ACQUISITION ISSUES

The speed and cost-effectiveness of defence equipment acquisition continues to be a major debating point as UK MoD struggles to introduce major changes in the wake of the Defence Industrial Strategy, which itself appears to be increasingly sidelined. Despite all the activity, many aspects are not being addressed at all and we at RUSI Defence Systems are attempting to provide insight into these. The RUSI Acquisition Focus paper in this issue looks at decision-making in MoD and industry, while this section provides new analysis of the widely noted but little understood phenomenon of defence inflation, which remains twice as high as non-defence inflation. We also publish further details of the ability to predict acquisition performance which was trailed in our previous issue. SMEs are another vague area and we provide two views on what needs to be done. Rapid acquisition and information assurance are also covered, while progress in the wake of the UK's Strategic Defence Review of 1998 and the US's Quadrennial Defense Reviews since 1997 is compared.

Is Defence Inflation Really as High as Claimed?

*by **Professor David Kirkpatrick***

David Kirkpatrick is an Associate Fellow of RUSI. In this article he examines the facts behind the claims that defence inflation is higher than the national GDP deflator and provides illumination on the heat generated by others.

When the UK government publishes its plans for public expenditure, the future annual budgets for defence are eagerly reviewed by various interested stakeholders (particularly by the Armed Forces and by defence contractors) and are compared with the present defence budget. If the planned annual increases in the level of the public expenditure allocated to the Ministry of Defence (MoD) exceed the expected annual increases in the Gross Domestic Product (GDP) deflator (an index which represents the average change in the prices of UK goods and services), the government announces its plan as a 'real' increase in defence spending.

This announcement is regularly followed by a debate about whether the actual price inflation in the goods and services procured by the MoD is greater than that of the GDP deflator, and hence whether the government's planned expenditure will really enhance the military capability of its armed forces. More often in recent years, the debate has centred on whether the government's planned expenditure is sufficient to avoid a significant decrease in the UK's military capability, and corresponding danger to its national security. Some assert that defence inflation is larger than the GDP deflator, while others assert that it isn't or that if it is it ought not to be. In this debate special pleading by interested parties often generates more heat than illumination.

To provide a better basis for this recurrent debate, this paper discusses the construction of a simple price index, the price indices now used by the UK Government to assist economic management, and how the price inflation in the MoD's budget might relate to the GDP deflator and other national price indices. The conclusions rely on published data, and should be refined by more detailed analysis.

I am grateful to Professor Ron Smith of Birkbeck College, University of London, for much helpful advice, but any remaining errors and misconceptions are my own responsibility.

Construction of Price Indices

Retail Price Index

To illustrate the construction of price indices, consider the example of a medieval town which derives its income from the production and sale of salt, and in which the population now spends its disposable income on bread, beer and firewood in proportions 5:3:2. If between this year and the next the prices of these goods rose by 10%, 40% and 20% respectively, the town's retail price index for next year can be calculated by first multiplying the price increase for each item by a weighting factor proportional to the town's relative expenditure on that item, and then adding the results.

Retail price index = (0.5 x 1.1) + (0.3 x 1.4) + (0.2 x 1.2) = 1.21

This calculation takes no account of any fish or fruit which the inhabitants might catch or gather for themselves since these items are not marketed; it also excludes the expenditure of the local baron on armour and French wine, since his expenditure is atypical, and would distort the index if it were included.

The figure of 21% retail price inflation implies that next year the town's inhabitants would be able to afford less bread and firewood, and much less beer, or that they would have to increase the quantity and/or the price of the salt produced next year in order to sustain their living standards. However, these price increases would not have the same effect on all of the town's inhabitants, since the figure of 21% is an average and not universally applicable. The abstemious priest, for example, drinks no beer and spends equal shares of his meagre income on bread and firewood so he would face an inflation rate of only 15%; on the other hand the town drunk would be more severely affected.

Consumer Price Index

The town's retail price index for next year was calculated above as the arithmetic mean (weighted according to the town's expenditure) of the increases in the prices of bread, beer and firewood, and assumes that the quantities of those items consumed by the population would remain constant from one year to the next (in statistical terminology, it is a Laspeyres' index). Alternatively, the town's 'consumer price index' can be calculated as the geometric mean of the changes in the prices of the three items, weighted in proportion to the town's expenditure.

