STRATEGIC INSIGHTS

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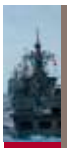

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Strategic choices:
Defending Australia in the 21st century

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AUSTRALIAN STRATEGIC POLICY INSTITUTE

Mark Thomson and Andrew Davies

At the time of writing, the next Defence White Paper is taking shape. When it is released, the government will set out its thoughts on the strategic circumstances that Australia is likely to face in the future and what our defence posture within that environment will be. But that is just the narrative. If Sir Arthur Tange was right, and talking policy means talking resources, then just as important will be the decisions concerning the funding to develop and sustain the future force structure of the Australian Defence Force (ADF).

The strategic narrative and the development of the future defence budget are complementary activities. At various times in Australia's history, the nation's strategic circumstances have demanded a large investment in defence. At other times 'peace dividends' have been redirected to other components of government expenditure.

ANZAC frigate HMAS *Parramatta* on the 'gun line' behind other ships participating in gunnery practice firing at the exercise RIMPAC 04. An expansion of Australia's naval capability has been discussed in the context of the new Defence White Paper. One such option is detailed in this paper (p20). Photo courtesy Australian Department of Defence

Consequently, resource decisions in the White Paper will say at least as much as the narrative regarding the regional security framework of the future and about the role that Australia sees for itself. It is not enough to posit a strategic narrative and an associated force structure without a discussion of the resource implications. To be sure, it is hard to provide realistic costs for hypothetical force structures—and sometimes convenient not to. Discovering that the proposed structure was not affordable would deflate even the loftiest ambition. But it is important to try; strategy and resources must be matched.

... with what many are calling 'the Asian century' now underway, now is the time to take a fundamental look at the strategic choices Australia faces.

This ASPI *Strategic Insight* contains two papers that, between them, look critically at Australia's ability to fund defence into the future and the costs of various options for future ADF force structures. The first paper, by Mark Thomson, discusses Australia's capacity to pay for defence into the future. This is not an idle question. Recent Treasury forecasts have suggested that the defence budget will come under significant pressure as demographic and economic trends play out over the next few decades. Bearing in mind that some of the decisions taken in the White Paper will affect the ADF out to the middle of the century, it is important to understand the context in which defence budgets will be raised.

The second paper, by Andrew Davies, explores the force structures that are possible at different levels of expenditure. Not surprisingly, there is a strong link between the scale of strategic military ambitions and the price tags for the force structures needed to implement them. Four options are described and costed. At the high end of the spectrum is a force structure that would turn Australia into a 'muscular regional power'. At the other end is a drawn-down ADF which is less well-equipped than presently for high-end combat operations, but which is adequate for peacekeeping, stabilisation and disaster relief operations. The difference between those two options is significant—more than 1% of the nation's GDP, or over $10 billion per year. Such a wide spread may seem fanciful given that the broad size and shape of the ADF has been relatively stable over the past forty years. But with what many are calling 'the Asian century' now underway, now is the time to take a fundamental look at the strategic choices Australia faces.

The proposed acquisition of the F-35 Lightning II (Joint Strike Fighter) is an impending multi-billion dollar decision that potentially determines the RAAF's frontline air combat capability for decades to come. The current plan is for an acquisition of up to one hundred. A more 'muscular' ADF force structure could include more of these fifth generation aircraft (see p22). Photo courtesy Lockheed Martin

Australia's capacity for national defence to 2050

Mark Thomson

A country's defence depends on a myriad of factors, including the effectiveness of its alliances, the adroitness of its diplomacy, the wisdom of its leaders, and the unity of its people. As interesting as it would be to speculate on how these intangible factors will manifest in Australia decades hence, our goal here is both more modest and more concrete; to estimate Australia's absolute and relative capacity to generate military capability out to the middle of the 21st century.

We begin with the question of absolute capacity, with a particular focus on the impact of changing demographics. The simple fact is that Australia is ageing. Today there are around 5.2 working age Australians for every person aged 65 or over; on current projections the ratio will fall to less than 2.4 by mid-century. Aside from the social impact of this demographic shift, there are economic and fiscal consequences to be reckoned. At first glance the results are less than encouraging; Treasury modelling predicts progressively slower economic growth in the decades ahead accompanied by steadily rising health and aged care costs.

There are two essential questions. First, will slower economic growth and rising age-related spending make national defence unaffordable? Second, will Australia's ageing population provide enough young people to sustain the defence force? We conclude that our national defence will remain both affordable and sustainable, provided, that is, we do not have to increase the size of the force far in excess of what we have today.

To round out our analysis, we survey the economic prospects of our neighbours to see whether our capacity for defence is likely to be outstripped by those around us. Or to put it another way, we check to see if Australia might indeed need a larger defence force than it has today. Here things are less encouraging. Not only is our economic capacity likely to erode relative to the countries of Southeast Asia, but the already appreciable economic margins enjoyed by China and India are set to grow substantially. Assuming our neighbours follow the long-established international trend of increasing their defence spending in line with economic growth, our relative military capability will decline in the absence of action on our part.

Thus our conclusion is mixed. On the one hand, it looks certain that we can maintain a defence force of the scale and sophistication we have today, or even somewhat larger, despite an ageing population. On the other, as the economic growth of our neighbours outstrips ours in the decades ahead, our relative strategic weight will atrophy, all other things being equal. Whether we can afford to make up the growing difference by simply spending more is hard to say—it might work for a while. But that should not be our first recourse. Instead, we need to make sure that we get maximal returns on the money going to defence now and in the future. Given the growing list of failed projects and undeployable assets, there is more than ample room for improvement.

Economic prospects

Because our capacity for national defence depends on our economic capacity, we begin by surveying Australia's economic prospects to mid-century.

Treasury's *2007 Intergenerational Report* (IGR) estimated Australia's economic trajectory out to the year 2047 using the deceptively simple model:

Gross Domestic Product (GDP) = Population x Workforce Participation x Productivity

The logic behind the model is straightforward; it multiples the number of people working in the economy (population times participation) by the average amount produced per worker (productivity). A good deal of effort is devoted in the IGR to estimating how population, participation and productivity will evolve so that the annual rate of economic growth can be projected out to 2047. The baseline prediction is that economic growth will slow from 3% this decade to 2% in the 2040s due mostly to progressively slower workforce growth.

Because many of the parameters used in the modelling are far from certain, the IGR explores the sensitivity of the results to credible variations therein. As it turns out, the most acute uncertainty arises for labour productivity. Not only has productivity exhibited significant variations historically but the variations are not properly understood even in retrospect. Table 1 shows the significant decade-by-decade variation over the past half century; even larger variations routinely occur on a year-to-year basis.

In the face of this uncertainty, the IGR assumes that labour productivity will average 1.75% out to mid-century, with a credible lower bound of 1.2% and upper bound of 2%. Figure 1 shows the projected size of the Australian economy for these three values assuming that all other parameters (fertility, immigration, workforce participation etc) are as per the IGR baseline estimate. Because the uncertainty of these other parameters is much less than that of labour productivity, the resulting spread covers most of the range of economic futures projected by the Treasury model.

In percentage terms, the Australian economy is estimated to grow between 103% (low productivity) to 182% (high productivity) between now and 2050. The baseline IGR prediction is 155%. Even when viewed on a per capita basis, Treasury's projections are encouraging. By mid-century per capita GDP is projected to grow to between $88,100 and $122,400 compared with only $57,700 per year in 2007 (all figures in today's dollars). Thus, despite the burden of an ageing population, the first half of the 21st century will see Australia grow richer and its citizens more prosperous.

The capacity for national defence

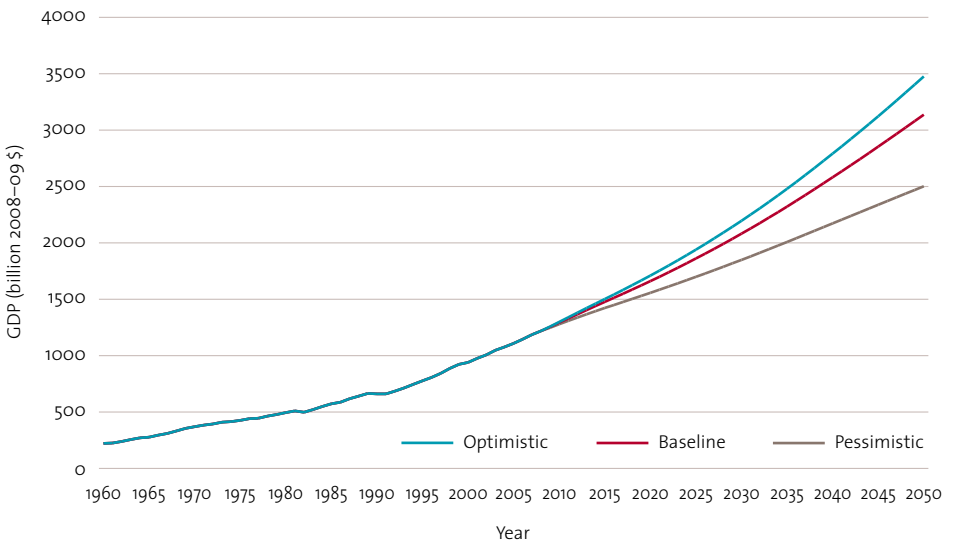
The capacity to generate military capability depends on the availability of just four factors; personnel, technology, money and enterprise. The last factor refers to the ability to bring together the preceding to create effective capability and includes both military art and corporate acumen. To gauge Australia's capacity to meet the future demand for these four factors, we use the current defence force as a benchmark. Irrespective of whether Australia's present defence effort is or will remain adequate, it is a tangible and convenient scale upon which to base our examination.

