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Debt, deficits and defence: the UK experience 1700-2016*

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Abstract

Military spending associated with wars has been a major cause of government deficits and debt financing. This paper looks at the the association between debt and defence spending in the UK over the last three centuries. The paper reviews the history, discusses the theory and provides some estimates of the effect of variations in military expenditure on debt. The association tends to be quite close and the effect of the change in the share of military spending in GDP on the debt-GDP ratio is quite stable.

Keywords: Government debt, military expenditure, wars, UK history.

1 Introduction

Over the longer span of history, a major cause of government deficits and the accumulation of national debt has been military spending, primarily during war. Before the 20th century the main expense of the sovereign was the military. This paper examines the association between military spending and national debt in the UK over the last three centuries. The UK has a long run of reasonably good data, had volatile military spending as a result of its engagement in many wars and at times had very high levels of debt relative to GDP. Barro (1987: 221) says "The British data from the early 1700s through World War I provide an unmatched opportunity for studying the effects of temporary changes in government purchases. Temporary increases, which appeared mainly as wartime spending ..." The wars the UK was involved in over this period were international or colonial wars, civil wars raise different issues. Slater (2018:196), in a history of the national debt, concurs, "small temporary aberrations of expenditure and taxation are dwarfed in the large war and peace story."

Consideration of national debt is interesting because there is a widespread belief that national debt above a certain limit has a negative effect on the economy. The European Union Maastricht criteria specifies that the government debt to GDP ratio must not exceed 60%. Reinhart and Rogoff (2010) estimate a debt-threshold ratio, such that ratios above 90% have a negative effect on growth, though this estimate has been widely criticised, for instance Herndon et al. (2014). Chudik et al. (2017) using a sample of forty countries over the period 1965-2010 find no evidence for a universally applicable threshold effect in the relationship between public debt and economic growth, although they do find significant negative effects of public debt buildup on output growth. Most of this literature has focussed on the post World War II period, but in certain respects this period is atypical of the longer historical record, and this longer perspective can be informative. In a related paper, Smith (2019) examines the effect of government debt on interest rates using a panel of 17 countries 1870-2016.

While the literature has not established any clear relationship between debt and growth, or between military expenditure and growth,[1] there does seem to be a clear historical association between military expenditure and debt. This association is the focus of this paper. It reviews the history of the UK national debt and military spending as shares of GDP, has a brief survey of some of the theory and provides some estimates of the interaction. It should be noted that there are substantial difficulties with the measurement of all the variables considered. The definition of Britain changed with the Act of Union with Scotland in 1707, and with Ireland in 1800 which created the United Kingdom of Great Britain and Ireland. It became the United Kingdom of Great Britain and Northern Ireland again with the 1921 British recognition of the Irish Free State in the South after the Irish war of independence from 1919. Since both debt and military expenditure were central responsibilities, these changes are probably not material. The official debt figures used are at par, face value, rather than at market value for much of the period, this is discussed by Barro (1987) and Ellison & Scott (2019). There are also inevitable difficulties with measuring military expenditure, but the fact that it needed to be authorised by votes in Parliament meant that defence spending was documented. The GDP series have to be retrospectively constructed by economic historians from limited data. While these difficulties are real, they are unlikely to change the basic story because the variations in both the share of military expenditure in GDP and of the debt-GDP ratio are so large.

2 History

Cicero, the Roman orator said "The sinews of war are infinite money". Over the longer span of history, the infinite money required for military expenditures

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[1] The conclusion of the critical review of the literature on the effect of military expenditure on growth in Dunne et al. (2005) that there was no clear effect, seems to remain relevant.

to provide the sinews of war has been a major cause of government deficits and the accumulation of national debt.

Eichengreen et al. (2019) consider public debt from a long term historical perspective, showing how the purposes for which governments borrow have evolved over time. Periods when debt-GDP ratios rose explosively as a result of wars, depressions and financial crises also have a long history. Many of these episodes resulted in debt-management problems resolved through debasements and restructuring. There were also successful debt consolidations, where governments inheriting heavy debts ran primary surpluses for long periods in order to reduce those burdens to sustainable levels. They analyze the economic and political circumstances that made these successful debt consolidation episodes possible.

