale to the July 2005 suicide bombings in London, the damage from such an attack would be approximately fifty dead and 500 injured. Employing the Bureau of Infrastructure, Transport and Regional Economics' human capital methodology for measuring the cost of a human fatality at \$1.9 million, the direct costs in terms of loss of life from this type of attack would be around \$95 million. The costs of a serious injury would be approximately \$400,000 and a minor injury \$16,000 per person. In terms of human life alone, therefore, the total cost of a terrorist attack of this type would be approximately \$140 million.

Measuring physical damage is more difficult given the unpredictable consequences of an attack. Previous studies have used a property damage estimate of approximately 25–30% of the total cost of human life. On this basis, a conventional terrorist attack on Australian soil would cost an additional \$35 million to \$70 million. The accuracy of this estimate would depend on a number of unpredictable factors including the timing and location of the attack, the 'class' of infrastructure (building, train, aircraft) and any mitigating circumstances such as physical protection or the 'hardening' of the target. Property damage per se does not appear to be a primary consideration of terrorist groups when planning an attack. Certain targets clearly have a higher symbolic 'value' than others. However, counter-terrorism efforts designed to protect iconic targets, such as the Sydney Opera House, could shift the focus of terrorist groups away from particular classes of targets towards less protected sites such

as public transport. This paper uses a figure of \$70 million.

Furthermore, there is an estimate of the post-event response, investigation, and immediate assistance resulting from a terrorist attack. In particular, this would include the response by emergency services to the incident, clean-up, the cost of measures to cope with the destruction of a piece of public infrastructure, victim support services, the initial investigation efforts by police and fire services and body and bomb identification and the associated public inquiry, and court costs and any immediate additional security and defence expenditures that would accompany an attack in Australia. The total cost of these efforts is estimated to be around \$50 million. This would be followed by another \$50 million in the following year reflecting the increase in police and associated security. These estimates are based on the experience from the 2002 Bali bombing and the response that occurred in Australia post the September 11 attacks that saw enhancements to Australia's national security.

Finally, the assessment must include some estimate of the effects on the Australian economy as a whole. According to one estimate by the International Monetary Fund, the September 2001 terrorist attacks on the United States cost the US economy up to US\$75 billion (or 0.7%) in lost GDP in that year alone. Others suggest that associated business costs, including added security for the airline industry and loss of tourism revenue, cost the US economy a further US\$160 billion over three years. Studies conducted on areas of endemic terrorist activity, such as Israel, suggest that an ongoing campaign of terrorist violence can reduce GDP growth by around 1% per year.

The consequences of a single terrorist attack on Australian soil are likely to have significant one-off costs for the economy. The tourism

sector alone contributes around 3.7% of GDP to the Australian economy or \$38 billion per annum and employs around 5.2% of the total workforce. Any major disruption to the tourism sector through a campaign of terrorist violence or a direct attack on the industry through the targeting of tourist centres such as Sydney harbour would have grave consequences for the broader economy.

Although the adverse economic consequences of a terrorist attack are unlikely to match the Israeli-type condition of 1% of GDP per annum, the economic costs would include significant disruption and a loss of confidence in the economy. For the purposes of this study, a 'one-off' economic cost of around \$1.05 billion or 0.001% of GDP is considered a useful means of measuring a 'unit' of terrorism. In sum, the death, injuries and economic losses from a single terrorist event are therefore calculated to be over \$1.2 billion before being adjusted in real terms. This estimate is likely to be an underestimate as ABARE (2006) estimated that the losses that would occur from an outbreak of Avian Influenza would see a short-term reduction in Australia's GDP by nearly 7%. Likewise work by the RAND Corporation estimated that losses to GDP from a moderate terrorist incident in the United States would be around 0.005% of GDP.

Table 1 sets out the various expenditures that are associated with the AFP's counter-terrorism effort based on data provided by the AFP. The information provided reflects a broad range of work which includes the Joint Counter Terrorism Teams, enhancements to the Rapid Deployment capability, international efforts to build capacity in the region, developing technology and the implementation of control orders. These are listed as positive values as they are producing community benefits. The analysis assumes a terrorist attack occurring in 2006–07. During that year the immediate

Table 1: Comparing ‘Units’ (\$million)

Period	-4	-3	-2	-1	0	1
	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
Real Value of AFP Expenditure	43.4	59.5	86.2	77.9	54.7	56.3
CT Event						
• Human cost					-140.0	
• Capital cost					-70.0	
Post Event Response and Investigation					-50.0	-50.0
Economic Losses to Business						-1046.0
Real Value of a Terrorist incident and the Response		0	0	0	-260.0	-1034.0
Net real Value	43.4	59.5	86.2	77.9	-205.3	-977.6

Note a discount rate of 0.06% is assumed.

costs include human deaths and injuries and property damages and the initial post-event response. Finally, the estimates go out one year and include the macroeconomic losses arising from the attack for the first twelve months and ongoing investigation, security and legal costs.

