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Three Centuries of Debt Management

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- The views expressed in this paper are those of the authors, and not necessarily those of the Bank of England or its committees.
- This is an initial draft:
  - We very happily welcome all comments and suggestions.
  - All results are preliminary and should not be cited without the prior permission of the authors.

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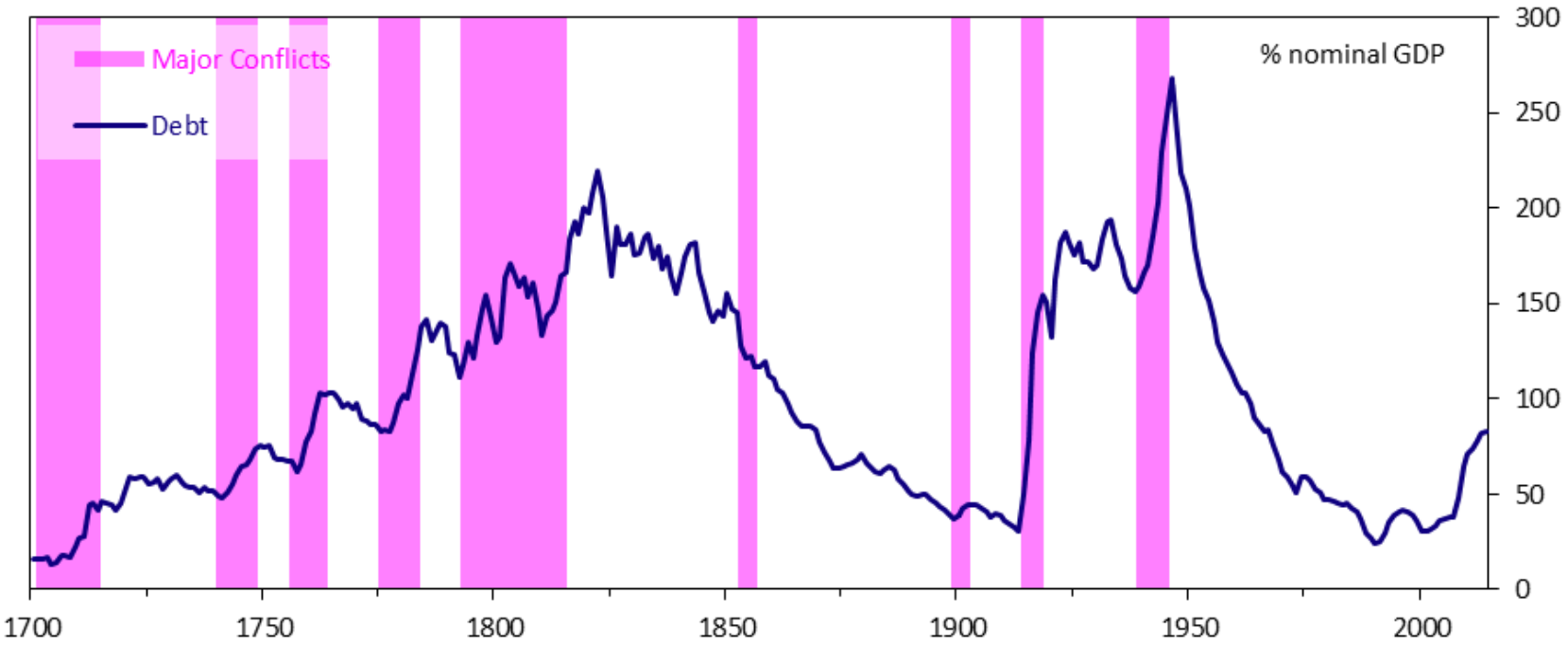
- Decomposing movements in the debt to GDP ratio
  - Debt accumulation
  - Debt consolidation
- Fiscal reaction functions
- Conclusions