Table 1: Historical labour productivity growth

	1960s	1970s	1980s	1990s	2000s
Labour productivity growth	2.9%	2%	1.2%	2.1%	1.5%

Source: 2007 Intergenerational Report, Australian Government Treasury

Figure 1: Historical and projected GDP for Australia to 2050



Source: ASPI analysis of data from Treasury's 2007 Intergenerational Report

Personnel

Although Australia's population will age significantly in the years ahead, the absolute number of people in the recruiting cohort of 18 to 26 will remain to be similar to or better than today thanks to overall growth of the population. Figure 2 displays the results for the three projections produced by the Australian Bureau of Statistics (ABS). Even for the most pessimistic projection, the annual intake of 6,000 people into the permanent force is a drop in the ocean compared with the more than 2,500,000 people available. With so many potential recruits available, there will be no demographic reason why the defence force cannot be maintained at its present size or expanded if necessary.

It is sometimes argued that, irrespective of the absolute size of the workforce, structural labour shortages will emerge in the years ahead because the workforce will not grow fast enough to meet the demands of the economy. While it is true that the rate of workforce growth is slowing, such fears are misplaced. At any point in time it is possible for the economy to 'overheat' and run up against labour capacity constraints—such is the economic cycle. But as we have seen recently here in Australia, when this occurs fiscal and monetary policies are adjusted to slow the economy and bring the supply and demand of labour back into equilibrium. In the long run, the imperative to contain inflation means that economic growth is limited by the supply of labour.

Recent experience shows, however, that a large pool of potential recruits does not guarantee success. From 2004 to 2006 the size of the permanent force fell despite plans for growth. In part, this reflected the tightening of the labour market over the period. More important was that ADF recruiting had failed to adapt to changing times. Once steps were taken to boost advertising, cut waiting times for applicants and provide more flexible options for ADF service (including the gap-year program), defence force numbers bounced back in 2007 and 2008 even as the labour market continued to tighten. While some skill

categories are still in short supply—as elsewhere in the economy—encouraging progress has been made over the past few years. This proves that, with the right approach, military service is marketable in 21st century Australia.

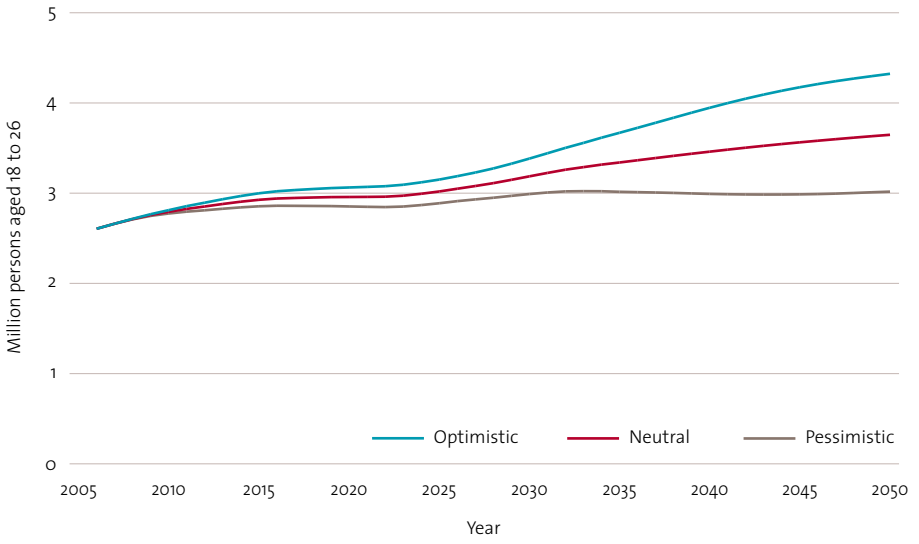
In the longer-term, the principal threat to sustaining adequate numbers in the defence force is economic not demographic. As growing prosperity expands the employment options available to potential recruits and serving members alike, the defence force will have to work hard to maintain an attractive employment offer.

Technology

Australia is poorly placed to develop military technology. Not only is our defence budget too small to support anything other than limited developments in niche areas, but our national level of technological innovation is dismal. Australia ranks 17th in the OECD in triadic patents on a per capita basis and accounted for just 414 of the 52,864 patents filed worldwide in 2005 (triadic patents are patents held simultaneously in the United States, European Union and Japan). It is fortunate therefore that as a close ally of the United States, Australia enjoys privileged access to US technology and the fruits of that technology in the form of intelligence. Following our support of the United States in Afghanistan and Iraq (especially the latter given the ambivalent position adopted by many European allies) our cache of alliance credit is high. While there is no guarantee that this will remain the case indefinitely, there is certainly no reason to predict a weakening of the alliance or its benefits on the timescale we are considering.

Even with good access to foreign technology, Australia still needs the domestic capacity to maintain, repair, modify, upgrade and integrate foreign defence equipment. In this regard, present and future capacity should prove adequate provided goals are kept realistic. The string of long-delayed and failed defence projects and deficiencies in fielded capability attests to the cost and risk of doing otherwise.

Figure 2: ABS projections for number of 18 to 26 year old persons 2000–2050



Source: ABS Population Projections, Australia, 2006 to 2101, Series 3222.0

Money

The projected growth in per capita and total GDP bodes well for the affordability of Australia's defence provided that; (1) the cost of delivering military capability does not rise too quickly, and (2) other demands on national output can be contained to manageable levels.

The potential cost of continuing to deliver military capability on the scale and range of today's ADF has previously been the subject of studies by ASPI and Treasury. In each case the broad categories of defence spending—personnel, equipment and operating costs—were extrapolated forward using historical trends. The specific parameters assumed in the ASPI study appear in Table 2. For a discussion of the rationale for specific rates see the relevant ASPI and Treasury reports listed at the end of this paper. (Treasury are slightly more optimistic about constraining the growth of personnel costs.) While this sort of approach lacks the precision needed for budget planning, it suffices for exploring long-term affordability.

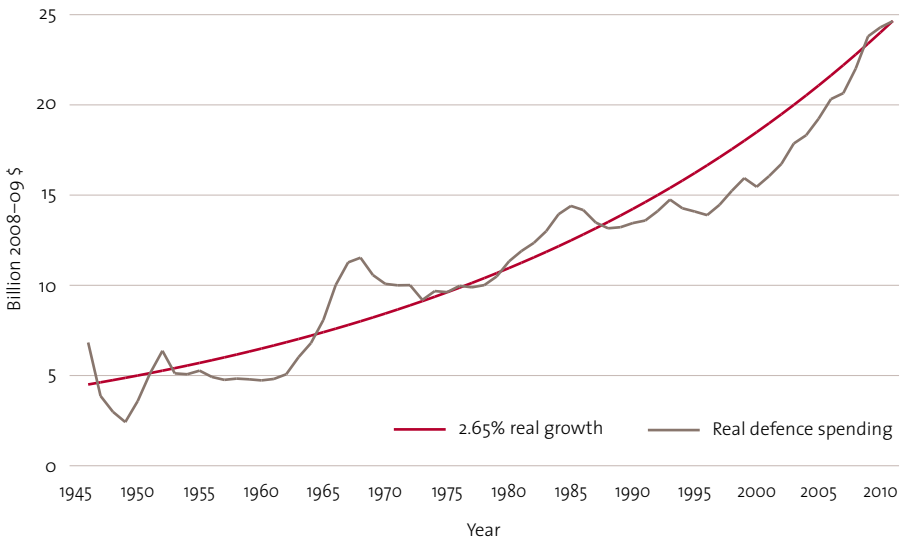
To a close approximation, projecting the various components of the defence budget by rates like those in Table 2 is equivalent to inflating the overall budget by a constant factor. The original ASPI analysis yielded 2.65% which, as shown in Figure 3, is close to the historical long-term trend post-WWII.

This sort of projection cannot claim to accurately predict the future given the simplicity of the approach and the complexity of defence spending. It is at best indicative of the likely cost of maintaining a force of the sort we have today. One thing we do know

Table 2: Indicative long-term trends in the per annum growth of the cost of defence

	Military equipment acquisition	Military equipment sustainment	Personnel costs	General operating costs
Real growth rate	4%	3%	2.0%	0%

Figure 3: Australian defence spending 1946–2010



Source: ASPI analysis of data from Defence Annual Reports and Budget Papers

for sure is that 3% real growth represents a firm upper bound on the cost of maintaining the present force; over the past eight years a steady, albeit moderate, expansion of the force has been achieved given that level of growth.

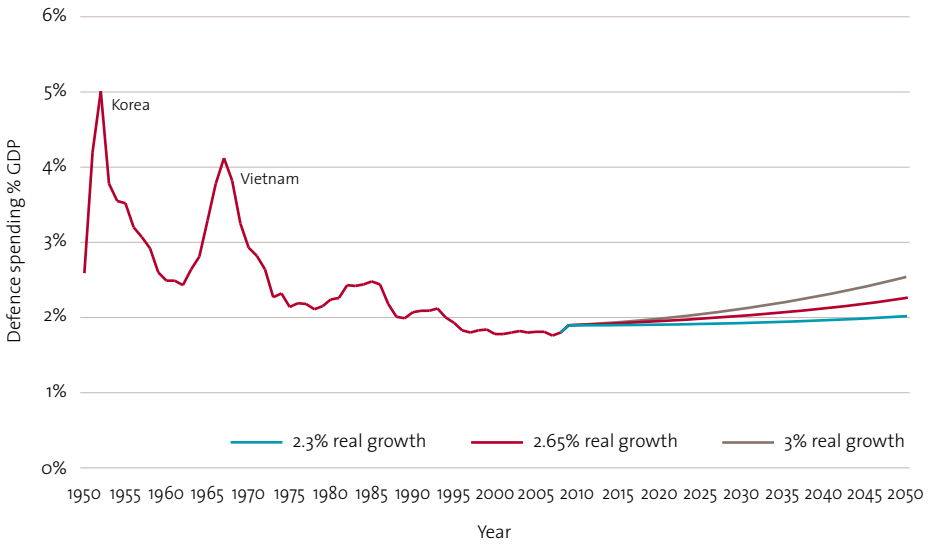
Figure 4 plots the share of GDP consumed by defence assuming that spending increases at 3% real a year until 2017–18 (consistent with government policy) and 2.3%, 2.65% or 3% thereafter and assuming the baseline projection of economic growth from the IGR. The lower bound of 2.3% has been chosen for no other reason than symmetry.