The net cost of a terrorist event on Australian soil in 2006–07 dollars would be over \$1 billion. This compares with the net cost of providing the AFP’s counter-terrorism protection of \$378.1 million in 2006–07 dollars. This naturally excludes the range of other expenditures that are undertaken by a variety of other agencies that work on counter-terrorism. Even if we are assuming that the AFP contributes about one-third of the national effort in deterring a terrorist incident there appears to be a community benefit from the AFP’s efforts. If there was a series of terrorist events, or the event itself was of much larger scale, then the losses arising from domestic terrorism would be much higher.

It should be noted that there are many other costs that are not covered in this analysis. In particular, the emotional impact on victims and their families is not included. Nor are such things as the medical recovery for victims that survive an attack. Similarly, neither are the

losses in productivity and efficiency that may occur if more stringent security measures are implemented on public transport. This would only increase the size of the costs associated with an attack.

The task is further complicated by issues of attribution and causality. The precise reasons why a terrorist attack has not been successful on Australian soil in recent years can be attributed to a variety of factors. Among these are the early intervention and disruption strategies employed by intelligence and police agencies. These include intelligence assessments as well as the preventive policing work carried out by the AFP both in Australia and in regional countries such as Indonesia and the Philippines where known terrorist groups operate. In several cases, it was the ability of ASIO and AFP to operate effectively together that has prevented domestic attacks and led to successful prosecutions.

Conclusion

This study has considered only one scenario—the costs associated with a conventional terrorist attack on a major metropolitan centre. Although this is the most likely scenario in terms of potential terrorist threats to Australia, further investigation is needed on costs associated with more severe forms of

terrorist attack, including multiple bombings across several cities, or an unconventional attack using chemical, biological, radiological or nuclear weapons.

From this analysis of the costs and benefits associated with counter-terrorism policing, Australia does not appear to be spending too much on counter-terrorism in comparison with similar jurisdictions overseas such as the UK. Indeed, for the AFP, the development of a counter-terrorism function has been largely a fixed-cost, with the investment in personnel, capital and equipment now in place. But having established a stronger counter-terrorism policing capability in Australia, the analysis also suggests that maintaining AFP funding at current levels may be sufficient and that any further investment would need to be justified in terms of the additional benefits that would accrue to national security.

Risk-informed decision support for counter-terrorism measures: the Air Security Officer Program

Mark G Stewart

Introduction

Although there is often a degree of certainty about counter-terrorism expenditure, there is considerable uncertainty about the benefits or rewards of such spending—the threat may never materialise (or evolve over time), consequences may depend on time of day of the attack, and so on. These uncertainties can be quantified by statistical and probabilistic methods and it is quantifying the ‘benefit’ side of the equation that is the focus of this paper.

Risk-informed approaches to cost-benefit analysis that consider economic and life-safety criteria for counter-terrorism

measures have been developed for buildings, bridges and other built infrastructure. In these, cost-effectiveness is contingent on the likelihood, cost, and effectiveness of the security measure and the consequence of a terrorist attack on such infrastructure. This approach has been used recently in the analysis of increased expenditure on Australian and US air marshal programs and the hardening of cockpit doors.⁷ These studies have found that the annual cost per life saved from air marshal programs is in excess of the regulatory safety goal of \$1–\$10 million per life saved and so would seem to fail a simple cost-benefit analysis. In contrast, the hardening of cockpit doors has a significantly lower annual cost per life saved, suggesting that this strategy is a more cost-effective security measure. Detailed analyses of individual security measures such as these are potentially instructive, enabling a meaningful assessment of the merits of each security measure in a rational, consistent and transparent manner.

A cost-benefit analysis is a robust indicator of societal risk acceptability as it considers costs and benefits in a logical way. However, past experience shows that it is likely that decisions may be made or over-ruled on political, social, cultural, economic, security or other non-quantifiable grounds. For example, some risks may be deemed unacceptable under any conditions based on their symbolic value to society. Nonetheless, a cost-benefit analysis is a useful metric for assessing trade-offs, which can provide a starting point for further discussion and perhaps more detailed analysis of how to manage the often conflicting societal preferences associated with assessments of risk, cost and benefits.