Motivation



Source: Bank of England “Three Centuries” dataset

- UK public sector net debt expected to peak above 80% of GDP
- Historically, two clear episodes of debt accumulation and consolidation

Related studies

- **Bohn (1998, 2008)**
  - Initiated the strand of literature we follow. Estimated fiscal reaction functions for the US, 1792-2003.
- **Mendoza & Ostry (2008)**
  - Extended the Bohn approach to a panel of advanced & emerging economies, from the 1980s to 2005.
- **Ghosh et al (2013)**
  - Extended the Bohn approach to explore non-linearities and the concept of “fiscal fatigue” in a panel of advanced economies from 1970-2007.
- **Mauro et al (2015)**
  - Look at a panel from 1800 onwards, examining the stability of fiscal “prudence” over time

Data (i)

Sources:

- Bank of England's Three Centuries dataset
  - *"contains a broad set of annual data covering the UK national accounts and other financial and macroeconomic data stretching back in some cases to the late 17th century"*
- Clark (2001)
  - Estimates of the UK debt stock at market values, from 1729 to 1840
- Office for Budget Responsibility
  - Fiscal Sustainability Report: 50 year projections of the economy and public finances based on the government's current plans for fiscal policy

Data (ii)

Definitional issues:

- Coverage
  - Our analysis focuses on the **central government** sector, that is, general government excluding local government. This sector has traditionally accounted for the vast majority of debt issuance in the UK.
  - The OBR's projections are on a **public sector** basis, that is, general government plus public corporations.
- Debt
  - We report debt at the value it trades at in secondary markets ("**market value**"), rather than its face value ("nominal value")
- Frequency
  - All **data is annual**. For the historical data, these are calendar years; for the projections, these are UK fiscal years (Apr to Mar in the following year)

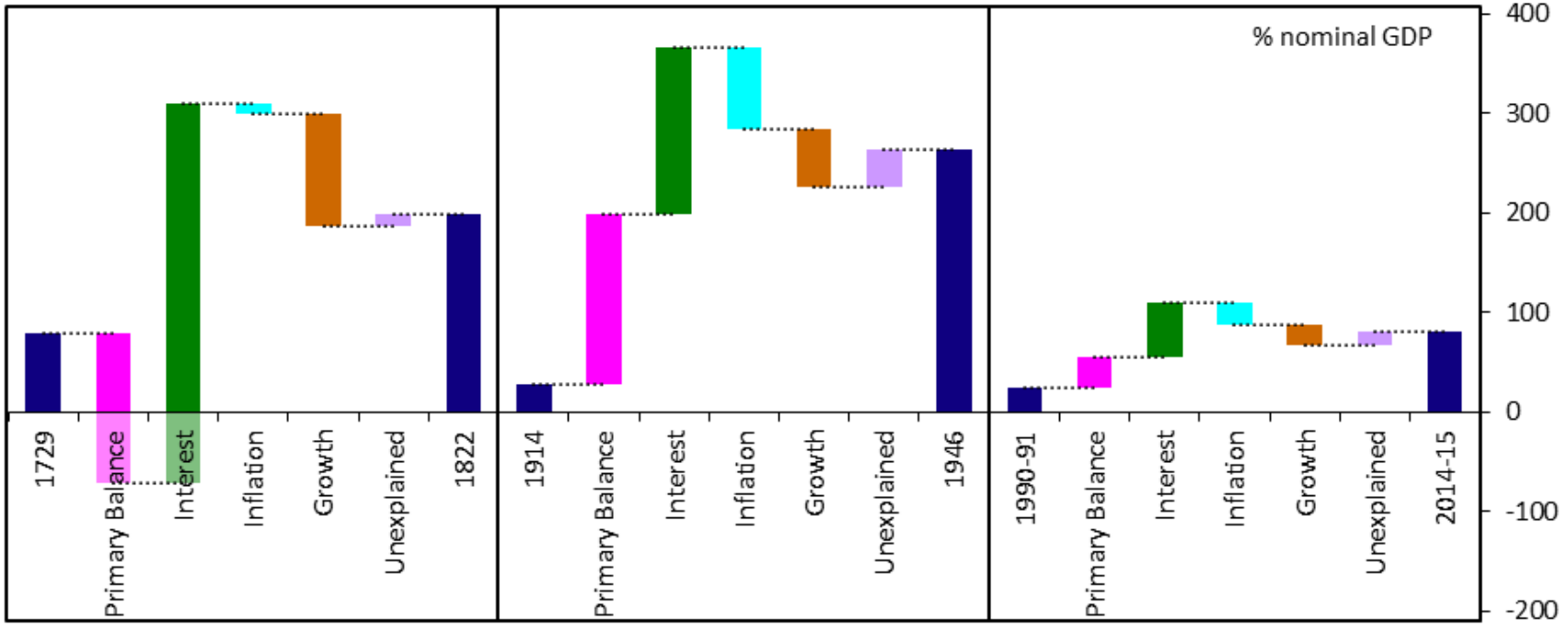
Decomposing movements in the debt to GDP ratio (i)