Consumer price index = antilog [0.5log1.1 + 0.3log1.4 + 0.2log1.2] = 1.203

The difference between the arithmetic mean and the geometric mean depends on the difference between the price increases for different commodities; if all prices rose at the same rate, the arithmetic and geometric means would be equal.

GDP Deflator

Although the concepts of a national Gross Domestic Product (GDP) and of a GDP deflator were not developed until modern times, it is illuminating to calculate these values for the medieval town. The town's GDP (= total expenditure = total income) includes not only the value of goods and services purchased by the population for immediate consumption but also the values of investments in capital equipment and of non-marketed public services. Investments (such as expenditure on new equipment for salt production) are assumed for simplicity to be zero. Public services are provided by the local baron, who levies a 10% tax on the sale of salt and spends equal shares of the resulting income in supporting a monastery and a contingent of mercenary men-at-arms. The monks consume only bread and firewood (in the same proportions as the priest) and use herbal remedies to treat sick citizens in the infirmary. The men-at-arms traditionally

supply their own weapons and their annual wages are linked to the town's retail price index. The public services, then as now, are valued by their input costs (though in modern times employees providing health and military services would expect their wages to rise, like other workers in a modern economy, faster than the retail price index).

The quantities of bread, beer and firewood consumed, and of health and military services provided, represent a better measure of the town's welfare than the value of its GDP measured in money. The GDP deflator, which links the money value of GDP to the volume of goods and services, is equal to the value of the town's goods and services in Year 2 divided by the value of the same goods and services at Year 1 prices. The GDP deflator derived from the assumptions above for the medieval town is:

Deflator = 100 / [45/1.1 + 27/1.4 + 18/1.2 + 5/1.21 + 5/1.15] = 1.195

This calculation of the GDP deflator assumes that the town adjusts its pattern of consumption each year to maximise its welfare obtainable from the available income.

The three alternative measures of monetary inflation in the medieval town yield different values:

Retail price index (RPI)	+21%
Consumer price index (CPI)	+20.4%
GDP deflator	+19.5%

The increase in the CPI is smaller than that of the RPI because of the ways they are calculated. The increase in the GDP deflator is even smaller in this case, partly because of the way it is calculated and partly because of the frugality of the monks providing health services. In principle the GDP deflator can rise more or less than the RPI depending on the scale

of the non-marketed public services, and the relative price inflation in those services.

UK Price Indices

Today in the UK there are now two principal measures[1] of the general level of market prices for goods and services bought for consumption. The Consumer Price Index (CPI) is used in association with the government's target level of 2% price inflation per year. The more familiar Retail Price Index (RPI) is used in adjusting many pensions and state benefits to maintain their buying power. Both of these indices represent the average change of the prices of a wide range of consumer goods and services, recognising that within this range some prices may rise more quickly than average, while other prices may fall.

Retail Price Index (RPI)

The range of items used to construct the RPI includes some 650 items which are representative of the much larger number of consumer goods and services in the market. These items include some goods and services which are 'essentials' and some which are 'luxuries', the distinction being largely subjective, and is updated annually to reflect the changing tastes and priorities of most of the UK population. The RPI includes council taxes and rates, but excludes national taxes and national insurance contributions.

The current price of each item in the RPI is assessed monthly by drawing data from retail shops, large commercial suppliers and government organisations. No attempt is made to differentiate between normal free market prices and those prices which may have been artificially raised by a monopolist or a cartel, or those which have been reduced by discounting or by illegal employment practices. For each item the price is what it is.

In those areas of the market (such as consumer electronics) where obsolescent products are rapidly replaced by newer products with superior performance, the price of the new product is adjusted downward to allow for the change in its quality relative to that of its predecessor, the increase in quality being measured in terms of additional benefits to the consumer. The change in retail price is thus based as far as possible on a like-for-like comparison.

The weighting factor allocated to each item in the RPI represents its relative importance in the typical household budget. This excludes the expenditures of the very rich and the very poor – i.e. households with the top 4% of incomes and pensioners on low incomes (both groups having atypical patterns of consumption which would distort the index). The change in the cost of each item is multiplied by the corresponding weighting factor, and the results are added to obtain the RPI. It thus follows the same principles, albeit on a much larger scale, as the retail price index for the medieval town described above.

Consumer Price Index (CPI)

The CPI is calculated according to harmonised European rules. It uses much of the same price information as the RPI, but its weighting factors are based on a broader proportion of the population and it covers a different range of goods and services. For example, the CPI excludes council taxes and rates, vehicle taxes, mortgage interest payments and the depreciation of dwelling houses. Because the range of included items and the weighting factors in the RPI and CPI are different, and because they are calculated as arithmetic and geometric indices respectively, the two indices have different values: over the last decade in the UK the RPI has been about 1% higher than the CPI, but a fall in the price of houses or in interest rates could reverse that situation.

