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The Economics of Defence in France and the UK

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1. Introduction

France and the UK face similar geostrategic circumstances: both were once Great Powers and still retain their positions among the five permanent members of the UN Security Council. During the Cold War both were dwarfed by the super-powers and were thus extremely sensitive about their status: what the French called their *grandeur* and the British called their seat at the top table. Despite their strategic similarities, they have differed in many of their defence policy choices and in particular how they balanced their strategic aspirations with their limited financial resources. Thus a comparison of British and French defence policies provides a revealing case study of military choices.

During the 1980s Jacques Fontanel and I conducted a comparative study of the defence effort in France and the UK, some of the results of which appeared in Fontanel & Smith (1985). That work was largely quantitative and directed to answering very specific and well defined questions. Here I will provide a more qualitative comparison of the structure and evolution of British and French defence policy. I will adopt an economic framework to structure this discussion based on the 'value chain' used in Smith (2009). The defence budget is set in the light of ability to pay and perceived threat. This budget buys forces, troops and equipment. The amount of forces acquired depends on the efficiency of the acquisition process and of the defence industry. This force structure provides military capability, including the ability to intervene in conflicts. This military capability supports the strategy by which a country maintains its security, given its place in the world. The policy problem is to maximise security subject to the constraints. In principle, solving such an optimisation problem involves thinking forward and reasoning back: working out where you want to be at the end and calculating how to get there in a way consistent with the available budget that equates the marginal security benefits of the defence budget to its opportunity costs.

In practice, the policy results not from constrained optimisation but from a less coherent process of political, bureaucratic and diplomatic battles. But for a long duration analysis of the type I

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wish to consider it is more useful to follow the principles and I will look at the elements of the value chain in the reverse order involved in thinking forward and reasoning back. I begin with security, the geo-strategic position and the use of military capability by the two countries; move back to their force structures; then consider the acquisition of labour, capital and technology to provide those forces and the industry that provides the weapons; then end with the defence budget and the budgeting process. Hartley & Macdonald (2010) provides more detail on the UK and Coulomb & Fontanel (2005) on France.

Strategy involves making and implementing hard choices; usually given a set of unattractive options, in an uncertain environment, with limited information. How these choices are made depends on the nature of the state and in many respects the French and British states are quite different. In the conclusion, I will make some comments on the efficiency of the process by which this was done in the two countries.

2. Geostrategic context and conflicts

From the successful invasion of Britain by the Normans in 1066 from France to the beginning of the twentieth century, Britain and France tended to be natural enemies and Britain repeatedly feared another invasion from France.² The enmity of Britain and France resulted partly from their contiguity and partly from their strategic objectives. From the 17th to 19th centuries, France tried to dominate continental Europe and Britain tried to ensure that nobody dominated Europe. Geography meant that France needed a large standing army, Britain a large navy. Occasionally they were allies, as in the 1853-6 Crimean War against Russia, though there is the, probably apocryphal, story that the British commander in Crimea kept calling the enemy the French rather than the Russians. The main change came with the Entente Cordiale in the early 20th century when both perceived that Germany was the bigger threat. France and Britain both acquired large colonial empires, though in somewhat different ways. Imperial history is controversial, but it has been suggested, for instance by Windrow (2010), that for Britain the flag tended to follow trade, sometimes rather reluctantly, while for France trade tended to follow the flag, again sometimes rather reluctantly.

Although their experiences during World War II were very different, both countries emerged from the war as impoverished victors: permanent members of the UN Security Council, with great power pretensions but little money. Among European countries, Britain and France are exceptional in having few doubts about the legitimacy of the use of force. As a result both have maintained the

² There is a myth that 1066 was the last time that Britain was successfully invaded. The myth was promoted by successful invaders, like the Welsh Henry Tudor and the Dutch William of Orange who, when they became King, did not want to represent themselves as invaders.

