Strategic Trends in Defence inflation

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Objectives of the Presentation

- Provide a view on the challenges for defining and measuring defence inflation.
- Identify and discuss areas of interest.
- Share the knowledge with the costing community.

Presentation Content

- Revisit what we mean by inflation and challenges
- Develop a defence inflation framework
- Review input price inflation and review recent work
- Consider production rate/volume in terms of learner behaviour
- Social trends – considering impact of two areas (Women's service roles and Crown Immunity)
- Social trends – a classical economic model to describe trade off between national security and other needs
- Tentative conclusions

What is inflation?

- Classical economic description:
  - "the annual rate of change in the prices of goods and services which are marketed within a national economy"
- Different products and services present a set of challenges:

Primary products of agriculture and mining	• Enduring and well defined. • Easy to measure in terms of change in the price of a given product.
Manufactured products (such as consumer electronics)	• Obsolescent designs are continuously replaced by newer designs having superior performance. • Prices adjusted downward to allow for the change in their quality relative to their predecessors. • Quality measured in terms of benefit to the consumer. • Inflation is measured as the change in the price of a product offering the same benefit.
Services (such as health, education, law and order and defence)	• Benefits are multi-dimensional and time-dependant. • Measurement of performance against multiple 'targets' have provoked controversy. • Often resort to simply considering prices of inputs, such as teachers and textbooks. • Defence is a service industry whose output is particularly difficult to define as we will see later.

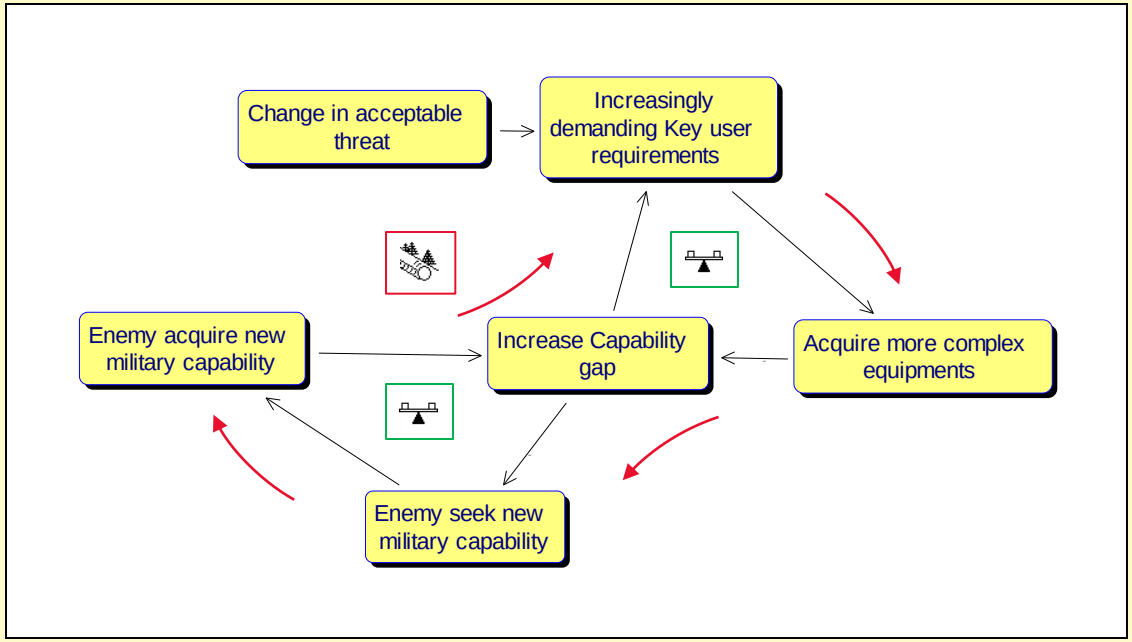
What is inflation?

- National aggregated measures
  - Each of the multitude of goods and services in a modern national economy has its own particular value of inflation;
  - Combine into ‘baskets’ holding a specified mix of goods and services to form overall inflation indices;
  - Retail Price Index;
  - Gross Domestic Product deflator.

- The unit price of any product (= unit cost + profit) may fluctuate from year to year depending on market conditions, but the long-term inflation in the unit cost of any product depends on changes in its supply and demand. These in turn are driven by
  - Prices of inputs;
  - Efficiencies in design and production;
  - Market structures (e.g. Monopolistic);
  - Social trends and legislation.

Challenges for defining and measuring defence inflation

- Defence poses several unique challenges for defining and measuring inflation.
- Primary output of MoD defence expenditure is the present and future national security of the UK.
- This depends not only on level of expenditure but on a variety of complex factors:
  - Present and future military capabilities and intentions of allied and hostile nations, which are themselves affected to some limited degree by the UK's own defence policies and planning;
  - This can generate the escalation or positive feedback loop.