Many uncertainties exist in quantifying risks, particularly for threats such as terrorism where data is scarce or non-existent and where the threat is highly transient. Cost-benefit outcomes will be most sensitive to

threat probability and risk reduction arising from security measures. Some statistical approaches exist for terrorist threat prediction, however, as these rely heavily on expert judgments from security and other experts the inherent uncertainties can still be high. Therefore, we need to rely on judgements and scenario analyses to quantify threat scenarios, risk reductions and damage consequences. Hence, it is essential that any cost-benefit analysis be subject to a sensitivity analysis.

Cost-benefit assessments

A cost-benefit decision may be based on activities that maximise expected monetary benefits, expected utility or other decision preferences. A suitable approach is to compare the extra costs of counter-terrorism measures with the extra benefits in terms of fatalities and damages averted as a result of these measures. The net benefit is the benefits minus the costs. A counter-terrorism measure is viewed as cost-effective if the net benefit exceeds zero.

The benefits will depend on the quantification of:

- threat probability
 - how likely is it that the threat will actually happen?
- consequences
 - how many fatalities? what will be the physical damages, loss of business confidence, etc. as a result of a terrorist attack?
- risk reduction
 - how will a CT measure reduce the chance of terrorist attack or reduce its consequences?

The Appendix provides a mathematical framework for this type of cost-benefit assessment. Consider a simple example where the threat probability is 0.1 (1 in 10 chance

per year of terrorist attack), risk reduction of the measure is 50%, and consequences of a terrorist attack is \$10 billion. The expected benefit of the CT measure is \$500 million per year. If the annual cost of the measure is less than \$500 million per year then it is cost-effective.

If the consequences differ considerably (such as fatalities versus loss of business confidence), and maximising life-safety is seen as an essential goal, then cost-effectiveness may alternatively be expressed as cost per life saved—i.e., the cost spent on counter-terrorism measures divided by the expected lives saved as a result of this expenditure.

Value of life, risk aversion and other issues

One of the most contentious issues associated with cost-benefit analyses is how to place a monetary value on human life, often referred to as the value of a statistical life (VSL). Appropriate methods and valuations of VSL are described and discussed in great detail in the literature. Australian dam safety regulators adopt a figure of \$5 million per life saved and the Roads and Traffic Authority of NSW uses a value of \$1.6 million. For most activities a VSL not exceeding \$1–\$10 million provides a reasonably accurate reflection of societal considerations of risk acceptability and willingness to pay to save a life.

Society tends to spend more money per life saved for efforts to prevent death from ‘dread’ type risks such as exposure to asbestos than for some efforts to prevent death from more mundane activities such as driving a motor vehicle. This is often a function of psychological and political aspects of risk perception. Although many individuals may be risk averse, governments need to be risk neutral in order to achieve the best outcomes for society as a whole. The reason for being

risk averse is that the events involving high consequences often are associated with ‘follow-on’ events which themselves may contribute significantly to the risk. The follow-on consequences for a terrorist attack may include a significant loss of consumer confidence leading to declining sales figures, expensive investigations by the authorities, reduced tourism investments, reduced government revenue, etc. All such ‘follow-on’ consequences should be included in the estimation of failure costs which will lead to a ‘risk neutral’ analysis. Nevertheless, if the decision-maker does wish to explicitly factor risk aversion into the decision process then utility theory is a well proven technique used in many applications.

There are also many issues related to assessing economic and financial aspects of costs and benefits. This includes the time horizon, annualising and discounting future costs and benefits to present values and ongoing economic effects of private and public expenditure. The total economic cost of security measures may be at least twice the direct public expenditure because government must obtain these resources through the tax system which imposes indirect costs upon the economy. This may also be defined as the marginal excess burden of a tax (deadweight loss), which for general taxation in Australia is approximately 25%. It is also appropriate to include the effects of excess tax burden in a sensitivity analysis.

There are many more issues associated with cost-benefit analyses, issues which cannot all be covered in this paper. The field of cost-benefit analysis is one that encompasses technical (economics, finance, probability, and reliability), social, political, psychological, cultural and other multidisciplinary fields. The influence of all these fields on decision-makers is well described in the literature.