capability to fight and in the years following World War II, both did a lot of fighting. France withdrew from Indochina after the defeat at Dien Bien Phu in 1953. War started in Algeria in 1954 and by 1958 a large part of the French defence budget was directed to North Africa. The acquisition of power by General de Gaulle in 1958 was followed by withdrawal from Algeria, a progressive reduction in the defence effort and an improvement in the economic situation. The conflict in Algeria also caused a crisis in civil-military relations, which has no British equivalent. For France the large wars in Indochina and Algeria made decolonisation more traumatic than for Britain whose decolonising wars in Palestine, Malaya, Kenya, Cyprus and Aden were smaller. Britain fought in the Korean War, had a domestic insurgency in Northern Ireland, for which there is no French equivalent, and fought the Falklands/Malvinas War with Argentina in 1982. Britain & France fought beside each other in the 1991 Gulf War, former Yugoslavia, Afghanistan, after the 2001 invasion, and in the 2011 Libyan intervention; though they differed sharply on the wisdom of the invasion of Iraq in 2003. Both intervened in former colonies, for instance the UK in 2001 in Sierra Leone, France in a more extensive and systematic way, particularly in Africa. Both contributed to UN peacekeeping forces. Britain had gained a reputation for effective counter-insurgency after Malaya, Kenya and Northern Ireland, but this was somewhat tarnished by its performance in Iraq and Afghanistan. British troops have died in action in every year since 1945, with the exception of 1968.

Probably the crucial strategic episode for both countries was their joint invasion of Suez in conjunction with Israel, in 1956. They were forced to withdraw by US threats to their currencies; a rare example of the effective use of the threat of economic sanctions. Britain and France drew quite different lessons from the episode. Britain decided that since the US was a global power that could not be relied upon to support British interests, Britain must keep as close as possible to the US to try to exert influence. France decided that since the US was a global power that could not be relied upon to support French interests, France must establish its independence. This independence was subsequently signalled by President de Gaulle's withdrawal in 1966 from NATO's integrated military command, though not from NATO, on an issue of nuclear doctrine. President Chirac attempted to return France to the integrated military command in 1997, but could not agree terms; President Sarkozy achieved return in 2009.

With the collapse of the Soviet Union after 1990, neither country faced a direct military threat to their homeland and military power seemed ineffective against other threats like terrorism, global warming or economic crisis. But since both countries could see threats to their global interests, both continued to spend a much higher share of output on defence than other European countries.

3. Force structures

Both countries tried to maintain balanced forces that replicated, on a smaller scale, the structures and types of equipment of the super-powers. In both cases there was an element of façade: the forces looked more impressive on paper, or on parade, than in combat. This was revealed, for instance, by the limited forces that each were able to deploy in the 1991 Gulf War. In the case of France, Coulomb & Fontanel (2005) call this Potemkinism.

Britain tested a nuclear weapon in 1952, France in 1960. The UK got its nuclear weapons systems relatively cheaply, bought or copied from the US, particularly after the Nassau agreement between President Kennedy and Prime Minister Macmillan in 1962. France found the cost of financing the development of its independent nuclear forces (*force de frappe* or *force de dissuasion*) was high and at the expense of conventional forces, as Brauer and van Tuyl (2008) discuss. Between 1964 and 1969 equipment expenditure took over half of the French military budget, and in 1967 nuclear expenditures took half of the equipment expenditure. There was probably more opposition to nuclear forces in the UK than in France, but UK governments maintained the deterrent.

Britain announced the end of conscription in the 1957 defence review and the last conscripts finished in the early 1960s. France announced the end of conscription in the 1994 White Paper and the last conscripts finished in 2001. Partly because of the reliance on all volunteer forces, AVF, Britain tended to have fewer troops and a more capital intensive defence posture than France. For Britain, inter-operability with the US was important and this may have led to higher specifications for weapons relative to France. For instance in 1985 for very similar military expenditures France had 563,000 in the armed forces compared to 334,000 in the UK. Even by 2008, after the end of conscription, despite very similar military expenditures, France had 255,000 in the armed forces (plus 99,000 paramilitaries in the Gendarmerie) compared to the UK's 181,000. The Gendarmerie complicate comparison because there is no British equivalent. Although paramilitary, most of their activity is normal police duties. They are now under the authority of the Ministry of Interior, but for many years were the responsibility of the Ministry of Defence. After 2008 both countries announced large cuts in personnel numbers. The French in the 2008 and 2013 Defence White Papers and the UK in the 2010 Strategic Defence and Security Review.