A formal definition for defence inflation

- Based on the challenges described earlier, we propose that the fundamental definition of defence inflation should be:

"the annual increase in the defence budget which is necessary to deliver a constant level of national security"

Rather Than:

Classical economic description

"the annual rate of change in the prices of goods and services which are marketed within a national economy"

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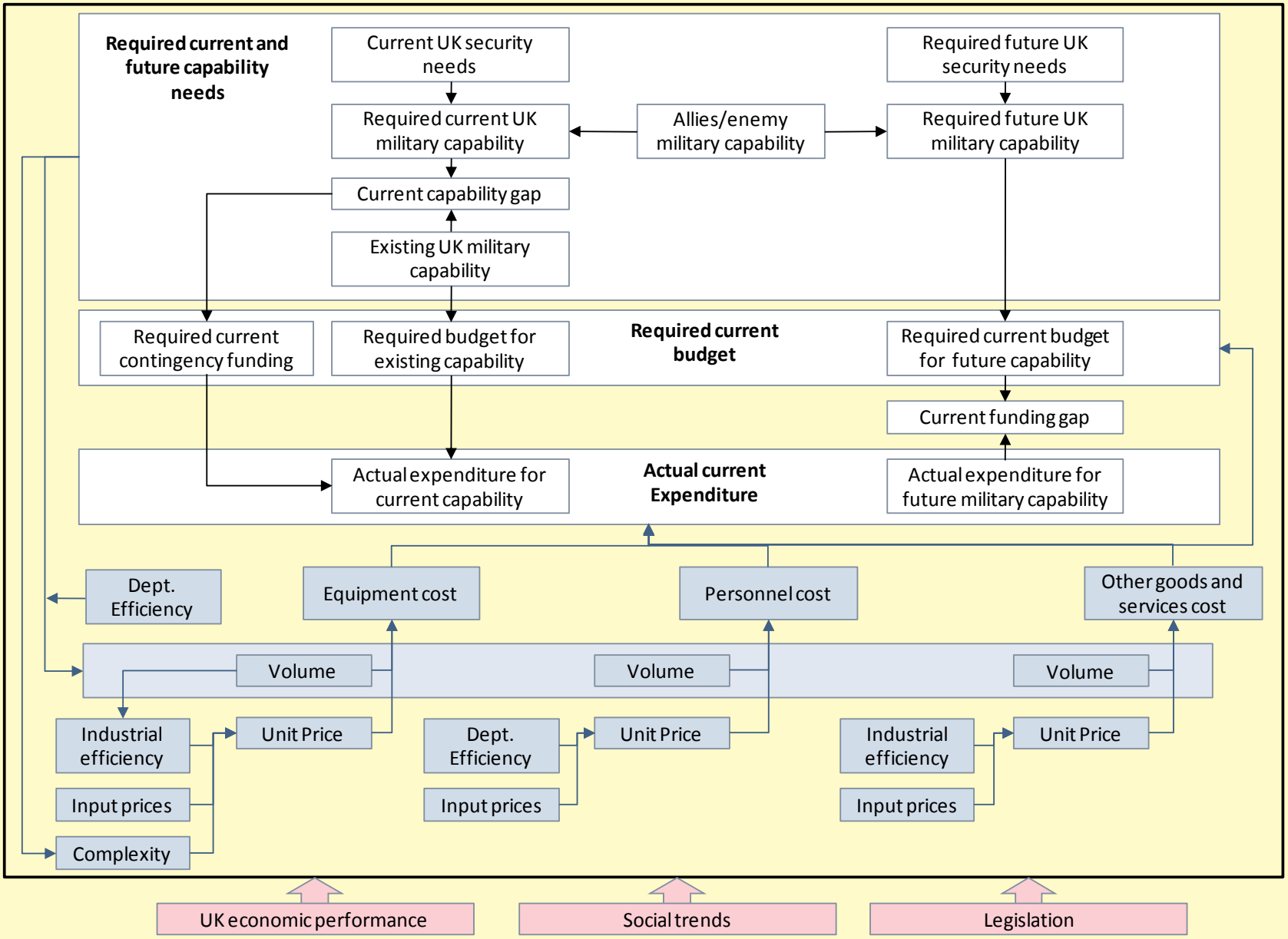
A framework to describe defence inflation



Expenditure cost streams

- We have broken down the cost of delivering defence capability into three key cost segments. These are:

Equipment costs	• Cost of the acquisition, support and operational cost of defence equipment (excluding service personnel). • This could be further disaggregated into acquisition and support.
Personnel costs	• Cost of the uniformed and civilian staff within the Department delivering defence capability. • It will also include the cost of pensions as well that are being incurred at the present time from personnel working in the past.
Other goods and services costs	• Cost of items bought in by the Ministry and cannot typically be described in defence terms.

Defence inflation components (1)

- We have identified 5 defence inflation component types:

1. Volume	• Number of a particular items required (personnel, aircraft, facility management contracts). • Delivering UK defence capability will require a large number of different items that may be influenced also by Departmental efficiencies. • In the case of equipment, we have represented explicitly a link to industrial efficiency. This is to recognise the importance of learner factors within a project as well as degrading the ROI on long term capital investment .
2. Input prices	• Prices of the inputs that are required to generate the unit of volume. • For the equipment line, this can be raw resources (steel, labour) if looking at the whole value chain or bought in components if focussing on final integration. • For personnel line, processes will be capitation rates for Ministry employed and will also include pension contributions. The unit prices of MoD's military and civilian personnel will probably match the growth in national wage levels and hence are a few percent larger than the GDP deflator. • The unit prices of other (non-military) goods and services are also probably close to the GDP deflator.