- Debt dynamics decomposition:

$$d_t - d_{t-1} = \frac{i_t}{1+\gamma_t} d_{t-1} - \frac{\pi_t}{1+\gamma_t} d_{t-1} - \frac{g_t}{1+g_t} d_{t-1} - s_t$$

  - Where:
    - d_t is the debt to GDP ratio at time t;
    - i_t is the nominal interest rate;
    - γ_t is the rate of nominal GDP growth;
    - π_t is inflation (measured via the GDP deflator);
    - g_t is real growth, and;
    - s_t is the primary balance as a share of GDP (tax receipts less non-interest spending)

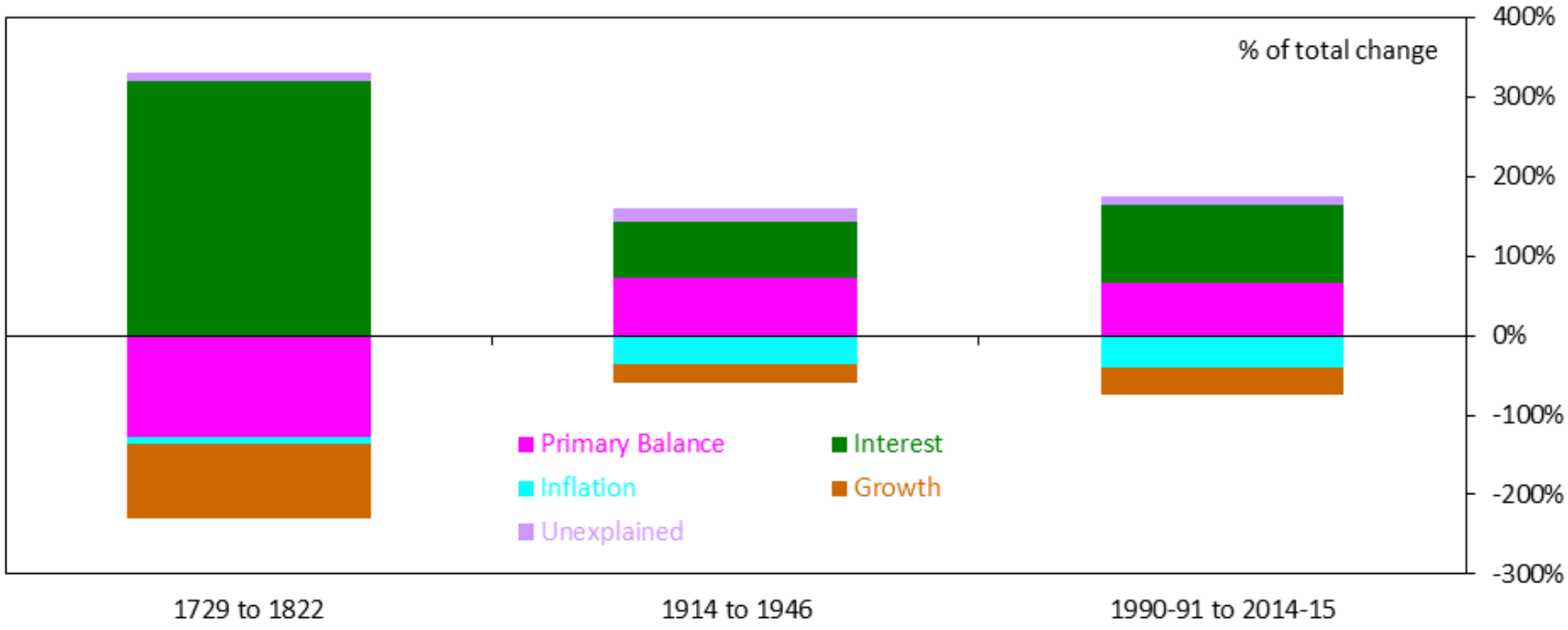
Periods of debt accumulation (i)