Figure 1 shows the ratio of debt to GDP taken from Bank of England (2017). The origin of the national debt is usually dated from 1694 when William III used a syndicate of merchants to sell debt to finance the Nine Years War. This syndicate went on to become the Bank of England. Ellison & Scott (2019) provide an overview of UK debt management and Slater (2018) provides a history of the national debt. The jumps in the national debt largely correspond to wars, followed by declines after the ends of wars. The debt-GDP ratio rises from zero following a sawtooth pattern around a trend increase during the 18th century until it peaks at 183% in 1816.

The 18th century was one of continual wars during which the share of military expenditure would increase to around 10% of GDP and as Slater (2018) notes each major war roughly doubles the national debt. The wars include the Nine Years War, 1688-97; the War of the Spanish Succession, 1701-1714; the Wars of Jenkins' Ear & Austrian Succession, 1739-48; the Seven Years' War, 1756-63; and the American Revolutionary War, 1775-83, which also involved conflicts with other countries. There then followed the French Revolutionary and Napoleonic Wars, 1793-1815, which pushed the share of military expenditure over 15%. This list does not include wars fought against Native American tribes and by the East India Company.

From the end of the Napoleonic Wars, the debt-GDP ratio then declined during the long "Victorian century" until the beginning of World War I, reaching a minimum of 28% in 1913. Debt then increased with World War I and the interwar depression, rising further with World War II to a peak of 259% in 1946. The share then declines again falling to a minimum of 22% in 1990, before rising slowly at first, then sharply after 2008.

The government budget constraint, which will be discussed more formally below, means that the government surplus or deficit, the difference between revenue and expenditure (military and non-military), must be matched either by changes in the money supply or changes in government assets and liabilities. Thus an increase in military expenditure must be financed by some combination of: reductions in other government expenditures; increased taxes; printing more money; borrowing by issuing more debt; or selling assets. The UK national debt was typically denominated in sterling but both World Wars had to be financed by selling foreign assets and incurring dollar denominated debt to the

US government. The UK only finished repaying its war debts to the US in 2006.

The UK experience does not suggest that high levels of debt are necessarily bad. The UK debt-GDP ratio was almost 200% of GDP at the end of the Napoleonic War and about 250% of GDP at the end of World War II. That high debt did not inhibit the first industrial revolution and relatively rapid post World War II growth. O'Brien (2017) says "Between the Peace of Paris (1763) and the adoption of free trade (1846-49) the economy of the United Kingdom passed through an accelerated phase of industrialisation and urbanisation, referred to as the First Industrial Revolution. For more than a third of that time the British state was: extracting and mobilizing resources (labour, capital, raw materials, intermediate and consumption goods) for the purposes of: preparing, waging and disengaging from warfare with enemies from the mainland of Europe, failing to repress rebellions by colonists in the Americas, and defeating Indian, Chinese and other armed forces in various parts of the world." Of course, one could argue that the rate of growth during the British industrialisation was rather low compared to countries that subsequently industrialised and the high military expenditure was a possible explanation for this. But this issue is not our focus.
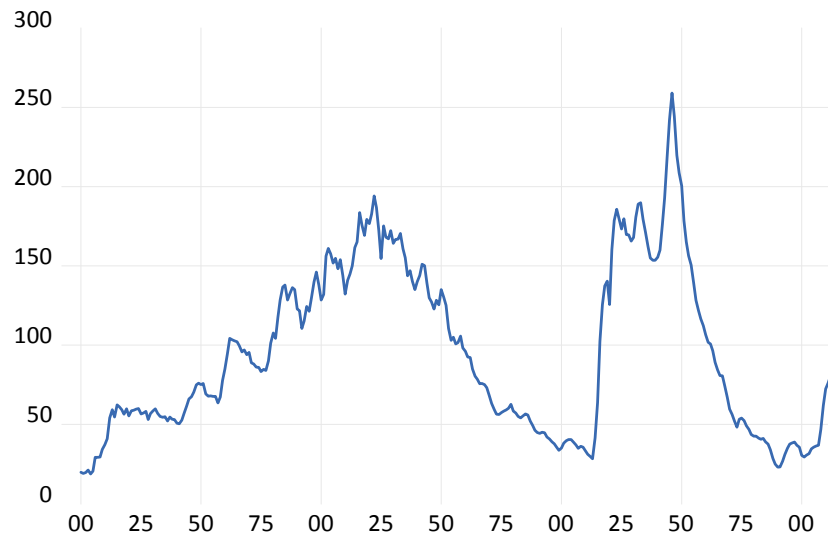