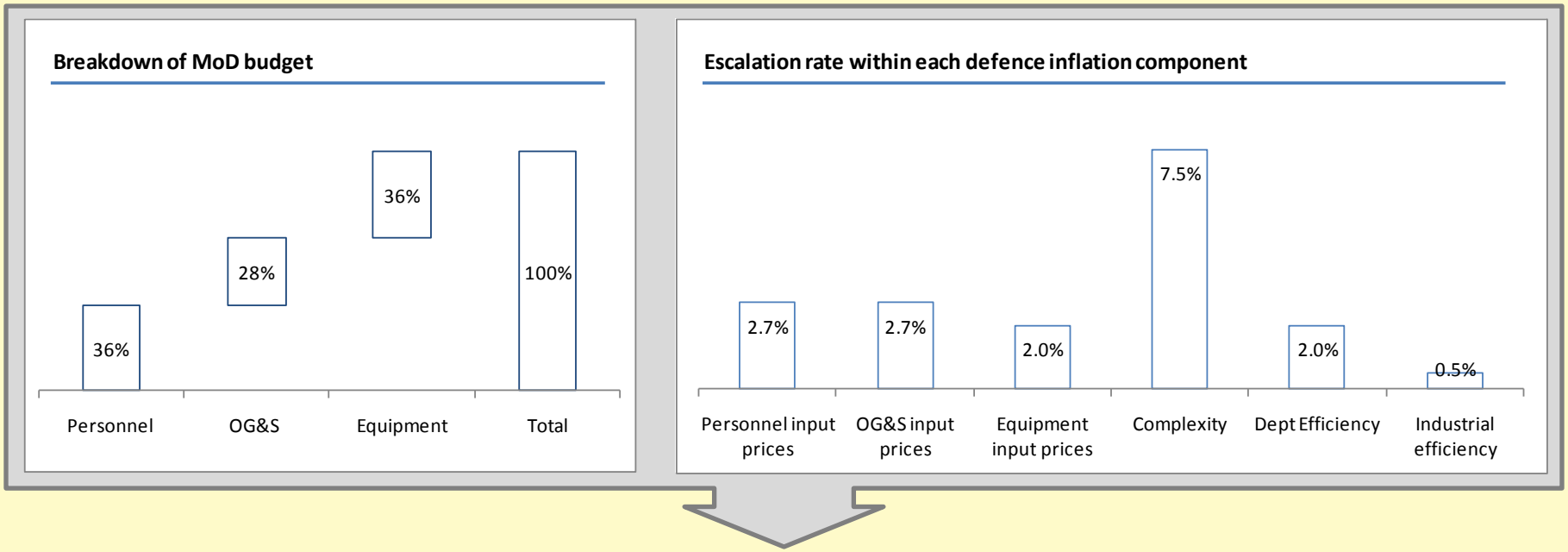
3. Industrial efficiency	• Reflects the ability of industry to operate at its most economic efficient level.
	• Include changes in productivity i.e. the ability to get more output from less resource inputs.
	• Unit cost of equipment to MoD may be affected by changes in the efficiency of the industrial contractors supplying such equipment due to:
	  • Developments in their production processes;
	  • Economies or diseconomies of scale arising from growth or shrinkage in demand from UK and foreign customers;
	  • Mergers and acquisitions.

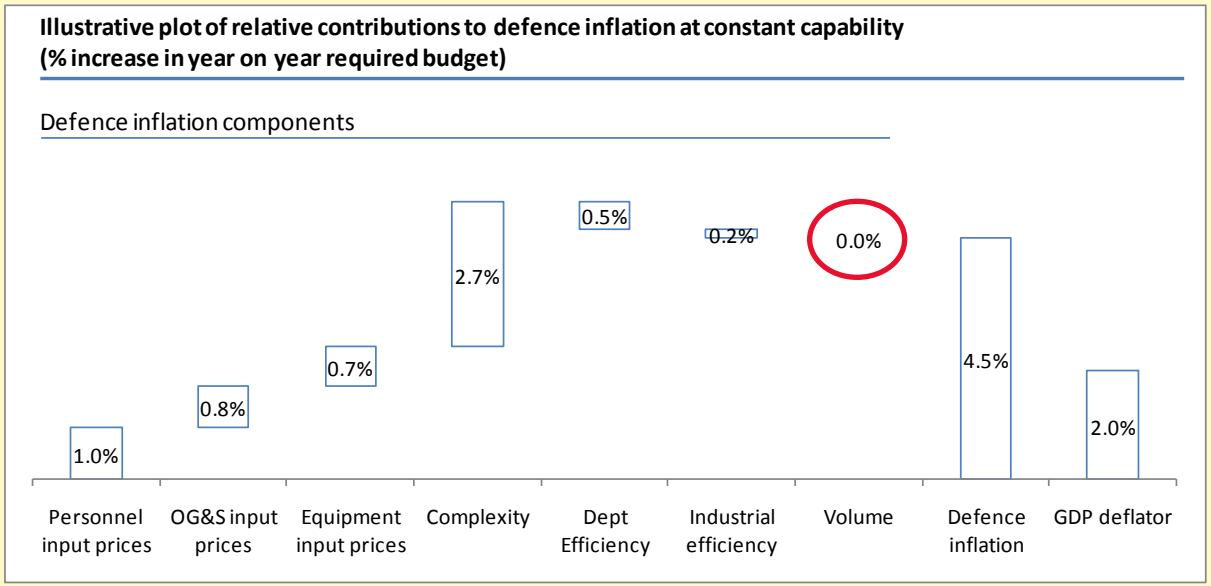
Defence inflation components (2)

4. Departmental efficiency	• Represents ability of Department to minimise the volumes of units required to deliver the required military capability. • Can be across all the acquisition cycle and operationally. • Will argue later that optimism bias introduces inefficiency in the Department and also a knock on effect within industry.
5. Complexity	• Represents the sophistication and complication of weapons systems and other equipment. • Will drive change in the scale and mix of input resources (with their associated input prices) that are required to deliver the capability. • Not be confused with volume – indeed the two are typically traded in acquisition decisions. • Evidence is that there has been a trajectory of ever increasingly complex equipments with corresponding cuts on asset numbers for many systems. • Complexity is driving what is also termed inter-generational cost growth. • Contributes primarily to the equipment cost element. • Personnel – not a driver. • Other Goods and Services - is assumed that these are typically in areas that are relatively simple and mature in the wider economy.