Source: Bank of England “Three Centuries” dataset; Office of National Statistics; Office for Budget Responsibility

- Debt accumulated as total spending exceeds revenues, partly offset by nominal growth.
- But differences across periods within those elements.

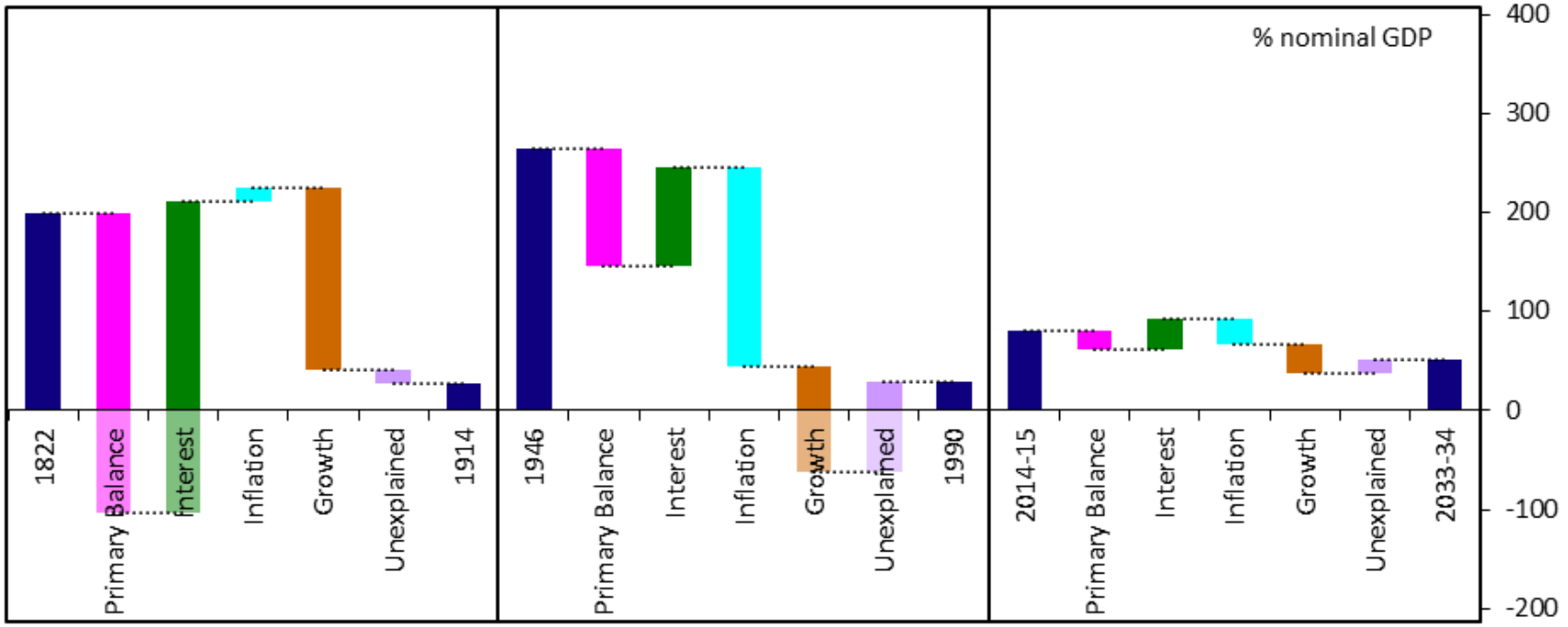
Periods of debt accumulation (ii)