The Air Security Officer Program

To illustrate the application of a cost-benefit assessment we can consider a simple case study where we assume a measure designed for a single threat scenario: the Air Security Officer (ASO) Program designed to prevent an aircraft hijacking that could lead to a 9/11-type attack on buildings and infrastructure.

The cost of the ASO program to the Australian Government and airlines is approximately \$55 million per year. Among terrorist groups, al-Qaeda is the only one that actually advocates attacking the United States itself, and the ten year period between 1992–2001 was the period of a heightened threat from al-Qaeda prior to the 9/11 event. If we consider this to be a suitable time period for the estimation of fatality rates then we will assume that, in the absence of enhanced security measures, there would be a 9/11 replication every ten years in the United States—hence threat probability is 0.1 per year.

Conceivably, Australia could experience a similar attack every ten years just as devastating as 9/11 itself. However, this is only a possibility, as the likelihood and motivation for such an attack also needs to be considered. The number of fatalities from the 9/11 attacks was 2,998, which for this study is rounded up to 3,000—i.e. the fatalities before any enhanced counter-terrorism measures is 3,000. The value of a human life is assumed herein as \$3 million. Estimates suggest that the direct physical damage (loss of aircraft and building damages) and clean-up costs caused by the 9/11 attacks amounted to approximately \$25 billion.

The reduction in the risk of a 9/11-type event due to the ASO program needs further quantification—this is a crucial aspect of a cost-benefit assessment. Previous studies have identified a range of measures implemented since 9/11 that include extra

and more vigilant intelligence, immigration and passport control, airport screening, and other pre-boarding security measures; crew and passenger resistance; air marshals; and hardened cockpit doors.

If an air marshal is on an aircraft then the risk reduction may be significant. However, the probability of air marshals being on a flight is around 10% and so the risk reduction of the ASO program is reduced significantly.

There are obviously many possible combinations of risk reductions dependent on the relative effectiveness of each counter-terrorism measure. For example, consider the case where it is predicted that: (i) the probability of a hardened cockpit door in foiling a 9/11-type hijacking is 0.5, (ii) the probability of pre-boarding security in foiling a 9/11-type hijacking is 0.5, (iii) the probability of crew and passenger resistance in foiling a 9/11-type hijacking is 0.5 and (iv) the probability of air marshals foiling a 9/11-type hijacking is 0.5. If this is viewed as a series of measures where each event probability is statistically independent then the probability of foiling the hijacking is around 93%.

However, we will focus on the minimum threat probability and risk reduction needed

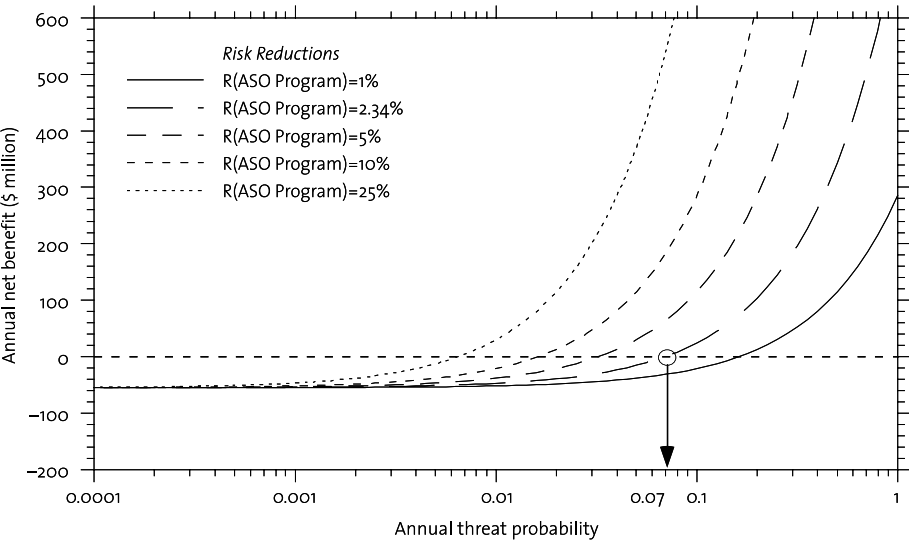
for the ASO program to be cost-effective. The actual threat is a matter for the security and intelligence services to predict, whereas the extent of risk reduction is based on expert judgment (or experience) or from detailed reliability analysis.

The cost-benefit analysis parameters for the ASO program are:

- cost of ASO Program = \$55 million per year
- fatalities before enhanced CT measure is 3,000
- value of human life = \$3 million
- direct physical damage = \$25 billion.