It's possible to take the analysis a step further and examine the defence share of GDP in 2050, not just for different rates of intrinsic defence cost growth but also across the range of possible economic trajectories. The results are set out in Table 3.

Because, in every case, the projected rate of growth in defence costs is roughly commensurate with the rate of growth in GDP out to 2050, the share of GDP needed remains in the range of 1.8% to 3.2% of GDP. This is hardly alarming by historical or international standards. Defence spending rose to 4.0% in Australia during the late 1960s, and the United States and United Kingdom today devote to defence 4.5% and 2.5% of GDP respectively.

Having established that the rising cost of maintaining our present defence effort is not, in and of itself, going to break the bank,

Figure 4: Historical and projected defence share of GDP 1950–2050



Source: ASPI analysis and data from Defence Annual Reports and Budget Papers

Table 3: Defence as a share of GDP in 2050

		Economic productivity		
		Low	**Baseline**	**High**
Defence spending growth	2.3%	2.52%	2.01%	1.81%
	2.65%	2.82%	2.24%	2.03%
	3.0%	3.15%	2.51%	2.27%

Source: ASPI analysis of data from Treasury's 2007 Intergenerational Report

we turn now to examine other emerging pressures on the government's finances.

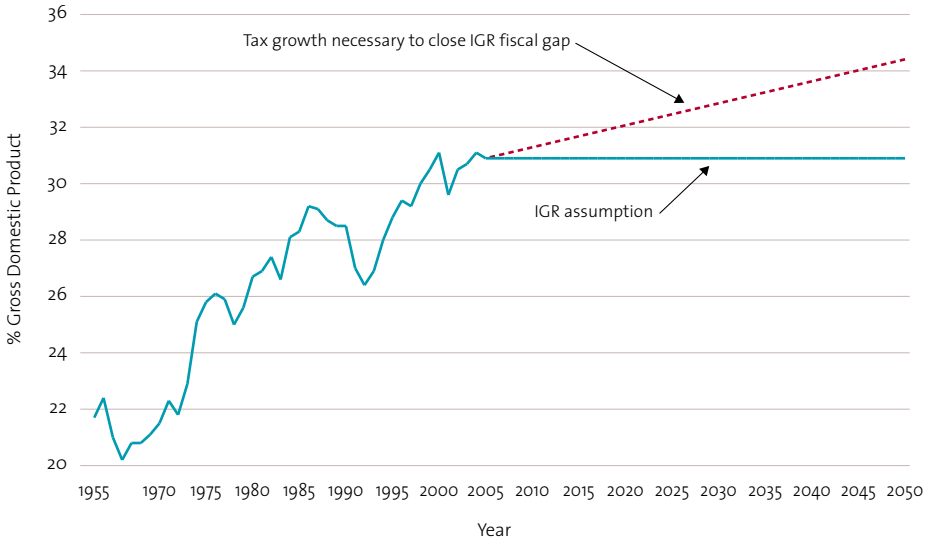
The 2007 IGR carefully examined the fiscal impact of rising age-related spending in the decades ahead. On the assumption that tax revenues remain at 2007 levels, the IGR projected that the Australian Government's average fiscal situation would shift from surplus to deficit in 2022 and then grow steadily to around 3.5% of GDP by mid-century. At first glance, this would seem to imply that a fiscal crunch is approaching and that drastic measures need to be taken to prevent the Commonwealth slipping ever deeper into debt. Indeed, this was the argument arrayed in the 2003 IGR to justify, among other things, 'containing growth' in the Pharmaceutical Benefits Scheme. Such arguments do not stand up under close examination.

To start with, the projected fiscal crisis is based on federal taxation remaining fixed as a proportion of GDP at close to its present level. Yet, as Figure 5 shows, the long-term trend has been for total tax revenue across all levels of Australian government to grow—as has been the case in most other OECD countries in the postwar period.

The pattern is clear; as our prosperity has grown, an ever larger share of income has been surrendered to the government in exchange for improved services and more extensive and higher social payments. To do so is neither good nor bad. The extent to which the government mediates in providing services to citizens is a matter of choice, as is the priority accorded to public goods relative to private consumption. Countries with high tax revenues as a share of GDP like France (44.5%), Norway (43.6%) and Sweden (50.1%), and those with low revenues like the United States (28.2%), Ireland (31.7%) and Australia (30.9%), are all healthy economies which continue to deliver their citizens increasing prosperity. It makes no sense to fixate on an arbitrary level of taxation as if it were somehow inviolate—especially with the Australian rate of taxation ranking 23rd in the OECD.

The question to be asked, and the one that the IGR ignores, is whether projected increases to government outlays on health, defence and

Figure 5: Total Australian tax, historical and projected



Source: OCED Factbook 2008

aged care would damage the economy. That is, would the diversion of another 3–4% of GDP through the government stifle Australia's economic growth or impoverish its citizens? The answer is clearly not. Far from being lost to the economy, spending on health, aged care and defence contributes to the general churn of economic activity that employs individuals and firms.

What's more; while defence spending will remain a small share of the economic pie at 2–3% of GDP, average individual prosperity is projected to grow appreciably in the decades ahead. Table 4 puts the economic burden of defence into historical context. If the economy could carry the burden of defence spending at 3.6% of GDP when average per capita was $27,000 it is difficult to see that we cannot afford 2–3% of GDP in forty years time when per capita GDP will be between $86,300 and $118,100.

Enterprise

So far the news has been broadly positive. Australia will have the people, money and access to technology needed to maintain a defence force of the size and shape we have today out to mid-century. But what about the enterprise needed to bring these raw inputs together and deliver effective capability?

On one level we can be confident. The professionalism of the defence force has been amply demonstrated over the past eight years in deployments around the globe. The ADF is now more experienced and better prepared for operations than at any time in the past three decades. If nothing else, recent deployments provide a firm basis for the development of future doctrine, training and tactics. This all bodes well for the future.

In other areas of defence activity, the picture is not so reassuring. Australia's capacity to plan, deliver and bring capability into service is poor. The list of delayed and cancelled projects grows longer every year. Billions of dollars of taxpayers' money has been lost in futile attempts to deliver overly ambitious projects. Billions of dollars of assets lie idle because of personnel shortages. Still further billions of dollars of assets cannot be used in anger because they lack mission critical components. And Defence is in a state of constant financial crisis because it consistently fails to take account of the money needed to operate new equipment.

If there is a silver lining in this sad state of affairs, it is that things can only improve. As we look to the future there is generous room for improvements to the way Defence turns taxpayers' money into military capability.

The demand for defence

While many factors contribute to a country's decision to spend money on defence, there is one simple overarching trend; large economies tend to spend more on defence than small economies. The trend is amply demonstrated in Figure 6 where the defence spending and GDP of some 151 countries is plotted.

Table 4: Defence spending and per capita GDP 1968–2048

	1968	1988	2008	2028	2048
GDP per capita (2008 $)	$27,600	$38,700	$57,700	$69,900 to $81,700	$86,300 to $118,100
Defence spending per capita (2008 $)	$960	$796	$1,042	$1,440 to $1,552	$2,057 to $2,542
Percentage spent on defence	3.8%	2.0%	1.8%	1.8%–2.3%	1.8%–3.1%

Source: Historical GDP and population data and projections from Treasury's 2007 Intergenerational Report

The corollary of this trend is that as a country's economy grows, so too does its defence spending. This has been true of Australia in the past, and will no doubt be the case for our neighbours in the future. Thus, while the earlier projection that the Australian economy will grow by at least a factor of two over the next forty years is reassuring, our economic prospects need to be seen in the context of those of our neighbours and strategic partners.

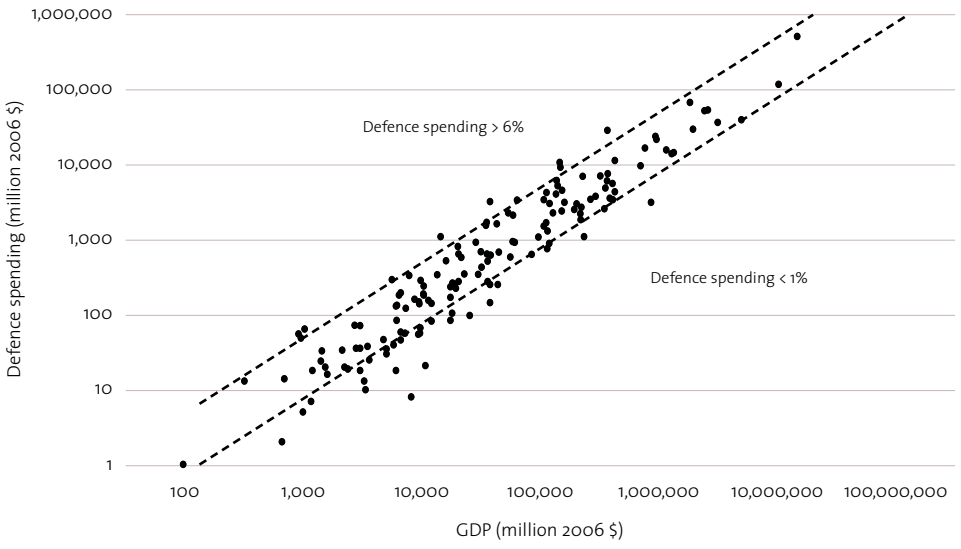
A convenient set of long-term international economic projections is produced each year by the US Energy Information Administration (EIA). While lacking the detailed approach of the Treasury's IGR for Australia, the EIA estimates have the merit of coming from a single source yet cover a range of countries. Using their latest estimates, which extend to 2030, it is possible to project the relative size of selected economies to our own using the baseline IGR estimate. The results appear in Table 5 based on GDP at market exchange rates. Although the projections have been extrapolated out to 2050, the estimates beyond 2030 should be treated as speculative given the time-horizon on the EIA estimates.

Nonetheless, a clear conclusion can be drawn; apart from Japan, which is set to be ravaged by a rapidly ageing population, our relative economic weight is in decline regionally.