The similarity in their geo-strategic positions made co-operation between France and the UK attractive in principle, but the dissimilarity in their interests, including their rivalry over dominance in Europe, made co-operation difficult in practice. Though there was some collaboration in weapons

procurement, such as the Anglo-French Jaguar aircraft (as well as the civilian Concorde), they often found it difficult to collaborate with each other and ended up competing. France withdrew from the Eurofighter consortium (now EADS, BAE and Finmeccanica) to build the Rafale. A late Cold War comparison is provided by Boyer et al. (1989). Despite the title *Franco British Defence Co-operation: A New Entente Cordiale*, the papers in the collection tend to bring out the difficulties of co-operation. Hartley (2008) discusses recent European defence collaboration. The European Union excludes defence from single market regulations under article 346, but from 2006 there has been an intergovernmental regime on defence procurement to encourage competition in defence procurement.

Britain had traditionally been sceptical about the European Security and Defence Policy, ESDP, preferring such issues be left to NATO, whereas France tended to support developing a European pillar, as long as it followed French policies. But in the 1998 St Malo meeting with President Chirac, Prime Minister Blair endorsed ESDP. It is unclear whether this endorsement helped ESDP, which was renamed the Common Security and Defence policy in the Lisbon treaty of 2007. Britain and France signed two Lancaster House treaties in November 2010 covering nuclear research, the development of a joint Unmanned Aerial Vehicle by BAE and Dassault and cooperation on aircraft carriers. These agreements reflect the financial pressures on both governments, and have been labelled an *entente frugale*.

4. Force acquisition and procurement

The defence budget is usually split into various sub-totals, including personnel costs; equipment expenditure to acquire new weapons; operations and maintenance costs, including fuel; research and development; and infrastructure such as construction of military bases and housing for troops. Good international data on these sub-totals are difficult to get, but they appear to differ substantially between countries. The cost of military personnel is less than a quarter of the US budget, and total personnel costs around a third, because it has a relatively capital intensive military. In the UK personnel costs are just over 40% of the budget and have tended to be closer to 50% in France. By international standards these are rather low proportions; personnel costs are often around three quarters of military budgets in countries that adopt more labour intensive military postures, as most do. The effect of moving to AVF on the share of personnel costs in the defence budget is ambiguous: the troops are paid higher wages but there are fewer of them. There are data for most members of NATO and Bove and Cavatorta (2012) use these to examine the determination

of the various shares of the defence budget, though they do not have data for France. They find no effect of the move to AVF on the share of personnel: the price increase and the quantity reduction offset each other. Fontanel & Smith (1990) look at the determinants of the composition of expenditure in France.

The relationship between the state and the military sector was rather different in the two countries, partly reflecting their different industrial traditions: French *dirigisme*, British *laissez-faire*. In France a tight symbiotic relationship existed between the procurement agency, the Direction Générale de l'Armement (DGA) and what were originally largely nationalised arms firms. There has been some privatisation, but the state still retains a considerable shareholding in many arms companies. Ownership does not imply control and state ownership can mean that the arms industry controls the state rather than the state controls the arms industry. Even when the firms are private, the state as sole buyer of weapons in the country, has considerable leverage.

In the UK in 1979 much of the British arms industry was state owned including four of the seven firms paid over £100m a year by the Ministry of defence. The Royal Ordnance factories had always been state owned; British Aerospace and British Shipbuilders had been formed through the 1977 nationalisation by the Labour government of aircraft and shipbuilding companies; and Rolls Royce had been nationalised in 1971 by a Conservative government after being bankrupted by the development of the RB211 civil engine. Subsequently, Mrs Thatcher privatised all the arms firms and introduced competition under Peter Levene, the head of defence procurement during the 1980s. This commitment to competition was given credibility by occasional purchases of foreign weapons. This reliance on competition and markets meant that from 1979 the UK did not have an explicit defence industrial policy until 2002, when the Labour Government announced one that developed into the 2005 Defence Industrial Strategy and a subsequent Defence Technology Strategy. The coherence and feasibility of these strategies were widely questioned.