How can these defence element components add up?

Preliminary
For discussion





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These components have been considered in a variety of other studies

- Recent discussions in RUSI Defence Systems
  - Key areas of discussion were in inter-generational growth and ability to win efficiency savings.

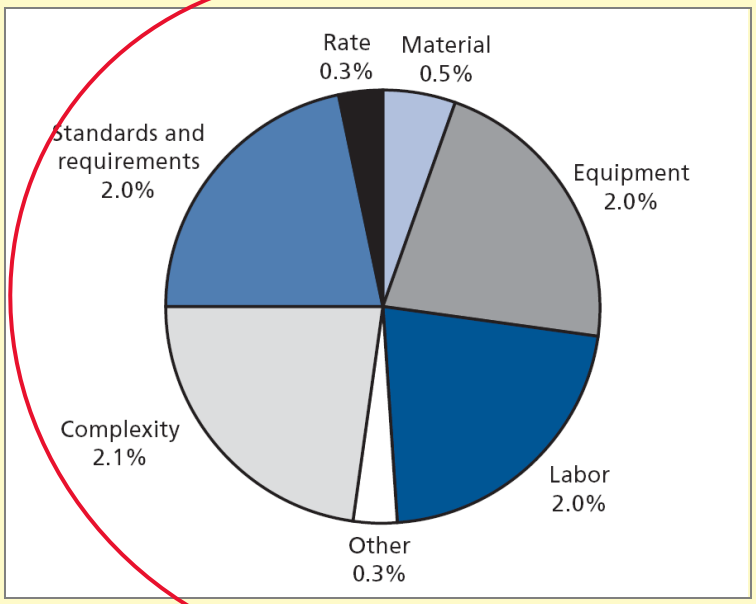
- Kirkpatrick , Pugh, Augustine
  - Series of vicious loops.
  - Arms race – escalation archetype (clear in Cold War – still going?).
  - Reduced production numbers lowering production efficiency and increasing unit costs….
  - Increasing requirements driving development costs slowing acquisition cycle and requiring larger technology leaps…

- Chalmers et al
  - Efficiencies can be achieved – transition underway in parts of defence community to help bring down inflation.
  - Manpower.
  - Acquisition reform.

These components have been considered in a variety of other studies but the inclusion of volume is a key addition

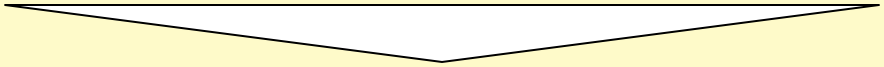
- RAND Corporation undertook a study of causes of unit cost escalation in warships (average of 9.2%pa).

Complexity and efficiency



DSB 10 – MoD latest defence inflation methodology

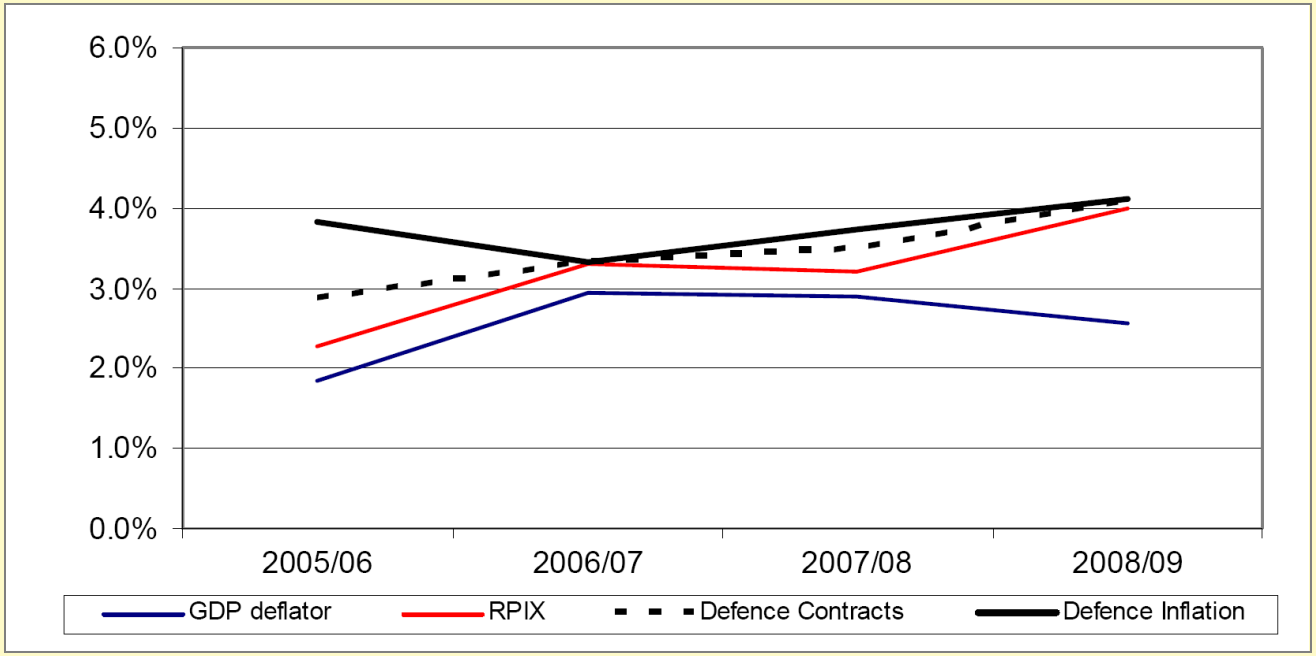
- DASA has undertaken a major push to develop methodology.
- Focused on a traditional economic model – the Lespeyres approach using a chain linked indices to allow for changing mixes of expenditure.
- Determines from MoD accounts the levels of inflation in the unit costs of personnel, non-military goods and services and military equipment under existing contracts.
- Limitations:
  - Short time window;
  - No account of increasing complexity driving long term inter-generational cost growth;
  - Poor at accounting for transfer of personnel from service to civilian.