Our economic advantage relative to our key Southeast Asian neighbours will lessen, and Indonesia will overtake us around 2030. And while we will more-or-less retain our position relative to the United States and make steady gains on Japan, we will fall further behind South Korea. Not surprisingly, the largest shift will be relative to the emerging powers of India and China which, even by 2030, will have more than doubled their relative economic advantage over us.

While it is possible to quibble about the details, the trends set out in Table 5 are relatively robust over the longer term. Developing countries have a higher potential for economic growth than developed economies like Australia. The transition from labour intensive agriculture to even basic manufacturing is accompanied by a substantial increase in productivity, an increase that is no longer available to a country like Australia.

Figure 6: International defence spending 2006



Source: The International Institute of Strategic Studies, The Military Balance, 2008

Unless globalisation and international development stalls, Australia's relative economic weight will decline in the decades ahead. And although we are yet to see what the final outcome of the present financial crisis is, there is little sign of a retreat to the sort of protectionism that would derail recent trends.

Of course, it is possible that other countries will not increase their defence spending in line with their economic growth—the broad correlation between economic size and defence spending is not a law of physics. But this would be a heroic assumption for us to make given that we continue to increase our own defence spending. In all likelihood, if Australia chooses to maintain a defence force of the size and shape it has today, it will be a defence force that declines in relative capability in the decades ahead.

Conclusion

If demographics are destiny, our destiny is mixed. While we should be able to maintain a defence force like we have today—or even somewhat larger—out to 2050, our relative economic weight is set to decline in the decades ahead along with, more than likely, our strategic weight.

Just because we can afford to spend more on defence, does not mean we should; and just because other countries can afford to spend more on defence does not mean that they will.

This, by itself, is not argument for spending more on defence. Just because we can afford to spend more on defence, does not mean we should; and just because other countries can afford to spend more on defence does not mean that they will. Even as Australia's wealth grows in the decades ahead, every dollar spent on defence will continue to have an opportunity cost in terms of private income and public goods like health and education. That's why decisions about how much to spend on defence will continue to demand a careful balancing of benefits and costs.

Table 5: Projected relative economic size

	Projected Gross Domestic Product relative to Australia								
	Malaysia	Singapore	Thailand	Indonesia	Korea	Japan	India	China	US
2010	0.2	0.2	0.3	0.7	1.1	7.2	1.9	4.3	17.7
2015	0.2	0.2	0.3	0.7	1.1	6.6	2.2	5.1	17.4
2020	0.2	0.2	0.4	0.8	1.2	6.2	2.6	6.1	17.5
2025	0.3	0.3	0.4	0.9	1.2	5.9	3.1	7.4	17.6
2030	0.3	0.3	0.4	1.0	1.3	5.5	3.7	9.1	17.8
2035	0.3	0.3	0.5	1.1	1.4	5.2	4.3	11.1	18.1
2040	0.3	0.3	0.5	1.2	1.5	5.0	5.2	13.6	18.4
2045	0.4	0.4	0.6	1.4	1.6	4.7	6.2	16.7	18.8
2050	0.4	0.4	0.7	1.5	1.7	4.5	7.5	20.7	19.3

Sources: Economic growth rates; US EIA, 2008. Baseline GDP figures; DIO, 2007

Further reading

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About the author

Dr Mark Thomson is the Program Director for the Budget and Management Program at ASPI and is the author of the annual *Cost of Defence* review of the Defence budget.

Australian Army personnel of Timor-Leste Battle Group 3 during a capability demonstration at Aileu. The ADF deployment in Timor-Leste is an example of the sort of low-intensity operation that could be supported by a pared-down ADF in the 'stand easy' force structure option (see p16). Photo courtesy Australian Department of Defence

Pay your money and take your pick—force structure options and their costs

Andrew Davies

The preceding paper argued that Australia can afford to maintain its present defence effort for the foreseeable future, and could—should it prove desirable to do so—expend a still higher proportion of GDP without damaging the economy. This section presents indicative force structure options that reflect different degrees of strategic military ambition and cost.

The baseline budget

Over the past few years, ASPI has tracked the projected cost of the force-in-being and planned acquisitions.[1] In the process, questions have been raised about the affordability of current plans even given the promised 3% a year real growth in the budget. But because this paper is about longer term force structure options, the working assumption is that the current force and the Defence Capability Plan (DCP) 2006–2016 can be more or less afforded within the planned budget. And, more generally, we assume that ongoing 3% real budget growth will be available and adequate to replace current matériel with its future equivalents beyond the ten-year horizon of the present DCP. These assumptions are probably not too optimistic; work underway within Defence to reduce waste and improve efficiency should go a good part of the way to meeting any existing unfunded budget pressures. In any case, for our present purposes, any shortfall is likely to be small compared to the cost of making significant changes to force structure. Table 1 shows the baseline budget against which changes are calculated. (Since we are looking at the medium- to long-term, the current financial crisis is not included in any projections.)

The ADF today

Before discussing changes that might be made to the ADF force structure, it is necessary to understand current ADF equipment and capability. ASPI has recently published capability summaries that include the current and approved future composition of the force for each of the services and for the joint command and control systems. The keen reader might wish to read them before proceeding.[2] However, the digests below provide the essential details.

Navy

The Royal Australian Navy (RAN) operates a fleet comprised of twelve surface combatants, six submarines, three amphibious vessels, fourteen patrol boats and two major support vessels as well as a range of helicopters. In size it is a little larger than the navies of countries like Singapore and Thailand, but is much smaller than those of China, India and Japan.

The Navy will acquire three new air warfare destroyers (AWDs) and two new amphibious ships (LHDs) in the first half of the next decade. In terms of capability, the RAN is currently a middle power force, with no fixed

Table 1: The baseline defence budget used in this paper is the 2008 budget increased in real terms by 3% per year (all figures in 2008 dollars)

	2010	2015	2020	2025
Budget	$24.07 b	$27.91 b	$32.35 b	$37.50 b

Source: ASPI analysis based on Defence budget papers

wing air power and with frigates forming the core surface combatant capability. The absence of an aircraft carrier (and the other elements of a carrier battle group required for escort) in the fleet circumscribes the range of operations the ADF can undertake. The principal operator of carriers, the United States Navy, can project air power and provide air cover for naval and land based operations in hotly disputed areas, capabilities currently denied other nations.

Of the other regional navies, Japan and South Korea currently operate air warfare destroyers. The LHD acquisition will put the RAN in the first rank of regional amphibious capability. Around the region, many nations are acquiring submarines[3], and Australia's naval forces will be operating in an environment where sophisticated diesel-electric and nuclear submarines are increasingly the norm. The RAN currently has a shortfall in the systems required for anti-submarine warfare, especially helicopter-borne sensors.

Army

With over 27,000 permanent and almost 16,000 part-time Reserve personnel, the Australian Army is small by regional standards and tiny given the size of our continent. At its core, the permanent Army is made up of six infantry battalions (including one commando battalion), two cavalry regiments, one armoured regiment and a Special Air Service regiment. These troops are supported by one aviation brigade, three artillery regiments, three combat engineer regiments and one air defence regiment, plus a comprehensive range of combat support and logistic support elements.

The Army's capacity to deploy and sustain operations is being increased through the progressive addition of two more permanent infantry battalions, to a total of eight. This will see the full-time Army expand to around 30,500 personnel by early next decade. At the same time, the land force is being re-equipped with better armoured mobility and networked communications under the Hardened and Networked Army (HNA) program. The HNA program is essentially a move from a light infantry force to one with a medium-weight focus.

Air Force

The Royal Australian Air Force (RAAF) operates around 100 fast jet fighter and strike aircraft and over 100 aircraft of other types, including airlift, tanker and maritime patrol aircraft and trainers. In terms of size, the air forces of Singapore and Thailand are comparable. The Japan Air Self Defense Force is larger, and India and China both operate much larger air arms.

In terms of hardware, the Air Force is about to undergo a transition, in which most of its front-line fleet will be replaced by 2020. Some of the decisions on replacement types (and genuinely new capabilities in some instances) have already been made and acquisition projects are well underway. Other new additions to the RAAF's fleet will include the well-publicised Super Hornets, air-to-air refuelling aircraft and sophisticated Airborne Early Warning and Control (AEW&C) aircraft.

The RAAF has seen its long-held regional qualitative lead in air combat capability eroded somewhat in recent years through the acquisition by regional nations of advanced aircraft, in some instances accompanied by AEW&C and air-to-air refuellers. But the acquisition of twenty-four Boeing Super Hornets with advanced sensor and electronic warfare (EW) systems and the Wedgetail AEW&C will provide a capability boost that should see the RAAF regain its capability edge against at least Southeast Asian air forces until the 'fifth generation' Joint Strike Fighter is acquired. While fifth generation aircraft remain the most reliable guarantee of

medium- to long-term air combat superiority, the advanced fourth generation capabilities of the Super Hornet should suffice in the Southeast Asian theatre for some time to come.

Future options

In 2003, ASPI went through the exercise of identifying and costing a number of strategic options for Australia's forces.[4] The options presented ranged from 1.3% of GDP through to 2.5%. At the lower end, some tough decisions were required; the ADF was reduced in size and capability, losing the FFG frigates and the (then still to be approved) air warfare destroyers, the F-111 and (future) JSF and a proportion of the Army. At the upper end, the ADF started to look like a formidable military power, with all of the currently planned capability augmented by extra naval air warfare capability, two aircraft carriers, more airlift and air combat support elements and a considerably expanded and mechanised Army.

It is timely to revisit this exercise in 2008. With a Defence White paper in preparation, the government will no doubt be presented with a number of force structure options, each of which will have an associated price tag. There are a few hints in the public domain as to what the government might be thinking—for example, the Prime Minister has suggested that Australia needs an expanded naval capability to protect its sea-lines of communication. And there has been a number of force structures—usually uncosted—suggested by various defence commentators.