Source: Bank of England "Three Centuries" dataset; Office of National Statistics; Office for Budget Responsibility

- Two most recent episodes much more similar in the contribution of different elements.

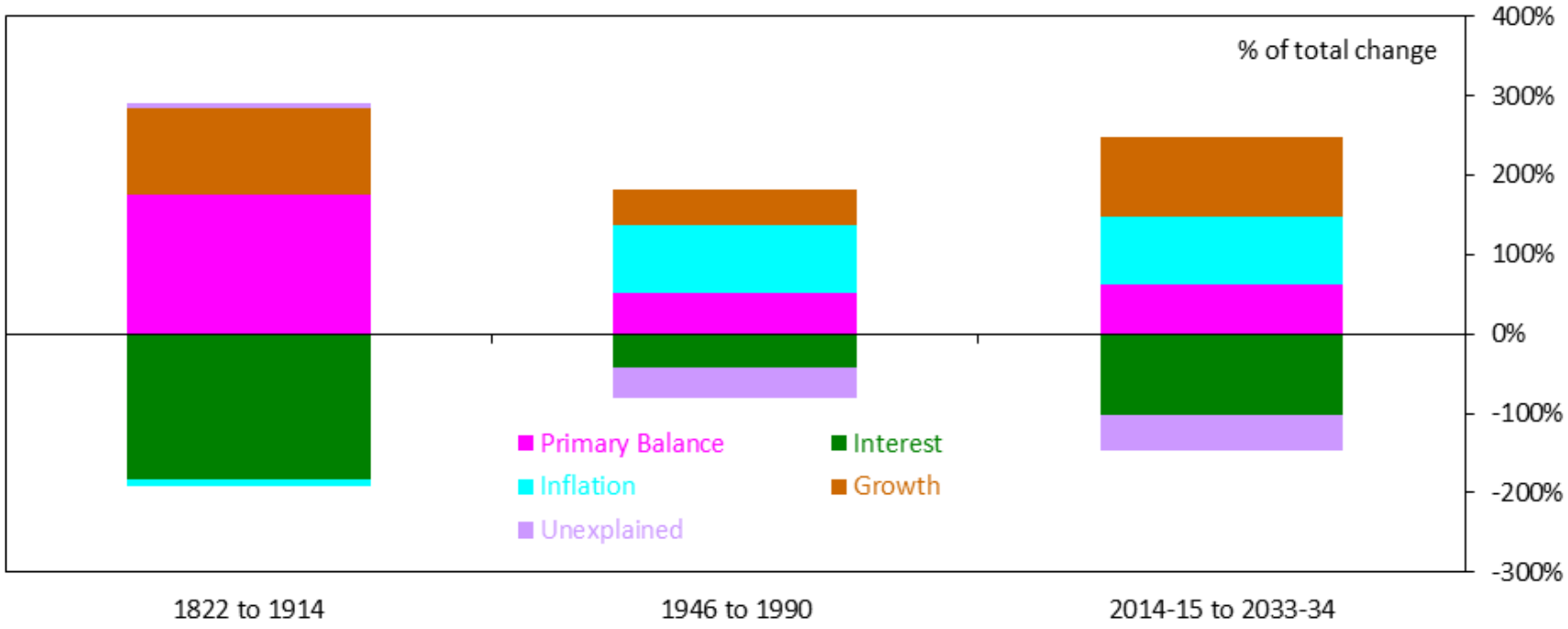
Periods of debt consolidation (i)