- Likely to reflect only the impact of input prices and industrial efficiency.

Recent work on defence input price inflation (DSB 10)

Measured annual inflation rates 2006/2009

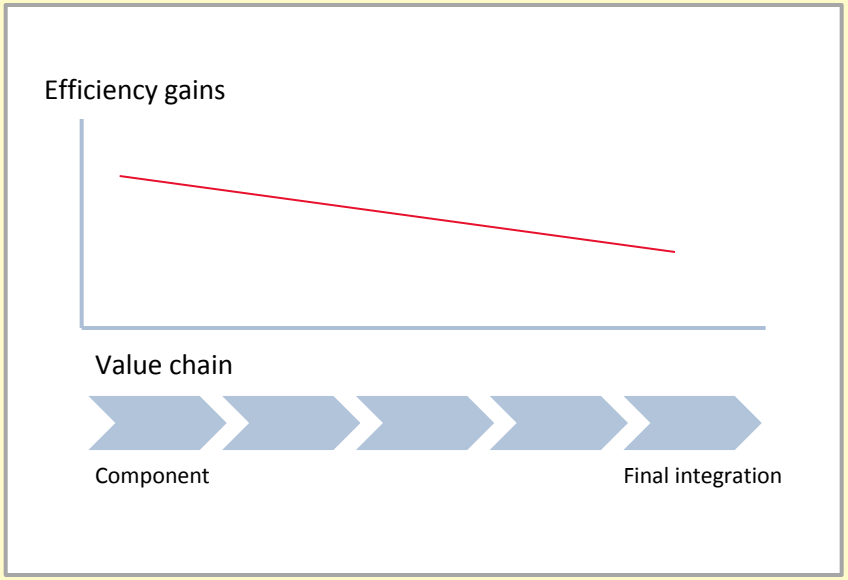


- Close alignment to RPIX as expected
  - Limited time window
- Even able to explain the larger discrepancies in 2005/6 and 2008/9.
  - Former to an adjustment in Superannuation;
  - Latter because of the Sterling weakness against currencies in which a number of contracts are placed (DSB 10 quotes that over £4B spent each year in foreign currencies).

Labour productivity across the value chain has grown at 6% pa

Turnover/employee (£000, 2008 ec)

Hypothesis – illustrative balance of productivity gains



- Improvement in the productivity of contractors is likely to be lower than the concurrent productivity growth in other, commercial sectors of the UK economy.
- Commercial contractors have greater freedom to modify their product designs and their production processes in response to different levels of inflation across the range of their inputs.