To discuss alternative force structures realistically, credible costing data is required. And as well as the bare acquisition costs, the spread of those costs over the life of the acquisition and the ongoing 'through life' personnel and support costs of equipment is required for budget planning. While precise costs are not generally available for many of the force structure elements of interest, figures in the public domain nevertheless provide a basis for estimating the costs of different force structures. The annex to this paper sets out the methodology that was used to produce the estimates used here. The results are summarised in Table 2.

In this section we examine the budgetary impacts of some hypothetical force structures. Not surprisingly, the more ambitious ones involving an expanded ADF capability require an increased defence budget and an increased proportion of Australia's GDP. So, for balance, it is worth showing what resources could be freed up through a *reduction* in defence capability. And there are options that are almost cost neutral but which still result in a differently focused ADF.

We discuss four broad options (with sub-options for two of them). The options are presented in order of cost, from the least expensive—no defence force is cheap—to the most. We acknowledge that they far from exhaust the spectrum of possibilities. But hopefully there is enough data tabulated here for the interested reader to generate and cost their own force structure should they feel sufficiently motivated to do so.

The costs of the various force structures are presented in three ways; first as an absolute amount (all figures quoted in this paper are in 2008 dollars), secondly as an increase or saving against the 'plus 3% per annum' baseline and, finally, as a proportion of Australia's projected GDP.

Option one—'stand easy'

This option is predicated on Australia taking the strategic decision that it doesn't need to (or doesn't want to) compete with the increasing economic and military strength of the Asia–Pacific region. In this model, high-intensity warfighting capabilities such as

Table 2: Estimated costs for major force structure elements (all prices in billion 2008 $)

Platform	Unit acquisition cost	Annual unit operating costs	20-year operating cost	Ratio of 20-year operating costs to acquisition cost
Navy				
Aircraft carrier QEII class	8.50	0.85	17.00	2.00
36 F-35C Joint Strike Fighter + 4 shipborne AEW&C aircraft	5.80	0.44	8.80	1.80
AWD (marginal cost)	1.94	0.11	2.20	1.02
Amphibious ship (LHD) (marginal cost)	1.00	0.16	3.20	3.30
New frigate (4,000t)	1.33	0.07	1.40	1.06
New submarine (4,000t)	2.40	0.13	2.40	1.04
12 naval helicopters	1.00	0.11	2.21	2.21
Sealift catamaran	0.19	0.03	0.56	3.00
Replenishment ship AOR	0.404	0.06	1.10	2.72
Auxiliary oiler AO	0.24	0.03	0.56	3.00
Air Force				
24 Joint Strike Fighters or Super Hornets	3.12	0.22	4.48	1.44
Additional air-to-air refueller	0.25	0.02	0.36	1.45
Additional Wedgetail AEW&C	0.35	0.03	0.51	1.45
Additional C-17 strategic airlifter	0.50	0.04	0.72	1.45
Additional P-8 maritime patrol aircraft	0.26	0.02	0.37	1.45
Army				
Medium infantry battalion	0.91	0.25	4.91	5.39
Special Forces battalion	0.79	0.26	5.19	6.54
Light infantry battalion	0.78	0.27	5.36	6.90
Chinook CH-47 medium lift helicopter	0.08	0.01	0.16	1.90
Intelligence				
Constellation of Low Earth Orbit (LEO) satellites	3.00	0.15	3.00	1.00
100 additional analysts	–	0.08	1.67	–

Sources: ASPI analysis and as detailed in the annex

air combat and air warfare destroyers are of low priority compared to forces tailored more towards contributions to regional and global operations for 'the common good', including peacekeeping, stabilisation and humanitarian operations. This model might be attractive if the government decided that some of the funds nominally allocated to defence would be better used elsewhere in its program.

The 'stand easy' option provides substantially fewer strategic options than the current ADF force structure. It would have implications for the ANZUS alliance, Australia's ability to contribute and sustain forces in international arenas alongside coalition partners and the extent of our ability to defend our air and maritime approaches. It would run the risk of Australia being seen as a free rider on US military capability and the notion of Australia as the natural leader of regional coalitions, as articulated in the last White Paper and reiterated in the subsequent updates, would be less sustainable. However, Australia would still be able to contribute on a similar footing

to its regional neighbours and may choose to make low intensity multilateral operations the raison d'être of the force—Australia as a 'good international citizen' rather than a significant regional military power.

The main force structure changes, using the current ADF as a baseline, would be:

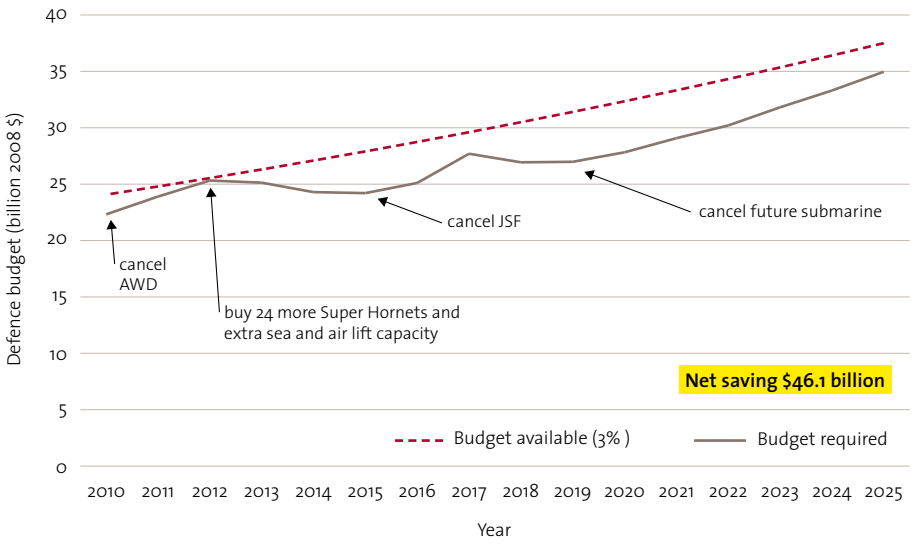
- cancelled acquisition of air warfare destroyers (frigate fleet remains as is)
- no acquisition of the JSF, and a tactical aircraft fleet of forty-eight Super Hornets (retaining the planned AEW&C and air-to-air refuellers). The 'classic' Hornets would be retired in 2015.
- four additional maritime patrol aircraft
- no submarine post-*Collins*
- additional sea-lift in the form of three catamarans
- an additional two C-17 airlifters and three additional medium-lift helicopters
- less hardening and networking of the Army, with an ultimate battalion structure of six light, one special forces (plus SAS) and one medium.

The results for the budget are summarised in Table 3 and Figure 1 below. The impact of major force structuring decisions is obvious and there is, as expected, a net saving of $46.1 billion over the forecast period 2010–2025. But there are also some subtleties in these figures worth noting. The proportion of GDP being expended—even with this much more modest ADF capability—is slightly higher in 2025 than is the case in 2008. This is manifested in Figure 1 by the tendency of the graph to trend back upwards after the one-off savings obtained by cancelling major programs. There is a straightforward

Table 3: Budgetary impact of the 'stand easy' model (all prices in billion 2008 $)

	2015	2020	2025
Required budget	24.2	27.8	35.0
Change to +3% baseline	−3.7	−4.5	−2.5
Proportion of GDP (1.80% today)	1.61%	1.64%	1.84%

Figure 1: The predicted budget requirements for the 'stand easy' model of force structure



but important explanation for this effect: the projected growth in GDP from 2014 on[5] is less than the average rate of growth of defence costs. The difference is not great—hence the slow trend—but the compounding of even small differences in rates means that the maintenance of defence capabilities will gradually consume a greater proportion of national resources.

Option two—the 'focused' force

This is the force structure proposed in an earlier ASPI publication.[6] Strategically, it is predicated on the observation that Australia's hitherto clear economic and technological advantage is being eroded and that the existing 'balanced' force structure, largely unchanged since the 1960s, is not optimised for such an environment. In this model the ADF is structured to be able to defeat the forces of any similar sized power in the event of them mounting a direct threat to Australian interests close to home. Further afield the intention is to be able to make valuable contributions to US-led coalition operations and to obtain a level of deterrence through an enlarged submarine fleet.

Other considerations include the increased vulnerability of surface combatants to emerging threat technologies and the proliferation of modern submarine types around the region. The emphasis of the naval force structure is therefore away from surface combatants as the predominant naval capability and towards a larger fleet of submarines with anti-shipping and possibly land strike capabilities. The surface vessels that remain in the fleet would have greater air defence capability and an improved ability to prosecute anti-submarine warfare (ASW) and perform over-the horizon anti-surface warfare (AsuW) roles. Both of those tasks would require capable embarked helicopters able to deploy dipping sonar and anti-shipping missiles. As well, ASW and AsuW capability would be boosted by the acquisition of four additional maritime patrol aircraft.

In the land domain, the traditional combined arms approach of infantry, armour and artillery is seen as less relevant for near-region stabilisation and assistance missions and as not the highest-value (or at least not necessary) contribution to coalition operations. The proposed land force involves a two-tier restructure of Army focused on developing more Special Forces for deployment to war zones in coalition activities and mobile light infantry units for regional stabilisation, humanitarian and peacekeeping missions.

In the air combat domain, two options are costed here. The first is based on the judgement that the capability of the Super Hornet, when combined with the in-train Wedgetail AEW&C and air-to-air refuelling aircraft, will be sufficient given the current and projected capability of Southeast Asian air forces. In that approach the JSF purchase could be deferred until needed, assuming that the RAAF's ageing tactical aircraft capability was augmented by additional Super Hornets in two additional tranches of twenty-four aircraft each. Alternatively, the JSF purchase could proceed as planned.

In summary, the changes to the currently planned force structure would be:

- an additional six submarines (for twelve in total)
- (a) forty-eight additional F/A-18F Super Hornets, ordered for delivery in two tranches in 2012 and 2016 (but no JSF purchase in the near future) or (b) the JSF purchase proceeds as planned
- a 'two-tier' Army, with additional special forces (one additional commando battalion for a total of two plus the SAS Regiment) and six light and one medium infantry battalions

- two additional air warfare destroyers, with an accompanying reduction in the frigate force from twelve to eight
- four additional maritime patrol aircraft.