Source: Bank of England "Three Centuries" dataset; Office of National Statistics; Office for Budget Responsibility

- In both historical periods primary surpluses were largely offset by interest payments.
- Nominal growth accounts for a large share of consolidation, with inflation playing a bigger role in the 20th century

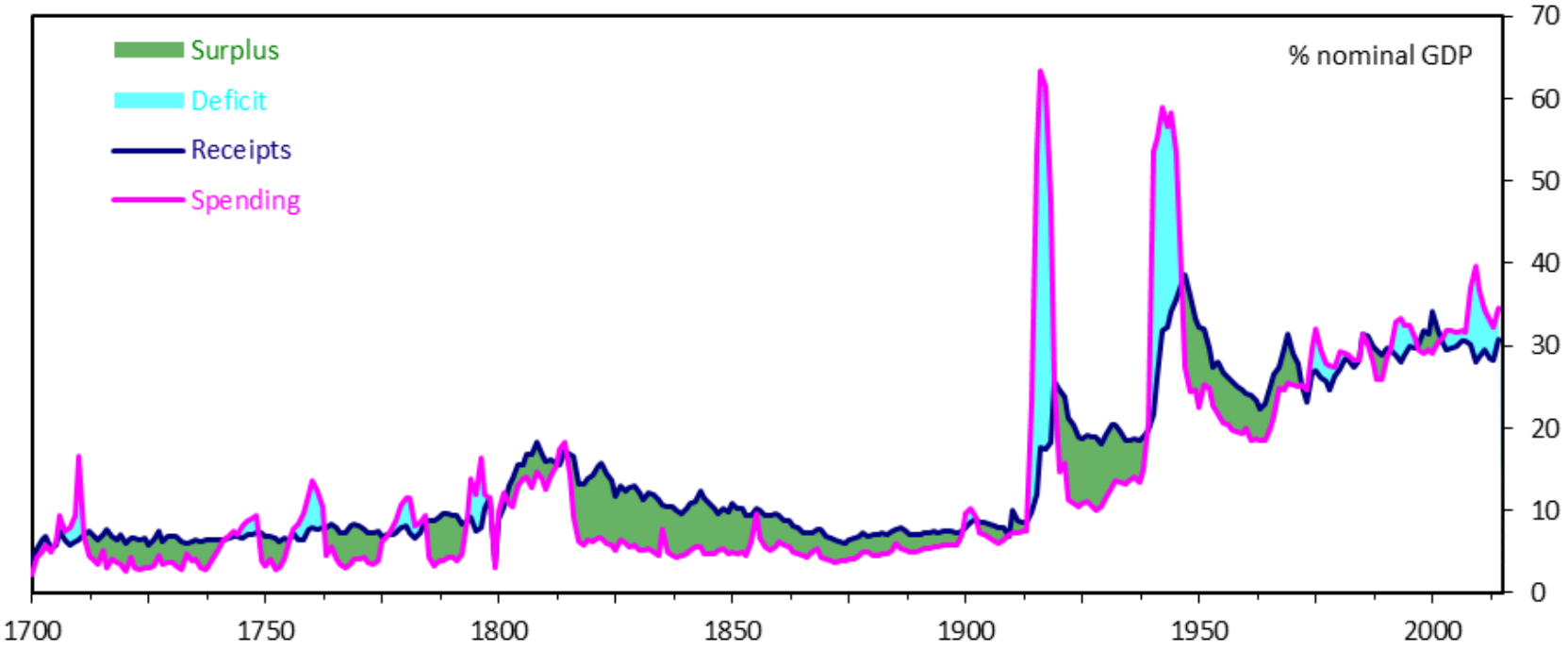
Periods of debt consolidation (ii)



Source: Bank of England "Three Centuries" dataset; Office of National Statistics; Office for Budget Responsibility

- As with debt accumulation, the two most recent periods (albeit the latest is a projection) are much more similar in the contribution of different elements.