In France, the DGA acted as a patron for the industry, using procurement and export promotion as part of a coherent industrial strategy developed over decades, in which defence firms, mainly state owned, had considerable freedom to develop weapons they thought would sell abroad. To a certain extent the armed forces and politicians were marginalised by technocrats trained at the Ecole Polytechnique who moved between the arms firms and the DGA. Kolodziej (1987) is the classic source.³ Because of the more positive attitude to the state in France than the UK, the human

³ Kapstein and Oudot (2009) comment that "Although the book was published twenty years ago its analysis of the DGA and the French procurement system remains compelling."

capital available to the French state was greater than in the UK where the best and the brightest tended to gravitate to finance rather than government.

Weapons acquisition involves hard choices between quantity, quality, time and cost. For instance, urgent operational requirements in combat have to be provided quickly, which adds to the cost, and must use readily available technology. Adding quality, through enhanced performance, faces rapidly decreasing returns, the marginal cost of extra performance rises as the target performance rises. At the top of the line, adding the last 5% to performance may double the cost. The contracting system also matters, both cost-plus and fixed-price after competition have major disadvantages. For instance, fixed-price contracts provide incentives to reduce costs, which cost plus contracts do not; but cost plus allows flexibility for design changes during the project, which are expensive under fixed price contracts. The UK has tended to alternate between the two methods as it discovered the disadvantage of each.

In terms of the efficiency of the weapons procurement system France seems to have done better than Britain. Kapstein and Oudot (2009) say “Beginning in the early 1990s, France embarked on a series of policy reforms that enabled the state to contain skyrocketing weapons costs. We emphasise three, inter-related aspects of the defence acquisition environment in France that favoured cost containment: first, hard budget constraints; second the great technical capacity that the French government brought to bear on the weapons acquisition process, coupled with its iterative relationship with a small number of suppliers; and third the use of contracting techniques that empowered project managers.”

In contrast, Bernard Gray, who wrote a scathing report on British procurement and subsequently became Chief of Defence Materiel, said in evidence to the House of Commons Defence Committee in January 2010 that when he began the review he was told by the Treasury (the UK Finance Ministry) that there were three main problems. Firstly the defence programme was substantially out of balance. Secondly there was a lack of clarity and leadership in the Ministry of Defence main building, particularly at the head of the organisation, and a lack of accountability and responsibility. Thirdly there were insufficient skills inside the procurement organisation, Defence Equipment & Support, to discharge the job. Lord Levene in his independent report to MoD on Defence Reform identified a structural ‘inability to take tough, timely decisions in the Defence interest, particularly those necessary to ensure financial control and an affordable defence programme’, Levene (2011, p13). There is some debate about whether responsibility for this recurrent imbalance between aspirations and resources should be attributed to planning failures by the Ministry of Defence or to

political failures by successive governments who were unwilling to make hard choices. Chin (2004) discusses the history of procurement reform in Britain.

A major cause of the UK programme being substantially out of balance was the lack of a hard budget constraint: projects were not cancelled if costs overrun. This reinforced the incentives for all the participants in the procurement process to contribute to a “conspiracy of optimism” about time, cost and performance. Then as the optimism proved ill-founded and the projects ran over-budget they were not cancelled. Instead the number purchased was reduced, increasing unit costs, and expenditure postponed, also increasing unit costs, creating what was called a “bow wave” of planned expenditure. Such postponement is not unknown in France, such as during the construction of the nuclear powered aircraft carrier, the Charles de Gaulle, during the 1990s, but has tended to be a greater problem in the UK. In 2010 the incoming Conservative administration claimed that there was a £38 billion funding gap between planned expenditure and available resources. This is close to one year’s defence spending. Chalmers (2011) discusses the size of the gap.

Lord Currie in his independent report to the Ministry of Defence on non-competitive pricing in the UK made very similar points to Kapstein and Oudot (2009) about the technical experience of the French DGA staff relative to their British equivalents, Currie (2011p52&139). But Currie rejected a move towards the French system of more legally formalised contracting system and less changes in requirement, because of the strong differences in culture and preferences between the two systems. Hard budget constraints, cancelling projects that went over time or budget would provide the right incentives against the optimism bias, but may not be credible in the UK. Currie notes that in the US programmes should be cancelled if a 25% overrun occurs, but they rarely are cancelled, since the Secretary of Defense can override this by submitting a report detailing why the programme is essential.