The Super Hornet option is very close to cost neutral against the 'plus 3%' baseline. There is a net saving of $5.3 billion over the forecast period. The JSF option requires an extra $7.1 billion above base over the same period. Either of these models would cost less than 2% of GDP—the choice between them essentially coming down to the priority afforded the fifth generation air combat capability of the JSF.

Option three—Securing the waves

In September 2008, the Prime Minister gave a broad hint that an expansion of Australia's naval capability was on the cards:

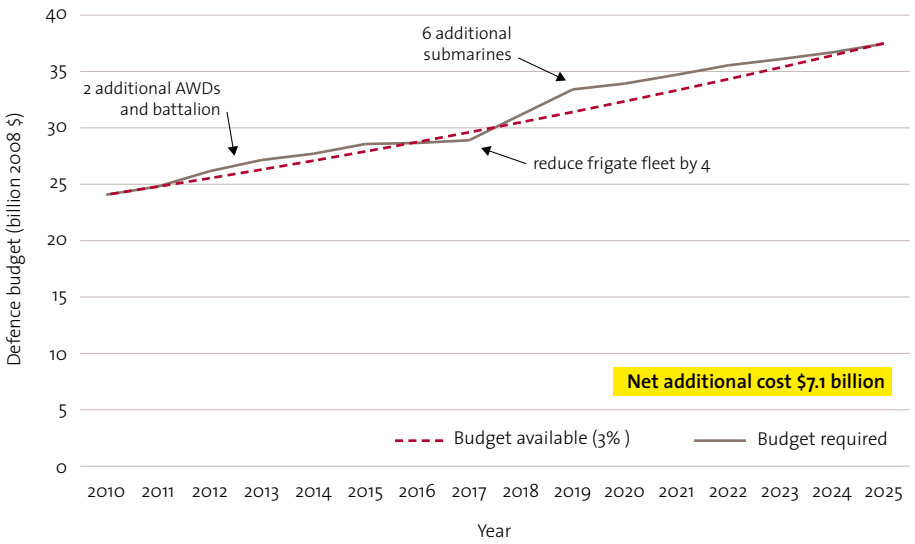
> 'If we are going to defend our sea-lines of communication to the rest of the world, we have got to make sure that we have got the naval capability to underpin that. And Australia therefore must have necessary maritime power in the future in order to give that effect'.[7]

While the Prime Minister did not indicate that the White Paper capability initiatives would be solely confined to the naval domain, it is worth investigating the resources required

Table 4: Budgetary impact of the 'focused force' model (all prices in billion 2008 $)

		2015	2020	2025
Required budget	(Super Hornet)	27.1	33.1	36.6
	(JSF)	28.1	33.8	37.3
Change to +3% baseline	(SH)	−0.8	+0.8	−0.9
	(JSF)	+0.2	+1.4	−0.2
Proportion of GDP	(SH)	1.80%	1.96%	1.93%
	(JSF)	1.87%	2.00%	1.97%

Figure 2: The predicted budget requirements for 'focused' force structure (JSF variant shown)



to provide a significant boost to Australia's naval capability.

In order to provide additional security to the sea-lines of communication that support Australia's international trade, the ADF could be supplemented with the ability to pull together an additional two task groups (with an air warfare destroyer and at least two frigates attached to each), new helicopters and additional maritime patrol aircraft (MPA) to bolster the ASW and AsuW capability. To support the extra surface forces, additional oiler and at-sea-replenishment vessels would be required. And, noting that denial of sea-lines of communication to an adversary is the flip side of securing our own—or keeping with the spirit of the Chief of Navy's recent remarks about additional submarines being part of a 'balanced' naval capability—additional submarines would round out the fleet. The posited force structure changes are:

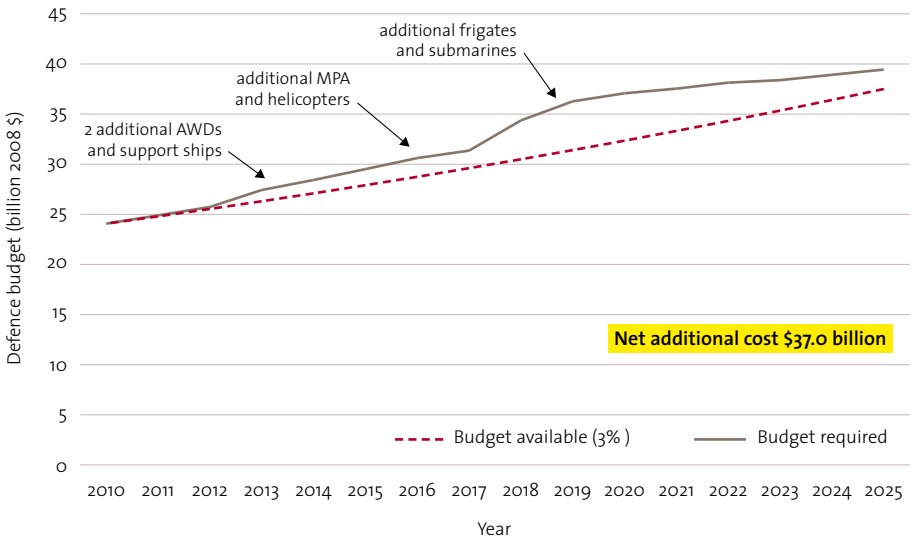
- two additional air warfare destroyers
- five additional frigates
- one additional oiler and at-sea replenishment ship
- twelve additional ASW helicopters
- six extra maritime patrol aircraft
- six additional submarines.

Not surprisingly, this maritime capability augmentation requires a larger defence budget than is currently the case. Over the period 2010–2025, an additional $37 billion must be found for the acquisition and operation of the new platforms. As a proportion of GDP, this model would require a maximum (over the forecast period) of 2.18% in 2019–20 when the acquisition programs for the new frigates and submarines are underway. The longer-term proportion comes down slightly, but remains above 2%.

Table 5: Budgetary impact of the 'Securing the waves' model (all prices in billion 2008 $)

	2015	2020	2025
Required budget	29.5	37.1	39.4
Change to +3% baseline	+1.6	+4.7	+1.9
Proportion of GDP	1.96%	2.19%	2.08%

Figure 3: The predicted budget requirements for the 'securing the waves' force structure



Option four—Australia as a 'muscular regional power'

The idea of Australia becoming a larger regional military power can be extended beyond the maritime domain. The rationale for such a force structure is essentially similar to that behind the 'focused force' option—the strategic and military relativities of the region are changing and the existing force will progressively carry less weight in the future. The difference is that the 'focused' option is predicated on Australia engaging a major Asian power only in coalition with the United States. In this model, Australia would be able to unilaterally engage such a power with a degree of confidence of prevailing (at least close to Australia), or at least being able to inflict enough damage to render belligerence against Australia unattractive.

One such model was described by its originator as containing a careful mix of capabilities that could, *in extremis*, 'rip an arm off' any major Asian power that sought to attack Australia.[8] The force was described as potentially including, amongst other things, 300–400 Joint Strike Fighters (with additional support capabilities) and/or twenty to thirty submarines. Other authors have also suggested that Australia boost its capabilities, generally with a focus on air and maritime capabilities. The option examined here stops short of some of the more extreme numbers, but 'beefs up' essentially the entire force structure. On top of current plans, the ADF would get:

- twelve additional submarines, for eighteen in total
- 150 additional Joint Strike Fighters (250 total) with six each additional Wedgetail AEW&C and air-to-air refuelling aircraft
- two additional air warfare destroyers plus five additional frigates
- one additional oiler and at-sea replenishment ship
- twelve additional naval helicopters
- four additional P-8 maritime patrol aircraft
- three additional medium battalions for the Army
- three additional medium lift helicopters
- one additional LHD amphibious ship
- one Australian-owned ISR low-earth orbit satellite capability with 100 extra intelligence analysts.

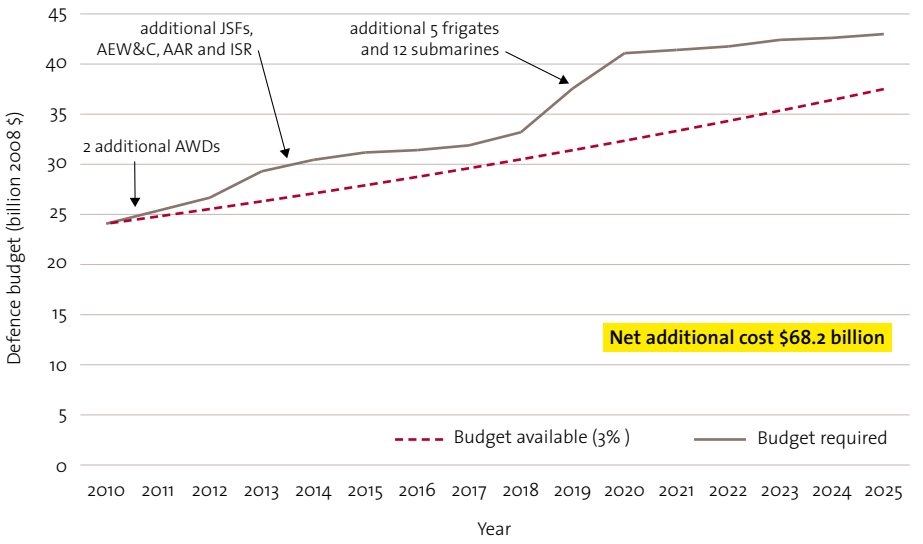
Maintaining boutique fleets of platforms in order to keep 'balance' in the force structure and across the procurement program results in a large number of fixed costs being incurred, without being able to take advantage of the savings that come with larger numbers.

Of course, the practicality of this program is questionable. If Defence pursued the route of Australian-specific specifications and developmental programs, the effort required to spend that much money in a relatively short time is likely to be beyond the ability of the DMO to manage and for industry to deliver. (Especially since many of the acquisition programs are programmed to run simultaneously.) But the acquisition of strictly off-the-shelf items could allow such a rapid build up and the focus of this exercise is the budget and the impact of ADF force structure ambitions on the bottom line.