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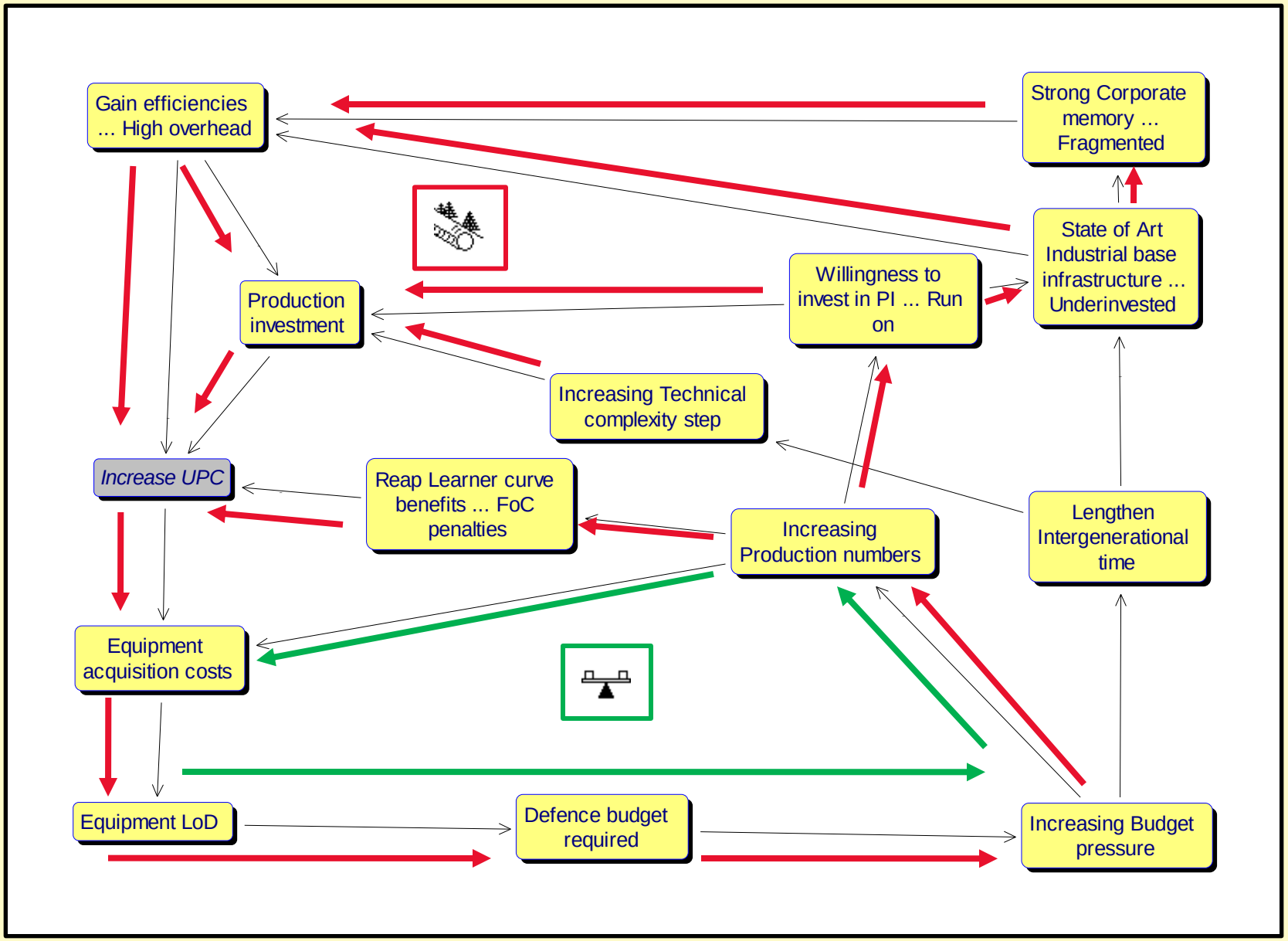
Many causal loops can be found if we look at drivers of inflation components – consider efficiency and productivity



Production Investment and Return On Investment Decisions

- Large body of work looking at the impact of increasing unit production cost on numbers of equipments purchased. Unit Cost Escalation – Implications for Policy, P Pugh paper given at ISMOR 1997, The rising unit cost of defence equipment — The reasons and the results D Kirkpatrick, Defence and Peace Economics, Volume 6, Issue 4 December 1995, Arms Industry and the Globalisation Process, Keith Hartley, Centre for Defence Economics, University of York.
- Recent work undertaken by DAS with a specialist military vehicle company involved in design, development and manufacturer highlighted step change in design and PI investment driven by the quantity and production rate of equipment ordered.
  - For low quantity/rate the design approach to vehicle manufacture and the level of PI would be similar to that adopted by specialist high performance car manufacturers. Quantities in the low 100's would not justify a high investment in PI and the approach would be to use what tooling was available to specialist tier two suppliers.
  - Had quantity/rate increased there would come a point where investment in design for easy of manufacture, tooling and infrastructure would be justified economically in order to both achieve the required production rate and to contain and drive down unit production cost with the PI spread across a large number of units.
  - Had quantity and rate increased consideration of the approach to manufacturing would increasingly need be undertaken at the design stage and this could produce a different design.

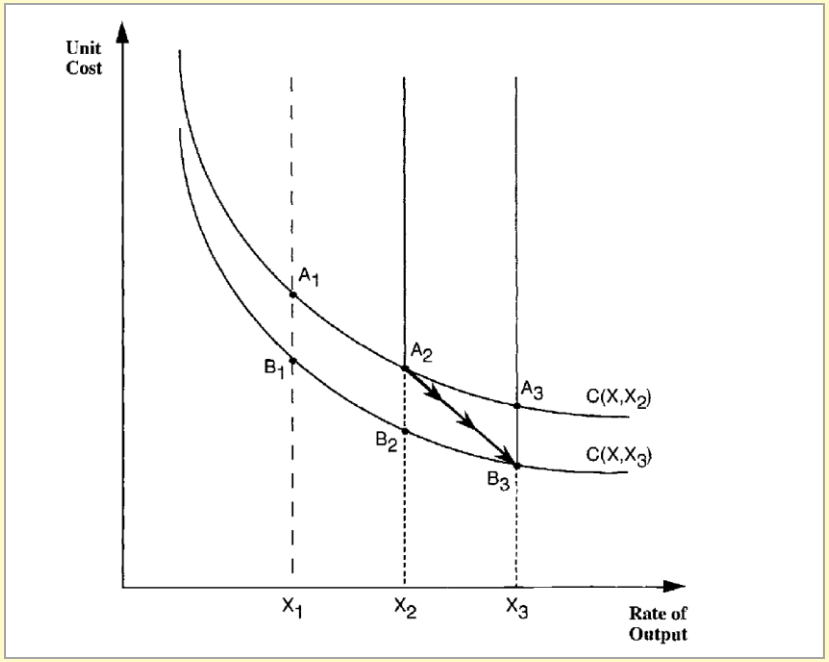
Production Investment and Return On Investment Decisions

- Design of any product is sensitive to quantity and rate and is an issue that the defence industry has been required to confront as production quantities have dropped.
- MoD continues to pursue strategies successfully applied in the commercial sector in the belief that these will drive down the cost of defence equipment. The adoption of techniques that are used with success in the commercial sector are not necessarily the right approach when you are considering the manufacture of small quantities i.e. 10 or few 100's. This is true in all three environments and is perhaps best typified by the use of computer based modelling for naval platforms made in one or two's off which can drive up development (first of class cost).
- Additional research is required to explore the link between unit cost of defence equipment and reducing procurement numbers .