French foreign policy was often driven by the desire to export arms and that equipment was designed in the light of perceived foreign demand rather than French military needs, prompting complaints by the armed services. Coulomb & Fontanel (2005) comment that French arms exports were sometimes promoted without any economic or commercial logic, particularly when firms tried to compensate for domestic budget cuts by increasing exports. France lost \$1.2bn on the \$3.4 bn 1993 order for 436 Leclerc tanks for the UAE, mainly from problems with foreign exchange hedging. In 2003 the French government ordered the arms firms not to offer products below production price. The choice in February 2012 by India of the Rafale as the preferred bid in its fighter competition was said to be on the basis of a low price.

British foreign policy could also be driven by arms exports, in particular the Al Yamamah programme of arms exports to Saudi Arabia. The contract, initially signed in 1985, was worth about £40 billion over its first two decades and is still continuing today as Project Salam. Over the period 2008-2010, SIPRI records both countries as exporting arms of about one billion dollars a year, though earlier in the decade France had been exporting about twice as much.

5. Industrial Structure

Despite the close relationship between the French state and the arms firms, there has been much less restructuring and globalization of the arms industry in France than in the UK, where market forces have tended to operate rather more. This is reflected in the relative sizes of their arms companies. In the SIPRI (2012) ranking of arms producing companies, the European companies that appear in the top 10 are BAE Systems of the UK, ranked 2 with 2010 arms sales \$32,880m; EADS, a multinational company, ranked 7, \$16,360m; Finmeccanica of Italy, which is 30% state owned, ranked 8, \$14,410m. French companies (with their rank) in the list were Thales (11), Safran (16), DCNS (22), CEA (42), Nexter (55) and Dassault (61). Other UK companies (with their rank) were Rolls Royce (17), Babcock (29) Cobham (40), Serco (44), QinetQ (50), GKN (66), Chemring (74), Ultra (75), Meggit (82). Total arms sales by French companies, excluding the share of EADS, was \$20bn, total sales by British companies was \$50bn. Much of these revenues came from production abroad: BAE got much of its sales from production in the US and Thales got much of its sales from production in the UK.

While the DGA has tried to encourage consolidation and rationalisation, progress has been slow. French military industrial politics can be quite complex. The French state has a 27% shareholding in Thales. Dassault increased its stake to 26% in 2008, then replaced Denis Ranque, the chief executive who had built up Thales, by Luc Vigneron, who was himself replaced by Jean Bernard Levy in 2012. EADS had wanted to acquire Thales, but was stopped by the French state. In what the Financial Times (16/2/2012, p19) calls “one of those strange quirks of French industry, EADS owns 46% of Dassault Aviation but has no control.”

EADS was formed in 2000. In addition to its civil Airbus business, it has a substantial defence business including the troubled A400M transport aircraft; Cassidian, the German based defence subsidiary and produces a range of military helicopters through eurocopter. BAE had acquired a share of EADS as a consequence of the 20% British contribution to Airbus, but had disposed of its share in 2006 to concentrate on defence. The fact that the Dassault Rafale fighter aircraft had beaten the Eurofighter-Typhoon (produced by EADS, BAE Systems and Finmeccanica) for a large

Indian contract in 2012 prompted EADS and BAE to discuss merging. A merger would have created the world's largest arms producer. On SIPRI (2012) figures for 2010, BAE+EADS would have arms sales of almost \$50bn compared with \$36bn for Lockheed Martin. The issues that arose in the failure of the proposed merger of BAE & EADS are informative about European defence industrial policy.⁴

EADS is registered as a company in the Netherlands. France and Germany each held 22.5% of the company, France through the Lagardère company (7.5%) and the French state (15%) and Germany through Daimler (22.5%). The Spanish state has 5.45%. Both Daimler and Lagardère were reluctant owners, forced by their governments to hold the shares to keep the German and French holdings equal. Following the failure of the proposed merger, the French and German holdings were reduced to 12%.