Figure 1. UK national debt to GDP ratio, percentage 1700-2016.

Figure 2 shows the share of military expenditure in GDP. The early military expenditure data are taken from Mitchell (1988) the GDP from Bank of England (2017). The later shares of military expenditures in GDP are taken from SIPRI (2019). As noted above the sequence of 18th century wars and the French

Revolutionary and Napoleonic Wars are as apparent in the shares of military expenditure as they are in the debt-GDP ratio. The period from 1815-1914 had a very low share of military expenditure around 2.5% of GDP, though this financed many colonial wars which massively expanded the British Empire. Between the Napoleonic wars and World War I there are two blips in the military expenditure series . The first is associated with the Crimean War 1853-6 and the Indian Mutiny/War of Independence 1857-8; the second with the Boer War 1899-1902. Then followed the massive peaks in expenditure associated with World Wars I and II and a further blip associated with the Korean War. The share of military expenditure remained high by historical standards during the Cold War, but then settled down to the historical peacetime norm, around 2%, after about 2000.
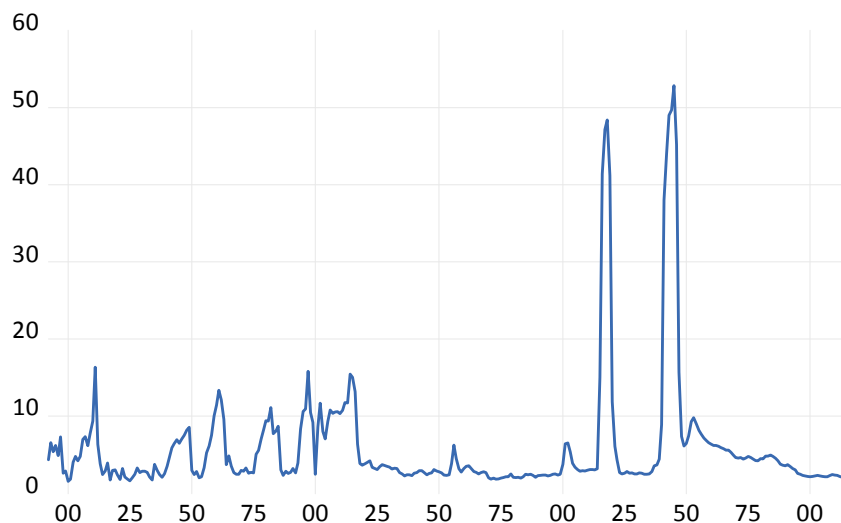

Figure 2. Share of military expenditure in GDP 1700-2016.

The UK was not alone, throughout Europe the fiscal state was a response to the costs of the wars that were required to secure borders, expand territory and survive. In the famous phrase of Tilly (1975:42) "War made the state and the state made war." As Ferguson (2001) documents, wars tended to be times of fiscal innovation, when governments found new ways to raise revenues. Income taxes were introduced in the UK during the French Revolutionary Wars, in 1798; abolished after the war in 1816, but reintroduced in 1842 and expanded substantially during World War I. US income taxes were introduced in 1861, during the Civil War, rescinded after the war and then subsequently reintroduced. Wallis (2000) discusses US government finance.