Learner behaviour – cumulative and scale up production rate

- Learner curves have been well established for many years.
  - Adam Smith 1776!
- More complex models have been tested that suggest that scale up in rates can shift learner curves.
  - Increasing rates offers new opportunities to learn;
  - Cumulative production learning plateaus.
- Automotive sector and others have be scaling up over many years – challenging in defence where difficulty to extend production activity.
  - ROI not attractive

Shifting learner curve through rate of production



What is the role of optimism bias and conspiracy of optimism in defence inflation (if any)?

- Optimism bias manifested through the conspiracy of optimism by stakeholders widely recognised within equipment acquisition.
- True forecast costs of future capability are consistently under estimated. What does this affect?
  - Management of the near term budget;
  - Need to slow down or delay acquisition activities, change the requirements or even alter the unit volumes to be procured.
- The impact of optimism bias is best placed as contributing to the efficiency of the Department and to industrial efficiency.
- Not clear how much the impact of optimism bias has changed over time. That it is present is beyond doubt but if it is constant then it will not contribute to net inflation.
- If it is changing then it will have an impact on the rate of defence inflation over the years over which this change takes place.
- This is likely to take place over many years and is likely to deliver only a small contribution compared to the inter generational growth and that of the input prices.

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Social and legislation trend – are they important drivers of defence inflation components?

- Two areas considered.
- We attempted to scale impact.
- Loss of Crown Immunity:
  - In late 90's loss of accident immunity;
  - Created legacy safety case requirement;
  - Safety management moved from implicit activity to more explicit formal processes;
  - SME interviews:
    - Indicated that 5-10% of acquisition can be attributable to safety management but much activity was there before;
    - Key areas in increasing safety management work loads are complexity of systems, interfaces, and interoperability;
    - These align very much with our inter-generational complexity factor.
  - Our limited research does not indicate this as a key driver.
- Increasing role of women in active service
  - US Navy study has indicated that additional cost of $300,000 per bunk on submarine or $3,000 per bunk on aircraft carrier;
  - Additional welfare costs for pregnancy identified as fractional – less than cost spent on alcohol and drug dependence support;
  - Again does not appear to be a key driver.

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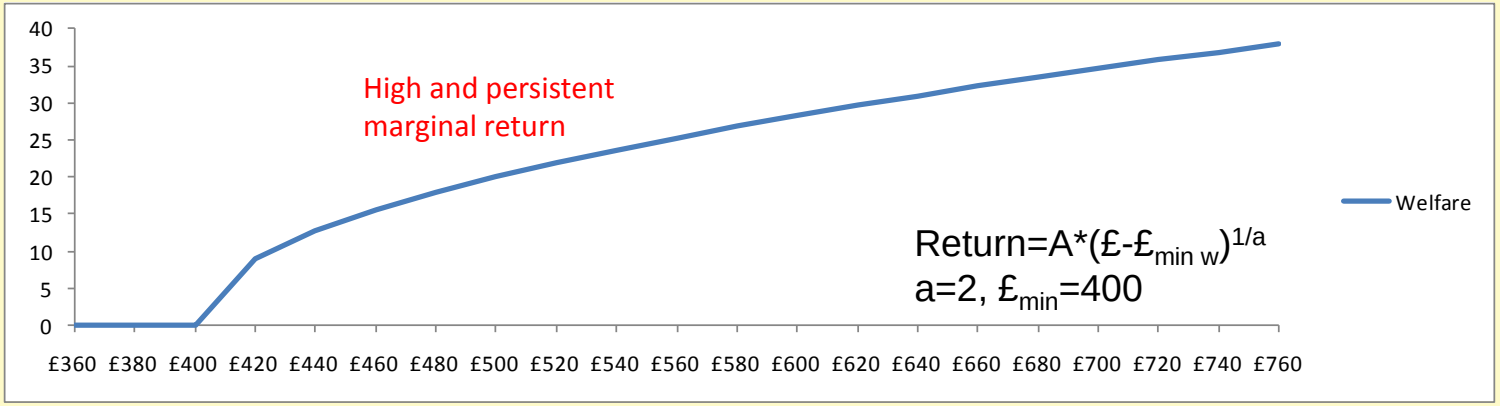
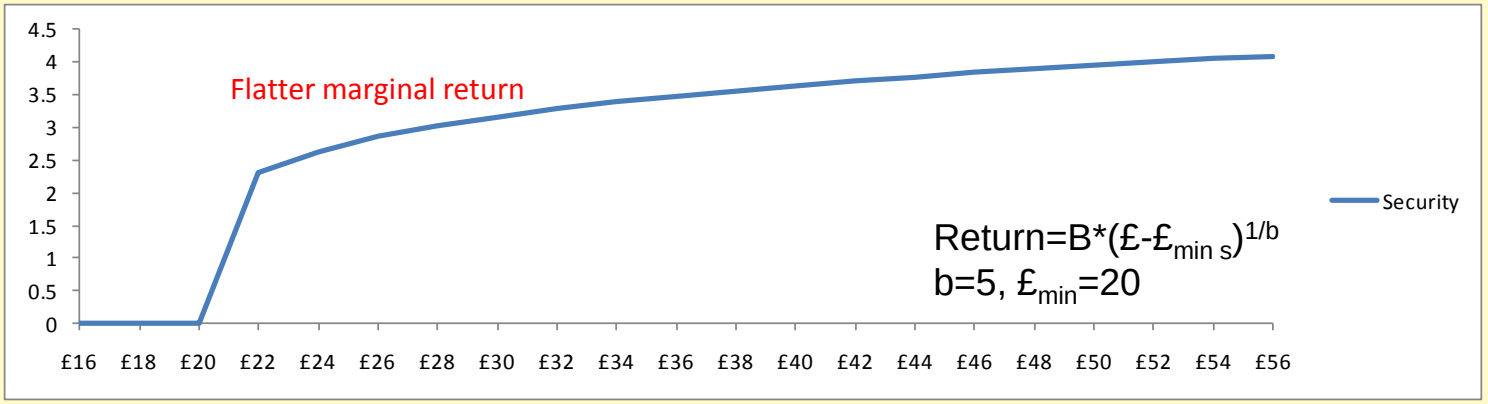
An economic model to describe how consequences of defence inflation will be managed? (1)