Table 6: Budgetary impact of the 'muscular regional power' model (all prices in billion 2008 $)

	2015	2020	2025
Required budget	31.2	41.1	43.0
Change to +3% baseline	3.3	8.7	5.5
Proportion of GDP	2.07%	2.43%	2.27%

Figure 4: The predicted budget requirements for the 'muscular regional power' force structure

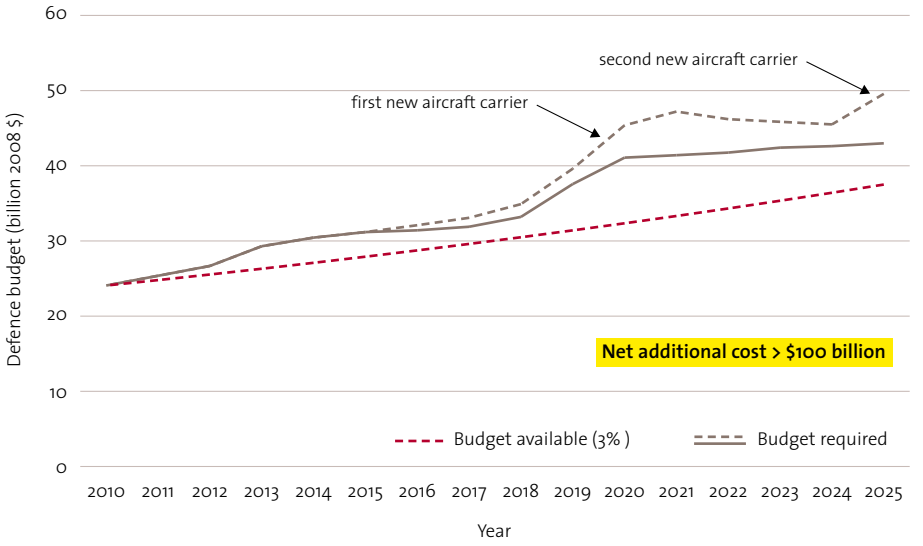


As expected, the impact on the budget is more dramatic in this model than the other options. However, the increases are moderated by the economies of scale that accrue when existing fleets are augmented by more platforms of the same type—an important gain. Maintaining boutique fleets of platforms in order to keep 'balance' in the force structure and across the procurement program results in a large number of fixed costs being incurred, without being able to take advantage of the savings that come with larger numbers.

Nonetheless, the 'muscular regional power' sobriquet comes at a cost. An additional $68 billion is required over the baseline and, at its peak in 2020, the acquisition and running costs will consume 2.41% of the nation's GDP.

But there is one more acquisition that might form a gleam in the eye of the more ambitious defence planner. A truly 'muscular regional power' could aspire to the power projection capability that comes with fixed-wing naval air power. To round out the discussion, Figure 5 shows the budgetary impact of adding two *Queen Elizabeth II* class aircraft carriers with an embarked air wing consisting of thirty-six short take-off, vertical landing F-35C Joint Strike Fighters and four AEW&C aircraft to the previous force structure. This option would require an additional $101 billion between 2010 and 2025, and at its peak would consume 2.73% of GDP.

Figure 5: The additional impact of two aircraft carriers on top of the 'muscular regional power' force structure



Conclusions

It is no surprise that the results of this paper boil down to a trade-off between strategic ambitions and the cost of the ADF required to implement them. The summary in Table 7 shows the 'results at a glance'.

Some of the costs here may be open to debate (and experience has shown that even the official cost projection figures can prove to be somewhat removed from the eventual reality) but the *relativities* between the force structures here are quite robust against changes to the assumptions that underpin the calculations.

The examples span a range of GDP share at various times in the 2010–2025 period that ranges between 1.61% and 2.74%. At the lower end of the spending spectrum, it is possible to harvest significant savings by reducing the ADF's capability. The consequence would be a reduced national capability to commit to military operations unilaterally, but we could still make a significant contribution to international coalitions or to humanitarian, peacekeeping and disaster relief efforts. At the upper end, Australia would have a powerful military capability for a nation of its size—to the point where explaining our intentions to the neighbours could present a challenge.

The difference between the capability levels at either end of the spectrum is quite striking. In no small part, that is due to the economy of scale that comes with building on existing fleets. The higher-capability models here are constructed for the most part by expanding the numbers of types already in the force structure. That approach gives a much better 'bang for buck' than adopting different types each with their attendant fixed costs.

The results here are consistent with the original 2003 ASPI *Pay Your Money & Take Your Pick: Defence Spending Choices for Australia* calculations, with the important proviso that *all* of the broad options are becoming more expensive in real terms as time goes by. That is because the cost of defence equipment continues to grow in real terms, while at the same time Australia's GDP growth is slowing. Over the period 2010–2025, the subject of defence budget forecasts in this paper, Australia's GDP is forecast to grow

at an average of just under 2.5% (not taking into account any long-term effects of the current global financial problems). At the same time, defence equipment will continue to escalate in cost by around 4%—and some commentators suggest it may be more like 6%.[9]

Ultimately, the government has to decide on the strategic challenges that it wants the ADF to be able to meet and then design the force structure appropriate to the job. The first section of this paper shows that the sort of costs associated with even the more ambitious models for the ADF should remain within the national means for decades to come, notwithstanding the observations in the previous paragraph. It really is a case of 'pay your money, take your pick'.

Table 7: Summary of force structure options and their costs

Model	Major changes	Budget change 2010–2025	GDP share in 2020
Stand easy	cancel acquisition of air warfare destroyers, JSF and future submarine	–$46.1 b	1.64%
	combat aircraft fleet of 48 Super Hornets		
	four additional maritime patrol aircraft		
	additional sea and air lift		
	less hardening and networking of Army		
Focused force	six additional future submarines (12 total)	(a) –$5.3 b	1.96%
	a 'two-tier' Army, with additional special forces and with six light and one medium infantry battalions	(b) +$7.1 b	2.00%
	two additional air warfare destroyers, 5 fewer frigates		
	four additional maritime patrol aircraft.		
	(a) 48 additional Super Hornets, no JSF		
	(b) the JSF purchase proceeds as planned		
Securing the waves	two additional air warfare destroyers, five additional frigates	+$37.0 b	2.18%
	additional at-sea replenishment ships		
	additional twelve naval helicopters and six maritime patrol aircraft		
	six additional future submarines (twelve total)		
Muscular regional power (MRP)	twelve additional submarines (18 total)	+$68.2 b	2.41%
	150 additional JSF (250 total) with six each additional Wedgetail & refuelling aircraft		
	additional two air warfare destroyers, five frigates and one LHD amphibious ship		
	additional at-sea replenishment ships		
	additional twelve naval helicopters		
	additional four maritime patrol aircraft		
	three additional medium battalions for Army		
	three additional medium lift helicopters		
	Australian-owned ISR satellite capability with 100 extra intelligence analysts		
MRP +	As above + two aircraft carriers with embarked STOVL JSF aircraft	+$101.2 b	2.67%

Annex—Methodology

Acquisition costs

Acquisition costs for equipment can be found or estimated in a number of ways. The most straightforward case is where a market price or a reliable forward estimate exists. A good example is the Super Hornet, where a firm price was obtained through a Foreign Military Sales contract. (And previous ASPI work showed the likely JSF will be very similar, so we use the same cost for both).[10] Similarly, the former Minister for Defence quoted a figure of $1.5 billion for a fourth air warfare destroyer (AWD)[11] (to which would need to be added the cost of the Aegis system). Similarly, an answer in Parliament this year yielded the figure of $4.8 billion over eleven years for two 'hardened and networked' Army battalions, which provides a benchmark against which the calculated figures can be compared.

Some of the items in the force structure 'shopping list' are additions to fleets already acquired or in train. For example, some of the options include additional Super Hornet, C-17 or P-8 maritime patrol aircraft or additional Army battalions. In those cases the acquisition costs are known from the first tranche and will be stable because the production lines are (or will be) mature.

In the case of platforms early in the production run, a reliable estimate of platform costs can be derived from industry standard 'learning curve' techniques. For example, the cost of a fifth AWD can be estimated as 80–85% of the cost of the fourth one (plus the cost of the combat system, itself available from US data), based on data provided with NASA's learning curve calculator.[12] The same technique allows the cost of a third *Canberra*-class amphibious ship to be estimated as approximately $1 billion.

It is more difficult to estimate the cost of entirely new platforms or capabilities. In such cases extrapolations of well-defined historical trends provide a useful guide. In the same way that historical aircraft cost trends can be used to predict the eventual cost of the Joint Strike Fighter (an estimate that is looking increasingly accurate), the cost of a future submarine or frigate can be estimated from the historical cost trends of those platform types. Costs per tonne can be used to refine the estimates if the future vessels are posited to be significantly larger or smaller than the current models. This technique results in an estimate of $2.4 billion per hull for a future 4,000 tonne follow-on to the *Collins*-class submarine and $1.33 billion for a future 4,000 tonne frigate.

This technique has the virtue of allowing for the generational increases in defence capital equipment. It has the disadvantage of providing a median value—the cost of ambitious (and thus risk-laden) developmental projects will tend to be underestimated and those of more modest extensions of existing platforms and technology to be overestimated. To give an example from US aerospace projects, the long-term trend figure underestimates the cost of the first-of-kind fifth generation F-22 Raptor but overestimates the cost of the advanced fourth generation F/A-18 E/F Super Hornet that built on an established design. Nonetheless, until the specific requirements of future projects are detailed, the historical trend provides as sound a basis for cost estimates as is likely to exist.

Land forces are more problematic to cost. The costs shown here are derived from the data presented in the most recent Defence Annual Report (DAR).[13] The DAR gives personnel, depreciation and supplier costs for light infantry, medium infantry and Special Forces (SF). The number of personnel in each type of force can be calculated from the per capita ADF personnel cost, and the costs for a

battalion of each type can then be calculated pro rata from that. The acquisition cost of each battalion type can be estimated as the twenty-year depreciation costs ascribed to each (assuming that the lifetime of vehicles and other equipment is approximately twenty years) and the running costs are the sum of the annual personnel and supplier costs.