The UK mainly financed its wars by issuing debt. During the 18th century the national debt was described as Britain's secret weapon in war. Following the establishment of the Bank of England in 1694, an innovation copied from the Netherlands, Britain had a well organised way of raising money. Unlike most continental monarchs, Britain did not default; therefore it was able to raise money on good terms at low interest rates. It could thus easily borrow to finance its continental wars. Although a naval-power, Britain could afford to subsidise allied European land-powers to do much of the fighting on the continent. Ferguson (2001), argues that it was finance, as much as firepower, that determined victory.

The UK fiscal-military state benefited from a positive feedback. 18th Century Britain was a credible borrower because it had effective fiscal systems. Parliament gave legitimacy to taxation. There was an efficient tax collection system, particularly of customs and excise. The Bank of England managed the national debt efficiently and debt holders had considerable political influence giving credibility to commitments to repay. Because it had good credit, it could borrow to finance wars. This money made it more likely that it would win the war and be able to pay its creditors; raising its credit further. Its defeated enemies, however, were likely to default making it harder for them to borrow in future. The main war that Britain lost, the American War of Independence, did not cause default or weaken British credit. Although British credit during the 18th century was good and the debt was managed efficiently, there was much agonising over its financing as described by Slater (2018) and Ellison and Scott (2019).

France seemed to have the advantage in resources. It was twice as big as Britain, both in land and population, during the 18th century. But it had inefficient fiscal systems; could only borrow on bad terms; so lost wars through lack of money; defaulted and had even more problems borrowing. Bordo & White (1991) compare British and French fiscal systems and note that the record of British and French finance during the Napoleonic wars presents the striking picture of the financially strong nation abandoning the gold standard, borrowing heavily, and generating inflation; while the financially weaker country followed more "orthodox" policies. This paradoxical behavior is explained by Britain's strong credibility as a borrower that allowed it to follow more flexible policies, while France's poor reputation for repayment forced reliance on taxation.

War and the national debt were closely linked to economic development. For most of history violence has shaped the environment within which the economic forces of supply and demand, production and trade have operated. The need for protection meant that the flag followed trade or trade followed the flag. Britain benefited from its strong navy and merchant fleet: controlling sea routes, establishing monopolies like the East India Company and extending its colonies. This mercantilist policy changed in the 19th century, when British encompassing interests and competitive advantages meant that it had incentives to promote free trade and freedom of the seas. As Marx and Engels noted in 1848 in the Communist Manifesto "The cheap prices of its commodities are the heavy artillery with which the bourgeoisie batters down all Chinese walls, with

which it forces the barbarians intensely obstinate hatred of foreigners to capitulate." Marx and Engels may have been being ironic, since the cheap prices were supported by real artillery in the first Anglo-Chinese Opium War. The British went to war to maintain free trade in Opium after the Chinese tried to stop the trade. The short war was ended by the 1842 Treaty of Nanking, the first of what the Chinese call the unequal treaties.

3 Theory

Barro (1979, 1987) provides the basic theory. Wars are regarded as providing exogenous and transitory variations in government spending. Certainly, no other category of government expenditure goes through such large changes as the increases in military expenditure at the beginning of a large war or reductions at the end and there are serious issues in war finance: how to manage the large variations in military expenditure. In both World Wars UK military expenditure rose from around three per cent of GDP to around half of GDP and then fell back by similar amounts after the wars. Barro argues that deficits are used to smooth taxes in order to maintain expected constancy in tax rates. Thus there is a positive effect on debt issue of temporary increases in government spending, as in wartime. He examines the effects of changes in debt on interest rates, the quantity of money, the price level, and budget deficits and finds that temporary increases in government purchases, which showed up in the sample as increases in military outlays during wars, had positive effects on long interest rates.

Over the UK sample of more than two hundred years, he found only two examples of major budget deficits that were unrelated to wartime – one associated with compensation payments to slave owners in 1835-36 and the other with a political dispute over the income tax in 1909-10. His sample ended in 1918, later years would show more cases, in particular after the crisis of 2008. Ahmed (1987) also uses British data from the 18th and 19th centuries to examine the role of net borrowing from abroad in financing temporary increases in government spending associated with wars looking at the balance of trade and terms of trade as well as debt. The results are quite sensitive to the sample period and the treatment of government spending.