Other Inflation Indices

The UK Government calculates other inflation indices to assist its management of the national economy, and to guide its budgets for social services expenditure. The RPIX index excludes mortgage interest payments, and is thus decoupled from fluctuations in the housing and financial markets. The RPIY index also excludes all indirect taxes (such as value-added tax and excise duties) and thus reflects underlying price changes in the commercial market for goods and services, undistorted by the government's fiscal policy. The Tax and Prices Index (TPI) includes all direct and indirect taxes as well as national insurance contributions, and is used along with data on national incomes to calculate the extent by which a typical taxpayer's standard of living is likely to be increasing or decreasing. Other indices are calculated, by the government

	% Average Annual Price Growth 1997–2007	% Average Annual Price Growth, Relative to the GDP Deflator
Labour	4.2	+1.7
Retail Price Index	2.8	+0.3
GDP Deflator	2.5	0
Consumer Price Index	1.9	
Inputs to mfg. industry	2.0	
Output from mfg. industry	1.4	-1.1

	£ Bn	
MoD's Net Cash Requirement, 2006-07	31.4	
Annually Managed Expenditure (mostly pensions)	0.6	
Cash Expenditure on Defence Capability	30.8	
Expenditure on Personnel	11.2	36%
Expenditure on Military Equipment	11.0	36%
Expenditure on Other Goods and Services	8.6	28%

and by various charities, to show how current price inflation affects particular groups within society having patterns of consumption significantly different from the average.

The GDP deflator covers the whole UK economy, including about 40% of total expenditure which is now allocated to a wide range of public services (education, health, defence, highways, etc.) provided by national and local government organisations. Over the last decade the GDP deflator has been very similar to the RPIX index.[2]

All of these indices are designed for different purposes and all show different values of inflation. None of these values is more 'right' than any other, and different individual households are differently affected by current changes in the prices of the myriad of goods and services in the market. Similarly, each of the government's Departments of State, each of which procures a different mix of goods and services, is differently affected by current changes in prices.

The Price of Labour

In recent decades the index of personal earned income in the form of wages and salaries (i.e. the price of labour) in the UK economy has risen about 1.7% faster than the GDP deflator, because of ongoing improvements in labour productivity which have continued since the Industrial Revolution. Such improvements tend to be larger in production industries than in personal services (output per worker in manufacturing industry has increased over the past decade by about 4% per year). The price of each item in the RPI is built up by increments of value added in production, distribution, marketing etc., so the prices of different items are variously affected (according to the proportions of value added) by increases in the productivity of those activities. Items which incorporate a particularly high proportion of their value added from personal services (such as residential care for the elderly) tend to rise more rapidly than others.

The various UK price indices[3] can be ranked according to average annual growth over the decade 1997–2007, as shown opposite.

Although the price of output from UK factories has grown by only 1.4% per year, the retail prices of the manufactured items within the RPI may have grown faster because of higher price growth in services (such as distribution).

The MoD Budget and Defence Price Inflation

The MoD budget can be divided into three principal categories – personnel, military equipment, and other goods and services. Military equipment can be further divided into combat and non-combat equipment. Combat equipment is directly involved in active operations, so that its effectiveness depends both on its own performance and on the threats presented by enemies. Non-combat equipment (such as transport vehicles) fulfils a distinctively military function, but its ability to fulfil that function satisfactorily does not depend significantly on the threat. The category of other goods and services covers items (food, fuel, office equipment, etc.) which perform essentially civilian functions and which appear also in the RPI. Even those items sometimes have to have special features to meet MoD requirements; anything likely to be deployed overseas must be robust and securely packaged, and even equipment for MoD offices in the UK may have more security features than the corresponding commercial equipment. The boundaries between the three main categories are not explicitly presented in current MoD accounts,[4] but estimates are presented in the table above.

Personnel

The MoD spends about 36% of its annual budget on the services provided by its Service and civilian personnel, and their wages must (to maintain satisfactory levels of recruitment and retention) rise broadly in line with the general level of wages in the UK economy. During periods of arduous and/or unpopular operations, Service wages and associated expenditure on Service personnel may have to rise faster than the general level of wages. In commercial organisations progressive improvements in productivity allow their business to be undertaken with ever fewer staff, but MoD personnel levels are set by the demands of future operational scenarios and must remain at those levels, even if its peacetime activities could be done more efficiently. For these reasons, the level of price inflation affecting this part of the MoD budget must be larger than the GDP deflator, probably about 1.7% higher.