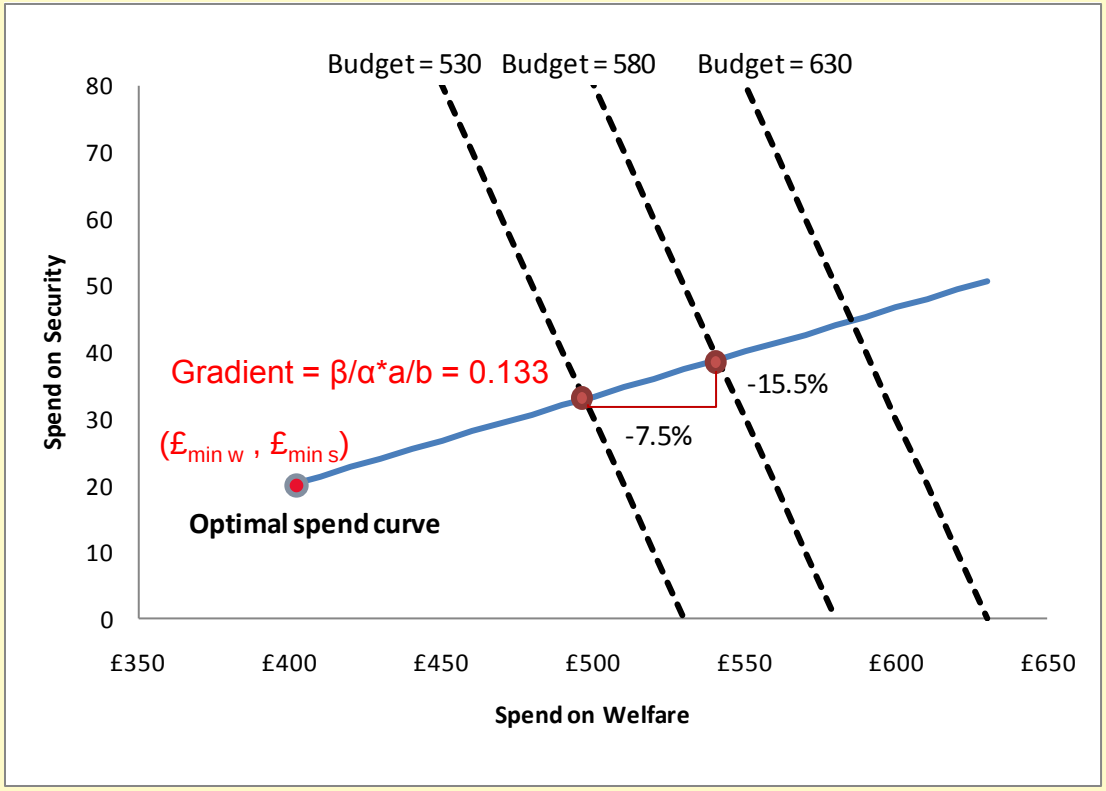
- Given that defence inflation is unlikely to align with GDP growth, the nation must trade off the need for national security and its welfare requirements.
- We can define a simple classical economics model to represent this.
- First we consider the marginal return of additional spending on each.





An economic model to describe how consequences of defence inflation will be managed? (2)

- Next we need to create a benefits algorithm to allow how nation values security and welfare collectively.
- Apply the well know Cobb-Douglas equation.
- Benefit = $W^{\alpha}S^{\beta}$ where $\alpha+\beta=1$ and say $\alpha=0.75$ and $\beta=0.25$.
- Combining our equations and assuming rational behaviour to seek optimal benefit then following plot can be constructed.



- This model provides a route to understand the implications of macro economic changes
- Gradient of optimal spend will shift as the Cobb Douglas indices change
- Social research can help populate these indices

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Conclusions and discussion

- We have provided a review of several avenues of research.
- Emerging conclusions are that defence inflation should be measured against a constant security need.
- This defence inflation can be decomposed into several components each of which can be measured. The volume is a key addition to this list as it allows the inter-generational complexity rise to be potentially offset by the unit volumes.
- There are multiple dynamic causal loops between some of these components.
- Key areas for further consideration:
  - Measuring capability outputs – has UK maintained constant security or a degradation in capability – defence inflation is then even higher if so!
  - More work on better understanding the unit volumes, production rates and PI decisions.
  - Link insights to industrial strategic challenges.

QUESTIONS

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