The government budget constraint is that net debt at the end of period $t+1$, D_{t+1} equals the primary deficit in t (the negative of the surplus $S_t = T_{t+1}-G_{t+1}$, taxation less government expenditure, military and non-military), plus interest on the previous periods debt, where R_t is the nominal interest rate, minus the increase in money supply. That is:

$$D_{t+1} = -(T_{t+1} - G_{t+1}) + (1 + R_{t+1})D_t - (M_{t+1} - M_t).$$

Dividing through by nominal GDP, and using $Y_{t+1} = (1 + g_{t+1})Y_t$ where g_{t+1} is the nominal growth rate of GDP we get:

$$\frac{D_{t+1}}{Y_{t+1}} = -\frac{S_{t+1}}{Y_{t+1}} + \frac{1 + R_{t+1}}{1 + g_{t+1}}\left(\frac{D_t}{Y_t}\right) - \frac{(M_{t+1} - M_t)}{M_t}\frac{M_t}{(1 + g_{t+1})Y_t}. \qquad (1)$$

Notice that it is the ratio of the nominal interest rate to the nominal growth rate that matters. Defining $(1 + r_{t+1}) = (1 + R_{t+1}) / (1 + g_{t+1})$ and using lower case letters for shares, this can be written as:

$$d_{t+1} = -s_{t+1} - \frac{m_{t+1}}{1 + g_{t+1}} k_{t-1} + (1 + r_{t+1})d_t;$$

$$d_{t+1} = b_{t+1} + (1 + r_{t+1})d_t$$

where $b_t = -(s_t + m_t k_{t-1}(1 + g_t))$ is the primary borrowing requirement, the primary deficit less that financed by money growth.

Iterating forward assuming $r_{t+h} = r$ is a constant:

$$d_{t+h} = \sum_{i=1}^{h} (1 + r)^{h-i} b_{t+i} + (1 + r)^h d_t$$

dividing through by $(1 + r)^h$ gives

$$d_t = \frac{d_{t+h}}{(1 + r)^h} - \sum_{i=1}^{h} \frac{1}{(1 + r)^i} b_{t+i}.$$

The transversality condition is that as h gets large the expectation of the first term goes to zero

$$\lim_{h \to \infty} \frac{1}{(1 + r)^h} E_t (d_{t+h}) = 0. \tag{2}$$

Given (2), the inter-temporal budget constraint is that the market value of government debt is the present discounted value of expected primary surpluses

$$d_t = -\sum_{i=1}^{\infty} \frac{1}{(1 + r)^i} E_t(b_{t+i}). \tag{3}$$

Bohn (2007) points out that (2) and (3) impose very little restriction on the time series properties of b_t or d_t. The reason for this is that the i-period-ahead conditional expectation of an mth-order integrated variable is at most an mth-order polynomial of the time horizon. The discounting in (2) and (3) is exponential in the time horizon. Exponential growth dominates polynomial growth of any order. Hence the discount factor $(1 + r)^{-i}$ will asymptotically dominate whenever debt is difference-stationary with any arbitrary order of integration.

Solvency cannot be inferred from the statistical properties of debt, it is an economic judgement that depends on the lenders expectations about the behaviour of the borrowers, in particular the credibility of their commitment to pay. Debt can grow rapidly as long as lenders expect to be paid. The UK during wars was a credible borrower so debt could increase rapidly. If lenders believe that the government is following a time inconsistent policy, and that it will default in the future, the lenders would not acquire the debt. The central

issue was continued payment of interest not repayment of the debt. For much of this period UK debt took the form of Consols, which were issued in perpetuity, the government need never redeem them. Taking advantage of very low interest rates, the last Consols were redeemed in 2015.