Ian King & Tom Enders, the chief executives of BAE and EADS, said in a joint article⁵ that the merger discussion did not reflect weakness because the two firms "are both strong businesses with clearly defined strategies that have enabled them to make progress in the past five years, and which would take them forward as independent companies." However both companies were perceived to have certain weaknesses. BAE was seen as too dependent on defence, which looked to be a declining market. EADS was seen as too subject to the political influence of France and Germany. It had argued that state involvement in its ownership had inhibited its efforts to make a big acquisition in the US and may have hindered its bid to win the US military tanker order. King & Enders hoped that merger would reduce both the weaknesses: creating a normal company without state influence and equally balanced between civil and defence work.

EADS Vision 2020 Strategy set out in 2007 by Louis Gallois, Tom Ender's predecessor as CEO, was to turn EADS revenue stream into something similar to Boeing's with half coming from civil aircraft and half coming from defence, which was seen as less cyclical. Boeing and EADS both produce military aircraft, electronics, missiles and space equipment. BAE has a much wider defence portfolio also including military vehicles, artillery, small arms and ammunition and warships, both surface and submarine. Thus the BAE defence portfolio has a less good fit with aerospace than that of Boeing or EADS.

Many were sceptical of the merger on commercial grounds given the difficulty of successfully merging two very different companies and the fact that academic studies indicate that most merger and acquisition activity destroys value. BAE's past history of deal-making did not

⁴ These issues are discussed in more detail in Smith (2013).

⁵ Financial Times 1 October 2012.

inspire confidence. Many had questioned the wisdom of its recent US purchases, its 2006 sale of its Airbus stake or, further back, its acquisition and divestment of a car company, a construction company and a property company. The shareholders in the two companies chose to own them for rather different reasons and were not sympathetic to the merger. BAEs largest shareholders expressed opposition to the deal, partly because BAE pays a much higher dividend than EADS. EADS shareholders expressed concern that the suggested 60:40 split did not reflect the true value of the companies and this caused a sharp decline in EADS share price after the merger announcement.

While there were commercial questions about the merger and issues about what the merged company would be called, the main obstacles were political. Merger would have required approval by the governments of France, Germany, Spain, UK and US (since BAE produces so much in the US) and of the European Commission under EU Competition Law. One tension in the case for the merger was that commercial weaknesses were political strengths and vice versa. For instance, because the companies did not overlap very much, there were few economic gains from synergies or rationalisation, a commercial disadvantage; but there would consequently be few losses of jobs or sovereignty, a political advantage. After the discussion of the proposed merger leaked in September 2012 there was an intense international debate before the merger was blocked in October by the German government; apparently because there would be no German head office. Many were surprised by the fact that it was the Germans who vetoed the merger, while the French and British government were quite supportive of it. Whereas successive UK governments have been rather relaxed about the multi-national consolidation of the defence industry in response to market forces, French governments had been more cautious. Thus the support for the merger was seen as indicative of a change in French attitudes to the globalisation of the defence industry.

6. Budgets

The budgeting process appears to have been smoother in France than in the UK, which conducted regular agonised reappraisals during repeated defence reviews. Except for the 1997-8 Strategic Defence Review these reviews were prompted by economic crises. France had to make similar adjustments, but seemed to do it more smoothly, with fewer major White Papers during the Cold War period. There were major reviews in 1994 and 2008, and another smaller review in 2013 which continued the cost cutting. A simple model of the budgeting process is given in an appendix.

The long term pattern in the UK since World War II was for systems costs (e.g. the cost of a type of platform between generation) to grow around 5-10%p.a. in real terms, though this may be slowing. Defence budgets grew a lot more slowly. For a while, the imbalance would be pushed into

the future by postponing work on projects. At some stage the growing imbalance between resources, capabilities and commitments would become unsustainable and would be temporarily resolved by a defence review. The defence review would sacrifice capabilities and commitments bringing the programme back into balance. Then the imbalances would start to grow again. In recent years the problem has been worsened by the fact that UK Ministers of Defence have had periods in office as short as that of French governments during the Fourth Republic.