Military Equipment

Almost all of the items in the category of military equipment (development and production of bespoke equipment, procurement of equipment off-the-shelf, and support of equipment in service) are delivered by manufacturing industry, and accordingly their prices might, other things being equal (which of course they are not, because of the particular characteristics of the defence equipment market), rise about 1.1% more slowly than the GDP deflator because of the impact of greater productivity on the manufacturing processes, which ought to affect the defence sector of manufacturing industry as well as the civil sector.

However, because most types of defence equipment are manufactured over a long period to rigorous and pre-agreed specifications, defence contractors have less scope than their civilian counterparts for adjusting the design or manufacture of such equipment to minimise the impact of input price

increases (for example, of rare materials) and it is appropriate to make an (arbitrary) additional allowance of 0.5%. The actual size of this allowance could be calculated from a detailed analysis of the volatility of the prices of inputs to the defence sector of manufacturing industry.

Military Equipment – Inter-Generational Escalation

Part of the MoD budget (probably amounting to two-thirds of the expenditure on military equipment) is spent on the acquisition of combat equipment for its armed forces. It is understood that within most classes of combat equipment (such as fighter aircraft) the unit cost of equipment increases from one generation to the next[5] by a factor of between three and ten (with a few exceptional classes outside this range), equivalent to a trend of 5–10% per year.[6] Equipment incorporating mature technologies tends to appear at or below the lower end of this range, and equipment exploiting rapidly advancing technologies tends to appear at or above the higher end. Such increases in unit cost occur in each class of equipment only infrequently, when a new design replaces its obsolescent predecessor in military service, but in the whole of the MoD's equipment acquisition programme such increases occur in a virtually continuous stream, and provide an average underlying cost growth of around 7.5% per year in the budget for the acquisition of combat equipment. Because the new combat equipment generally provides the same military capability against an enhanced threat (e.g. an acceptable probability of victory in aircraft v. aircraft or in tank v. tank battles during conventional warfare, or an acceptable probability of survival in a patrol vehicle exposed to the hazards of asymmetric warfare), it would be inappropriate to adjust the cost of the new equipment to allow for quality change (as is done within the RPI when successor products provide superior performance to the consumer). In some exceptional cases, where a new class of military equipment is introduced or where a breakthrough in military technology (such as stealth or Chobham armour) does provide a substantial increase in military capability against the threat, some price adjustment for quality could be calculated, but such exceptions are neglected in this analysis.

A more accurate figure (than the assumption of around 7.5%) could be derived from the proportions of the equipment budget devoted to different classes of equipment and from parametric analysis of the current trend of inter-generational price growth within each class. This calculation would require access to classified MoD data and even then the result could not be rigorously accurate, since there would be doubts about current price growth in the various classes and about any possible adjustments for quality. But even an approximate figure for the underlying price growth would be superior to the current practice of neglecting it entirely.

The price of non-combat military equipment need not increase to match ongoing developments in the threat. The quality of successive generations of such equipment may have to rise to match the expectations of recruits, but this factor will not be considered here. It may therefore be concluded that the price of military equipment increases, due to inter-generational price growth, by (7.5% x $^{2}/_{3}$) = 5% per year.

It is relevant that the MoD is not the only Department of State to be affected by this problem. The NHS has to spend part of its budget on ever more sophisticated and expensive drugs to counteract increasingly virulent bacteria that have now evolved to resist the cheaper drugs which have been used for some years. However, the NHS spends a smaller proportion of its budget on clinical supplies than the MoD spends on military equipment, so for the NHS this problem is less severe.