Grossman & Han (1993, 1999) provide a theory of war finance and sovereign debt. As emphasised above, the ability of a sovereign state to issue war debt depends critically on the lenders' expectations about the servicing of these debts. The lender faces two distinct risks. Firstly, there is the danger that the borrower will default if defeated, the victor typically does not pay the debts of the vanquished. Secondly, even if the borrower is not defeated, but suffer negative material consequences from the war, they may not fully service their debt. Thus debt service is contingent on circumstances, a form of risk sharing between lender and borrower, which provides the borrower some insurance. They show that war debt provides complementary functions - inter-temporal consumption smoothing through tax smoothing and risk sharing.

Grossman & Han argue that before World War II the desire to maintain a trustworthy reputation for honoring war debts was an important factor in inducing deflationary postwar monetary policies in both the UK and US. But after World War II, the US and UK partially defaulted on their debt through inflation because of differences in economic and political conditions. These included the extension of the voting franchise, the increased economic and political power of organized labor, and, perhaps most importantly, the large postwar demands on national resources with which the servicing of World War Il debts had to compete. Because these postwar developments were unforeseeable, but verifiable, contingencies, the partial default on World War Il debts was excusable and, accordingly, did not cause either the United Kingdom or the United States to lose their trustworthy reputation.

4 Estimates

Long span UK data is used to examine the association between military expenditures and the national debt and the extent to which there is an equilibrium level of debt. The other variables, apart from the deficit, in the budget constraint will be included. These are the rate of growth of nominal income and the nominal rate of interest, which appear in equation (1). We condition on these determinants of debt and adopt a linear approximation to the budget constraint. Notice that these regressions should be treated as descriptions of the process not causal explanations.

The first reason that they cannot be given a causal interpretation is because interest rates and growth rates are not exogenous, they are influenced by the change in debt; though governments would have an idea of the likely effects on growth and interest rates given the size of these changes in war time.[2] Although

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[2] It is slightly anachronistic to imagine governments responding to GDP before World War II, since there was no such measure then. However, they were very sensitive to claims on resources and inflationary pressures.

one cannot judge exogeneity from Granger causality, in a second order VAR 1705-2016, the share of debt in GDP was Granger causal for the share of military expenditure (high military expenditure and high debt persist together for quite long periods) and real growth; but not for inflation and the long interest rate.

The second reason that it cannot be given a causal interpretation is that governments always have choices in how they finance the military and may adopt different choices at different times. For instance, Barro found that the effect of military expenditure on the growth rate of money (bank notes) was positive only during the two periods of suspension of the gold standard (1797-1821 and 1914-1918). As long as convertibility of bank notes into specie was maintained, there was no systematic relation between government spending and money growth and inflation. Military spending may influence both the numerator and the denominator of the debt-GDP ratio. Debt may be increased to finance the military spending and the military spending may also boost GDP, if only because it is a component of GDP.

Finally, the ability to borrow to finance its fighting may have encouraged Britain to be more warlike.

We adopt a general to specific approach, starting from a second order ARDL equation, which is robust to the variables being integrated of order up to two. This makes the debt to GDP ratio a function of the share of military expenditure in GDP, the long interest rate (the consol rate in the Bank of England database) and the rate of growth of nominal GDP. A specification search then gave the OLS results in Table 1. While there was no serial correlation, there was significant heteroskedasticity and non-normality, so the equation was re-estimated by maximum likelihood using GARCH(1,1) and a t distribution. Both ARCH and GARCH terms were very significant and the estimated degrees of freedom of the t distribution was 3.33, indicating very fat tails, excess kurtosis. However the qualitative picture from the GARCH estimates is very similar to that from OLS.[3]

Any adjustment towards equilibrium is very slow, less than 2% a year, at which rate it would take over a century without shocks to remove 90% of the disequilibrium. This slow speed of adjustment is consistent with the very slow 19th century reduction. There is a very substantial momentum effect, changes in debt continue, the lagged change in the share of debt has a coefficient of about a half. The change in the share of military expenditure is highly significant, about three quarters of the change in the share of military expenditure gets transformed into a change in the share of debt. Current growth has a strong negative effect, which is what one would expect, lagged growth has a positive effect which is more difficult to interpret, but this effect is smaller and the total effect of growth is negative. Higher interest rates are associated with higher debt as one might expect.