The share of military expenditure in GDP is usually a good measure of the opportunity cost of military expenditure in market societies. It is not a good measure when things are not valued at market prices, for instance because of rationing during wartime or because conscripts are paid below market wages. Share for the two countries 1948-2012 are shown in figure 1. They look remarkably similar, though the French share may under-estimate the opportunity cost because conscription was maintained for longer. In 1948 in both countries the share was between 5-6% of GDP then jumped to around 9%: Britain rearming for the Korean War, France spending on the war in Indochina. Subsequently the share fell in both countries, interrupted in the case of France by the Algerian conflict. From about 1960 to 1995 the British share was slightly higher than France. The marked increase in the British share after 1979 in response to the commitment to NATO for 3% growth and the tension following the Soviet invasion of Afghanistan is not matched in France. From the mid 1990s they are almost identical.

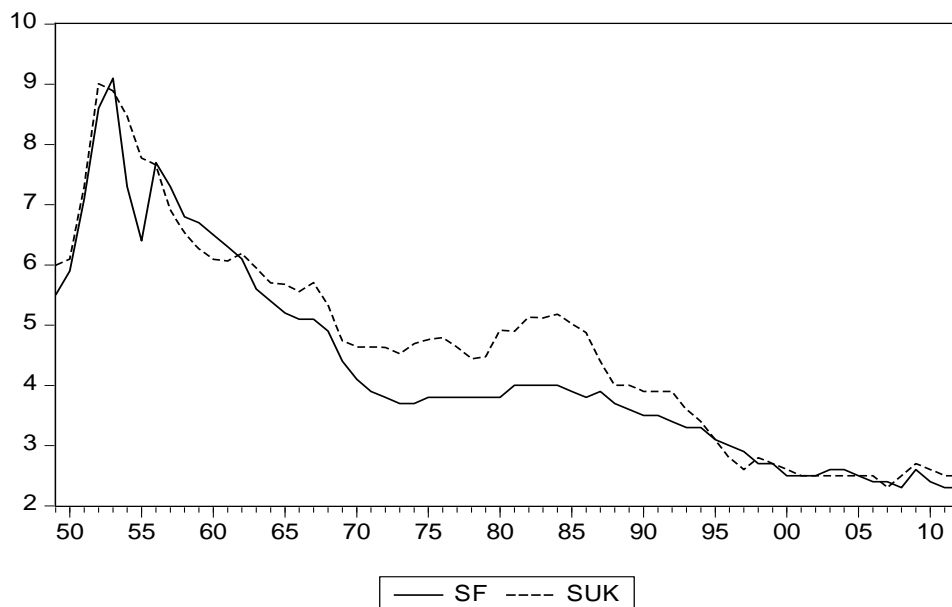


Figure 1. Share of Military Expenditure in the UK (SUK) and France (SF) 1949-2012.

In order to investigate the adjustment process that maintained this similarity, the Johansen procedure was used to model the shares of military expenditure in France, sf_t , and the UK, su_t , both of which are probably integrated of order one, $I(1)$. Despite the similarity in the graph over the period 1949-2012 there was little evidence of cointegration, though over the period 1960-2012, assuming unrestricted intercepts and restricted trends, there was evidence for one cointegrating vector. The long run relation for 1960-2012 (t statistics in parentheses) is:

$$sf_t = 0.894 su_t - 0.02 t + \hat{z}_t$$

(3.52) (-1.01)

The coefficient on the UK share is not significantly different from one, $t=-0.41$, so the long run relationship is for shares of military expenditure in the two countries to be equal. The vector error correction model is:

$$\Delta sf_t = -0.137 \hat{z}_{t-1} - 0.01 \Delta sf_{t-1} + 0.20 \Delta su_{t-1} \quad R^2 = 0.42; \hat{\sigma} = 0.11$$

(-4.07) (-0.09) (2.21)

$$\Delta su_t = 0.021 \hat{z}_{t-1} + 0.14 \Delta sf_{t-1} + 0.26 \Delta su_{t-1} \quad R^2 = 0.09; \hat{\sigma} = 0.18$$

(0.38) (0.66) (1.71)

Constants were included in the equations, but are not reported.⁶ The French share responds significantly to the deviations between the French and UK shares in the previous year and to the previous year's change in the UK share. The UK equation has no significant coefficients, so the UK share is close to a random walk, and more volatile than the French share, with a much higher standard error of regression.

These estimates suggest that it is the French share that adjusts to the UK share to maintain equality of shares of military expenditure in GDP. Of course, this is a very simple indicative model and the results may be sensitive to measurement errors and the inclusion of other variables, though the results are not changed when the US share of military expenditure is included in the system.