Project spend spreads

Arriving at a total cost is a necessary but not sufficient step to do realistic budgeting.

Big projects—even straightforward ones such as off-the-shelf purchases—do not expend all of their funds in one year. And very complex development projects can last for as long as fifteen years, making it important to capture the spread of spending.

We use two working assumptions that should provide a reasonable approximation to the spread over time of project costs. Firstly, for off-the-shelf acquisitions we use data from past Defence reporting to estimate the time it will take to complete various acquisitions based on analogous past examples. Secondly, for developmental projects, we assume that the spread of project spending follows a mathematical model called the Norden-Rayleigh distribution, which is often used as a planning tool for project management. A couple of examples are given below.

Example 1—purchase of twenty-four additional Super Hornet aircraft. The estimated time is between four and five years (as per the first tranche). Since this would be an additional off-the-shelf purchase, we allocate the funds as per the purchase of the first twenty-four aircraft. The relevant figures can be found in Table 1.1 of the Portfolio Budget Statements for 2007–08. (Taking care to subtract running costs off the post-delivery figures. The widely-reported $6 billion total for the first twenty-four aircraft actually included ten years of support costs.) When we do that, we get the breakdown of project costs as shown in Table A1.

Example 2—Replacement of the *Collins*-class submarine with six Australian designed and built boats, each of which is approximately 4,000 tonnes submerged weight. This would be a significant development project which, based on the *Collins* experience (and other Australian shipbuilding projects) could be expected to last around fifteen years. Plugging those numbers into the Norden-Rayleigh model gives the spend spreads shown in Figures A1(a) and A1(b). This approach does not accommodate the relatively small expenditure that is required pre-second pass approval. In the case of the air warfare destroyer project, this amounted to approximately $400 million over several years, or approximately 5% of the total project cost. We therefore adopt the 5% pre-approval as a working approximation for other projects.

Support costs

Once equipment has been procured, it needs to be supported during its operational life. Here annual reporting from Defence provides recent data.[14] But even there some estimation is required when applying them to different force structures, and extant circumstances can introduce uncertainties. For example, the *Collins*-class submarines have experienced well-known manning shortfalls, limiting the number of sea days the fleet has been able to produce. As a result, the running

Table A1: Super Hornet acquisition spend profile (acquisition cost percentage by year)

Year 1	Year 2	Year 3	Year 4	Year 5
14%	23%	29%	24%	10%

costs for the submarine fleet are likely to be underestimated. (We explain later how this effect is corrected for.)

As an example of the use of reported operating expenses, the cost of operating the current fleet of thirteen frigates can be extracted from the reporting of Defence Output 2.1, Surface Combatant Operations. The resulting unit operating cost should be a good estimate for a future frigate of about the same size and complexity, once the appropriate inflator is applied (see below). The cost of running a larger surface combatant (such as the 6,000+ tonne AWD) can be expected to be somewhat higher. The approach here is to calculate the crewing cost and subtract it from the total running cost to get an approximation of the vessel

Figure A1(a): Projected annual spends for a 15-year $15 billion project

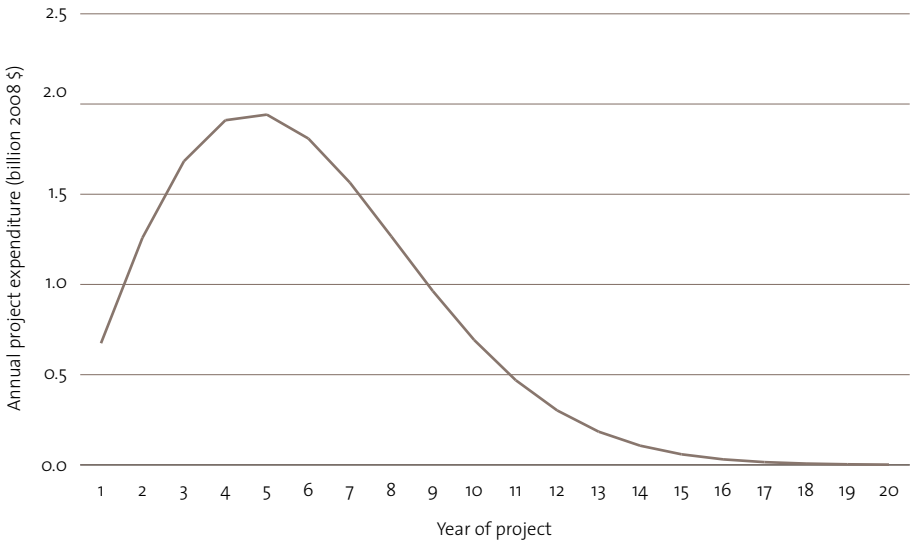
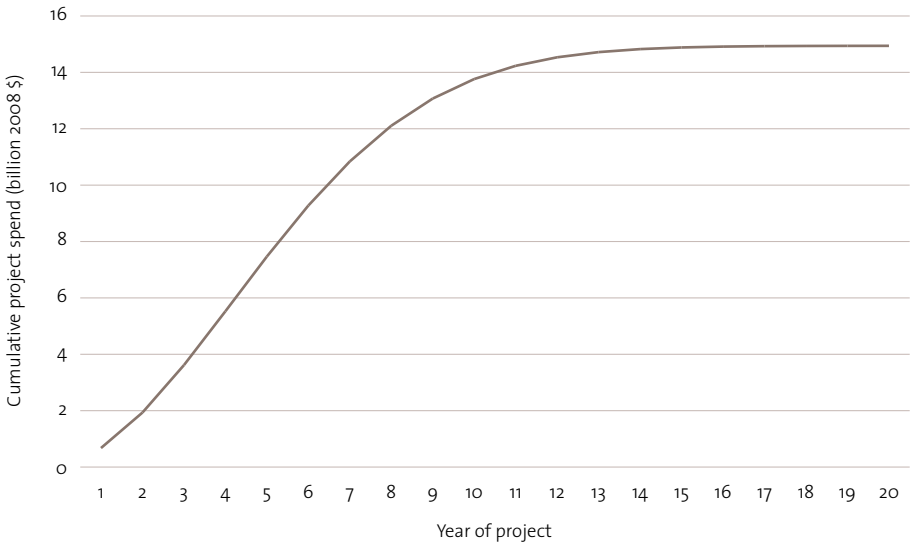


Figure A1(b): Project cumulative spend for a 15-year $15 billion project



running costs. For the AWD, the crewing cost is then calculated directly (the AWD crew is 240 versus an average of around 180 for the current frigate fleet) and the vessel running costs are scaled by the weight of the vessel. Established empirical rules in maritime economics provide a guide for the relevant scaling factors.[15]

In the case of platforms that add to an existing fleet of the same type, the running costs for the additional purchase will not be the same as for the first batch due to the fixed and marginal nature of costs associated with running any equipment. The approximation used here is that additional platforms will have running costs that are 80% of the initial purchase. This is an important observation—the economies of scale of operating larger fleets of similar platforms make some of the expansion models under consideration less financially daunting than they might first appear.

Inflators and exchange rates

The historical data on exchange rates provides no reliable way to predict future trends.[16] The values used here approximate historical median values: A$1 = US $0.75 = €0.60.

Finally, allowance must be made for the variation in prices due to inflationary pressures. The simplest approach would be to use a single deflator—the national CPI being the obvious choice—across the range of defence costs. And data over four decades from US Defense budgets suggests that this wouldn't be a bad approximation.[17]

But an improvement over that is to use different deflators for equipment, support and personnel costs. Consistent with the methodology in the ASPI 2008/09 budget brief, the working assumptions are shown in Table A2.

Results

Most of the results (summarised in Table 2 on p 17) obtained through these methods are unremarkable. The cost of ownership of major platforms over twenty years is typically between one and two times the acquisition cost. (And in fact, this empirical rule could be applied to get running cost estimates in the absence of better data). For example, the calculations produce factors of 1.02 and 1.06 for additional AWDs and future frigates respectively. The RAAF's aircraft are in the range 1.0–1.25, while the naval helicopters are somewhat higher at 2.21, perhaps reflecting the more demanding maritime operating environment.

The two anomalies from these calculations are the through-life costs of the LHD amphibious ships and the future submarines, which came in at 3.3 and 0.63 of the initial acquisition cost respectively. As mentioned earlier, the recent figures on the *Collins*-class operating costs (on which the forward estimates are based) are likely to be something of an underestimate. Consequently, and in the absence of other data, we have increased the running cost estimate to be commensurate with other combatant vessels.

Table A2: Deflators for various components of the defence budget

Category	Annual deflator (above CPI)
Defence specific capital equipment	4%
ADF and civilian salaries	2%
Defence specific matériel	3%
General goods and services	0%

The LHD figure appears to be more robust, and requires an explanation. For such large ships, their acquisition cost is relatively small—a 28,000 tonne LHD costs less than a 4,000 tonne frigate. But a ship of that size has relatively high running costs, even taking into account the economy of scale that comes with larger hulls. As a result, the ratio of running to acquisition cost is relatively high.

Finally, in the land domain, the acquisition costs—the equipment as opposed to the troops—for a light infantry battalion is less than a Special Forces battalion while the equipment cost for a medium infantry battalion in turn is about 15% higher. But by far the larger driver of costs over time is the cost of the personnel—the twenty-year cost to acquisition cost ratio is between 4.2 and 5.5 for the three battalion types. Note that Defence Annual Report data indicates a higher annual cost for a light infantry battalion than for a medium battalion. There is no explanation for that result in the report but the result is used here at face value. In any case, the differential between the various types is not great and the differences do not affect the final judgements.

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About the author

Dr Andrew Davies is the Director of the Operations and Capability program at ASPI. He has written on the impact of Asian military modernisation programs, nuclear proliferation, defence acquisition projects and major Australian capability decisions.

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