Military Equipment – Escalation During Procurement

The price of military equipment also tends to vary during the development and manufacturing phases of the equipment life cycle, as technical and management problems are resolved favourably or unfavourably. In

Category	Fraction of MoD Budget	Category Price Growth Relative to GDP Deflator	Contribution to Price Growth Relative to GDP Deflator
Personnel	0.36	1.7%	0.61%
Military Equipment	0.36	6.2%	2.23%
Other Supplies	0.28	0.3%	0.08%
Total			**2.92%**

principle, such variations could be upward or downward, but in practice the initial forecasts of cost tend to be over-optimistic and most revisions are upward. The National Audit Office regularly presents, as part of its annual Major Projects Report, the in-year variation in the reported procurement cost of the MoD's largest projects (about 20 in each year). These reports show that the reported procurement costs of the largest projects have increased in recent years by an average of 1.1% of their approved budgets. However, these reported costs are often distorted by reductions in the specification and/or the number of equipment to be procured and by accounting adjustments which allocate costs from a project to another part of MoD's budget. Allowing for such distortions, it appears that in recent years the actual increase in the MoD budget required to maintain the planned procurement programme for major projects has averaged 2.7% per year (though there is considerable variation from one project to another and from one year to the next). This number is assumed to be representative of the whole equipment programme.

Ideally there would be no 'conspiracy of optimism' between Service customers and industrial suppliers in the initial forecasts of equipment project costs; such cost forecasts would be unbiased, and the average annual increase in the cost of the MoD's equipment programme would be zero (masking some inevitable upward and downward variations in the costs of individual projects). In practice, however, the 'conspiracy of optimism' does exist and has endured through several well-meaning reforms of MoD procedures,[7] as the responsible stakeholders seem unable or unwilling to correct it. Whatever the reason, the tendency for the prices of equipment projects to rise during procurement is an observed fact (which is regrettable, but is as real as any increase in retail prices caused by a monopolist extorting excess profits) and thus should be included in a defence inflation index.

Assuming that the upward trend in projects' costs affects their procurement budgets but not their budgets for in-service support (which amount to some £3.8Bn of the £11Bn spent on military equipment), its overall effect on the budget for military equipment would be: (2.7% x 7.2/11.0) = 1.8%

This section suggests that the price of military equipment acquisition might be expected to increase at an annual rate above the GDP deflator of: (-1.1 + 0.5 + 5.0 +1.8) = 6.2%.

Other Goods and Services

The remainder of the MoD budget is spent on other, essentially civilian, goods and services which are not subject to the same military imperative to match enhanced threats, do not present the same problems of cost forecasting, and can be procured under relatively short-term contracts. While the composition of this sector of the MoD budget is very different from the range of goods and services in the RPI and, therefore, its price index will reflect differently the current variations in market prices of particular goods and services in any particular year, the price index for this category is likely to increase broadly in line with the GDP deflator.

Caveat

It must be emphasised that all of the figures in this section are illustrative and not definitive; the argument has been put in a numerical format only in order to clarify the issues and to facilitate further discussion. The annual argument over whether a planned increase in the defence budget is 'real' could be more constructive if the MoD undertook (or commissioned) a review of its expenditure to generate more authoritative data.

Conclusion

A detailed comparison between defence inflation and the GDP deflator would demand more detailed data on MoD expenditure than is available in the public domain, and is accordingly beyond the scope of this paper. However, the speculative and approximate calculation in the table below suggests that defence inflation is likely to be consistently about three percentage points above the GDP deflator.

It follows that if the UK Government intends to maintain the nation's military capabilities at their planned levels, it must provide increases in the annual MoD budget which are about 3% (or whatever similar percentage is derived from a more rigorous analysis) higher than the predicted values of the GDP deflator. If the government decides to provide a smaller increase, it should explicitly agree with the MoD the resulting savings in personnel and/or equipment, and acknowledge the associated reductions in the UK's military capabilities. If it fails to acknowledge those reductions, and the defence budget is accordingly overstretched by a mismatch between the MoD's resources and its aspirations, it is tempting for the MoD to make false economies (e.g. via delays to projects or inadequate risk management) which solve its immediate budgetary problems, but which in the longer term degrade the cost-effectiveness of the UK's armed forces. ■

NOTES

1 Office of National Statistics, Consumer Price Indices – a Brief Guide, Unpublished

2 Anis Chowdhury, The GDP implied deflator, Economic & Labour Market Review, Volume 2, No. 6, June 2008, pages 53–56

3 Office of National Statistics website, www.statistics.gov.uk

4 DASA, UK Defence Statistics 2007, The Stationery Office, London 2007

5 D. L. I. Kirkpatrick, The Rising Cost of Defence Equipment – the Reasons and the Results, Defence & Peace Economics, Volume 6, pages 263–288, 1995

6 P. G. Pugh, Performance-based Cost Estimating, Unpublished

7 W. A. Chin, British Weapons Acquisition Policy and the Futility of Reform, Ashgate, England 2004