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[3] While there is a better non-linear estimator, OLS remains the best linear unbiased estimator even if there is non-normality and GARCH, since with GARCH the unconditional variance is constant as required by the Gauss-Markov Theorem.

Table 1. Equations explaining the change in share of UK debt in GDP from start date given until 2016, (with t ratios in parentheses).

Δd_t	OLS	GARCH	OLS	OLS	OLS	OLS
start	1704	1704	1759	1920	1941	1976
c	0.028	-0.293	0.815	2.138	2.862	2.965
	(0.03)	(-1.3)	(1.01)	(1.2)	(1.8)	(1.8)
d_{t-1}	-0.019	-0.017	-0.019	-0.019	-0.041	-0.030
	(-3.9)	(-5.0)	(-3.5)	(-1.9)	(-3.0)	(-1.3)
Δd_t	0.444	0.510	0.551	0.613	0.542	0.763
	(8.6)	(11.1)	(9.4)	(6.8)	(6.6)	(6.5)
Δsm_t	0.777	0.688	0.752	0.542	0.559	3.834
	(10.9)	(12.0)	(10.0)	(5.7)	(6.3)	(1.8)
sm_{t-1}	0.269	0.270	0.192	0.138	0.263	0.602
	(5.5)	(6.4)	(3.5)	(1.8)	(3.3)	(0.74)
g_t	-0.845	-0.569	-1.069	-1.342	-1.049	-0.686
	(-20.3)	(-42.1)	(22.8)	(-13.9)	(-7.0)	(-3.8)
g_{t-1}	0.368	0.283	0.612	0.866	0.589	0.481
	(5.7)	(8.9)	(7.1)	(4.9)	(3.4)	(2.5)
R_{t-1}	0.427	0.195	0.380	0.266	0.220	-0.238
	(3.4)	(5.0)	(2.8)	(1.2)	(1.0)	(-0.7)
R^2	0.73	0.68	0.80	0.84	0.88	0.79
SER	3.96	4.35	3.69	3.74	2.97	2.06

One might question whether one should expect structural stability over such a long period. A Quandt-Andrews single unknown breakpoint test was used to find the main break. The equation was then re-estimated starting at the break-point and the process repeated. The first break was identified as 1759. The equation was then re-estimated over 1759-2016, the next main break identified as 1920, then 1941 and finally 1976. The estimates for each of the subperiods are given in Table 1. The results are quite consistent across the sub-periods, though coefficients lose significance in the last period. The only change of sign is for the interest rate in the last period, which is insignificant. The coefficients for the change in the share of military expenditure and the lagged share are very consistent, except for the last period when they become larger, but very imprecisely determined. This is because there was very little variation in military expenditure in the final period.

5   Conclusion

This paper approaches the relationship between military expenditure and the national debt from three perspectives: historical, theoretical and statistical. The history of the economic and strategic interactions between military expenditure and national debt in the UK over the period 1700-2016 shows that the

UK credibility as a borrower boosted its war fighting ability. The wars resulted in very high debt-GDP ratios at the end of the Napoleonic and World Wars. The theory suggests that the two variables are closely tied together because it is optimal to finance temporary war time expenditures by debt, both for consumption smoothing and for risk sharing reasons. The statistical analysis of the long span historical data took advantage of the large amount of variation in both debt and military expenditure. This may help identify connections between the variables, but also raises difficult questions about structural stability and whether the factors that determine debt now are different from those in the more distant past. Nonetheless, examination of the longer run data may be informative. The estimates of the effect of military expenditure on the national debt shows that until the most recent period there was a robust relationship between the share of military expenditure and the change in national debt, reflecting debt financing of wars, even after controlling for nominal income growth and the long interest rate. The statistical analysis is primarily descriptive, since there are difficult issues of endogeneity and identification, though it is plausible that the variations in military expenditure are largely exogenous. To understand the causal elements in the long run simultaneous interactions between growth, inflation, interest rates, debt and military expenditure requires a more structural model. Constructing such a structural model would be a challenging task.

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