Conclusion

Efficient defence planning would ensure that the marginal security benefits of military expenditure equalled the opportunity costs. France and Britain valued the security benefits of

⁶ These estimates are very similar to those for the period 1960-2009 reported in earlier versions of the paper.

military capability much more than other European powers, such as Germany, and consequently spent a much higher share of output on defence. In 1985 the UK share was 5%, the French share 4% and the German share 3%. In 2007 the French and British shares were 2.5%, the German share 1.3%. Britain and France also did the bulk of European defence research and development. This willingness to devote a higher share of output to defence revealed the higher French and British valuation of military capability, including nuclear weapons and power projection possibilities, relative to other European countries. As the threat declined so did the share of military expenditure in output, but it remained well above that of their European neighbours. The military capability they could field declined through time partly because of the declining share and partly because of the relative price effect as the cost of subsequent generations of military equipment rose relative to the general price level, as discussed in the appendix. This drove capability down in both countries, perhaps a little more in the UK because of its higher capital intensity, its preference for performance and its poorer control of costs. The adjustment in France also seems smoother than in the UK, which showed abrupt resolution of recurrent contradictions through defence reviews. The relation between state and industry in the two countries was quite different, the British *laissez faire* versus the French *dirigisme*, and the British arms industry consolidated and globalised rather more quickly than the French industry.

The long-run downward pressure on capability is unlikely to disappear in the future and both countries face economic constraints, including the need to reduce the national debt, which will restrict the growth of their defence budgets in the medium term. While both countries retain a taste for military intervention, the limited budgets mean that they will need to prioritise the range of tasks that they will prepare for and the types of equipment required to complete those tasks. This will require abandoning some commitments and capabilities, purely because they are unaffordable. Choosing what to abandon (such as nuclear deterrent or power projection) and who will suffer (army, navy or airforce) will be politically sensitive. The choices may be made a little less hard, by more cooperation such as that envisaged in the 2010 treaties, but while strategic and financial pressures make cooperation attractive, the politics of the two countries make it difficult. Thus given past experience, one cannot be optimistic about the possibilities of cooperation.

Appendix

Suppose optimisation of welfare, a function of security and consumption, gives a demand function for military output with unit elasticities with respect to real income, Y , the relative price of military to civilian goods, P , and the threat T .

$$M = kYT / P \quad (1)$$

This implies that the share of military expenditure in GDP will be a function of the threat, which is an assumption widely used in the literature:

$$s = PM / Y = kT$$

Suppose the supply function is constant returns to scale Cobb-Douglas function of equipment (capital, K) and troops (labour, L) and efficiency, A .

$$M = AK^\alpha L^{(1-\alpha)} \quad (2)$$

Where α is the share of equipment in military expenditure $\alpha = P_K K / PM$, and P_K is the relative price of military equipment, P_L of military labour. Denoting logarithms by lower case letters and taking first differences of (1) gives an equation for the growth rate of real military output

$$\Delta m = \Delta y + \Delta t - \Delta p$$

And (2) implies that the growth rate of military prices is

$$\Delta p = \alpha \Delta p_K + (1 - \alpha) \Delta p_L$$

So the growth rate of military output is given by: the growth in output (ability to pay), plus the growth in the threat; minus a relative price effect which depends on the rate of growth of the prices of military labour and capital:

$$\Delta m = \Delta y + \Delta t - (\alpha \Delta p_K + (1 - \alpha) \Delta p_L)$$

Military wages tend to grow in line with the economy (even if conscripts are paid a fraction of the free market wage, that fraction cannot fall indefinitely) so $\Delta p_L = \Delta y$. Then

$$\Delta m = \alpha(\Delta y - \Delta p_K) + \Delta t.$$

The UK had more capital intensive forces (a higher value of α) and higher technology equipment, (trying to maintain inter-operability with the US) and greater cost escalation (a larger Δp_K). Thus its budget was more squeezed than France with a lower value of α , lower cost escalation, plus perhaps an ability through conscription to set, at least for a time, $\Delta p_L < \Delta y$. Although this model is not operational because we cannot measure military prices or output, it provides a qualitative framework to consider some of the issues.

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