Using the calculations described in the Appendix, Figure 1 shows a plot of annual net benefit as a function of percentage risk reduction of the ASO program and the annual threat/attack probability. There are many scenarios in which net benefit for the ASO program is less than \$0 and therefore not cost-effective. Figure 1 shows that for the annual net benefit to exceed zero the annual threat probability must exceed 0.07 which is similar to the annual threat probability for the United States. Figure 1 also shows that if the annual threat probability is higher than 0.01 and risk reduction is high then the ASO program may be shown

Figure 1: Annual net benefit for ASO Program



to satisfy a cost-benefit assessment. The advantage of plots like this is that it allows the decision-maker to see where on the curve they believe they will be, and how sensitive is their decision to changes in risk reduction, threat probability, and fatality and cost estimates.

Conclusion

A cost-benefit assessment needs to consider a range of variables in the analysis of threat and

risk avoidance. The example here shows under what combination of risk reduction, threat probability, and fatality and damage costs the Australian Air Security Officer Program would be cost-effective. Detailed cost-benefit and risk assessments of aviation security and other measures may well reveal other inefficiencies and suggest where resources may be better allocated to maximise public safety.

APPENDIX: Calculation of net benefit

The net benefit E_b is:

$$E_b = \underbrace{C_B + p_{\text{threat}} \frac{R}{100} C_F}_{\text{benefits}} - \underbrace{C_R}_{\text{costs}} \quad (1)$$

where C_B is the benefit from the policy measure not directly related to mitigating terrorist threats (e.g., reduction in criminal behaviour), C_R is the extra cost of measures, p_{threat} is the annual threat probability, C_F is the consequences of the occurrence of the threat assuming no CT measures, and R is the percentage reduction in risk due to CT measures. Note that p_{threat} represents the threat probability assuming no protective measures. All consequences need to be given in the same units, which are usually monetary.

The percentage risk reduction (R) represents the extra benefits in terms of fatalities and damages averted which may arise from a reduced threat probability and/or extent of consequences. For any CT measure the percentage risk reduction R can vary from 0% to 100%. If a combination of CT measures will foil every threat then the sum of risk reductions from these CT measures is 100%.

The net benefit for the ASO program is:

$$\begin{aligned} E_b &= p_{\text{threat}} \underbrace{\frac{R(\text{ASO program})}{100} (C_{F1} + C_{F2})}_{\text{benefits}} - \underbrace{C_R}_{\text{costs}} \\ &= \frac{p_{\text{threat}} R(\text{ASO program})}{100} \{ [\text{fatalities before enhanced CT measures} \times C_{\text{life}}] + C_{F2} \} - C_R \end{aligned} \quad (3)$$

where p_{threat} is the annual probability of a 9/11-type attack, $R(\text{ASO program})$ is the percentage risk reduction due to the ASO program, C_{F1} is the cost due to loss of life, C_{F2} is the cost of direct physical damage and C_{life} is the value of a single life (VSL). Clearly, this is an oversimplification of what is a complex decision problem. The cost-benefit analysis parameters for the ASO program are:

- C_R = \$55 million per year
- Fatalities before enhanced CT measure is 3,000
- C_{life} = \$3 million
- C_{F2} = \$25 billion

Endnotes

- 1 Athol Yates 2008, '2008–09 Federal budget briefing on homeland security expenditure', Australian Homeland Security Research Centre. This paper focuses on Commonwealth government spending. It does not analyse the significant investment in counter-terrorism measures by state and territory governments or the private sector. Nor does the paper seek to make judgements about the balance between national and state expenditures.
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Henry Ergas spent a decade as an economist at the OECD in the 1980's, focusing on the analysis of issues affecting efficient resource allocation. At the OECD, he headed the Secretary-General's Task Force on Structural Adjustment, which concentrated on improving the efficiency of government policies in a wide range of areas. Since leaving the OECD, Henry's work has focused on competition policy and regulatory economics. He chaired the Intellectual Property and Competition Policy Review Committee for the Australian Government in 1999–2000, and was a member of the Prime Minister's Export Infrastructure Task Force in 2005 and of the Defence Industry Consultative Group in 2006. Henry was the founder and Managing Director of the Network Economics Consulting Group (NECG) Pty Ltd, which became part of CRA in November 2004. He is currently the Chairman of Concept Economics, an economics consultancy firm with offices in Canberra and Sydney. He is also an Honorary Professor in the Faculty of Economics at Monash University in Melbourne, and a Lay Member of the New Zealand High Court.

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