Decomposing movements in the debt to GDP ratio (ii)



Source: Bank of England “Three Centuries” dataset; Office of National Statistics

- Debt was accumulated “reluctantly”; substantial efforts were made to reduce debt accumulation after each major shock
- Taxes & spending have increased even in periods of debt consolidation.

Fiscal reaction functions (i)

- We follow Bohn (1998) and estimate a fiscal reaction function of the form:

$$s_t = \rho d_{t-1} + \mu_t + \varepsilon_t$$

  - Where:
    - s_t is the primary balance relative to GDP;
    - d_{t-1} is the stock of debt at the end of the previous period (also measured relative to GDP);
    - μ_t represents a range of additional controls, and;
    - ε_t is a well-behaved error term.

  - A positive value of ρ is a sufficient condition for a government to respect its inter-temporal budget constraint; that is, a positive value of ρ indicates sustainable fiscal policy (See, eg. Mendoza & Ostry 2008 for a full derivation).

Fiscal reaction functions (ii)

Table 1: Estimation results for baseline specification, 1729-2014

	I	II	III	IV	V	VI	VII
c	-3.628 (0.198)	-2.940 (0.132)	-4.575 (0.028)**	-2.408 (0.366)	-2.906 (0.292)	-1.488 (0.398)	-1.762 (0.354)
dbt(-1)	0.041 (0.012)**	0.070 (0.000)***	0.063 (0.000)***	0.040 (0.008)***	0.046 (0.002)***	0.038 (0.000)***	0.039 (0.000)***
y_gap	-0.132 (0.013)**	-0.186 (0.058)*	-0.242 (0.053)*	-0.109 (0.032)**	-0.098 (0.022)**	-0.070 (0.083)*	-0.072 (0.078)*
real_g_gap	-0.204 (0.000)***			-0.179 (0.000)***	-0.182 (0.000)***	-0.160 (0.000)***	-0.162 (0.000)***
defence		-0.463 (0.000)***		-0.151 (0.068)*	-0.149 (0.058)*	-0.170 (0.011)**	-0.170 (0.012)**
war			-1.173 (0.011)**				0.735 (0.218)
wwar			-12.334 (0.000)***			-7.199 (0.000)***	-7.831 (0.000)***
cpi					-0.071 (0.000)***	-0.062 (0.002)***	-0.063 (0.002)***
ar(1)	0.930 (0.000)***	0.813 (0.000)***	0.809 (0.000)***	0.915 (0.000)***	0.918 (0.000)***	0.886 (0.000)***	0.886 (0.000)***
Stable ratio	69.5	85.2	72.4	142.1	149.8	46.5	43.9
Obs	284	284	284	284	284	284	284
Adj. R^2	0.921	0.871	0.857	0.925	0.931	0.942	0.942
s.e.	2.017	2.583	2.716	1.965	1.892	1.732	1.729
AIC	4.258	4.753	4.857	4.210	4.137	3.964	3.964
HQ	4.284	4.779	4.888	4.241	4.173	4.005	4.010
SIC	4.322	4.818	4.934	4.287	4.227	4.067	4.079

*The dependent variable in all cases is the central government primary balance relative to GDP. P-values are reported in brackets, with *, ** and *** representing significance at the 10%, 5% and 1% levels respectively.*

dbt(-1): one period lag of the market value of central government debt as at the end of the period, relative to GDP

y_gap: deviation of real GDP from trend, estimated using a HP-filter with smoothing parameter of 100

real_g_gap: deviation of real government spending from trend, estimated using a HP-filter with smoothing parameter of 100

defence: nominal government defence spending relative to GDP

war: a dummy to control for periods of major conflict

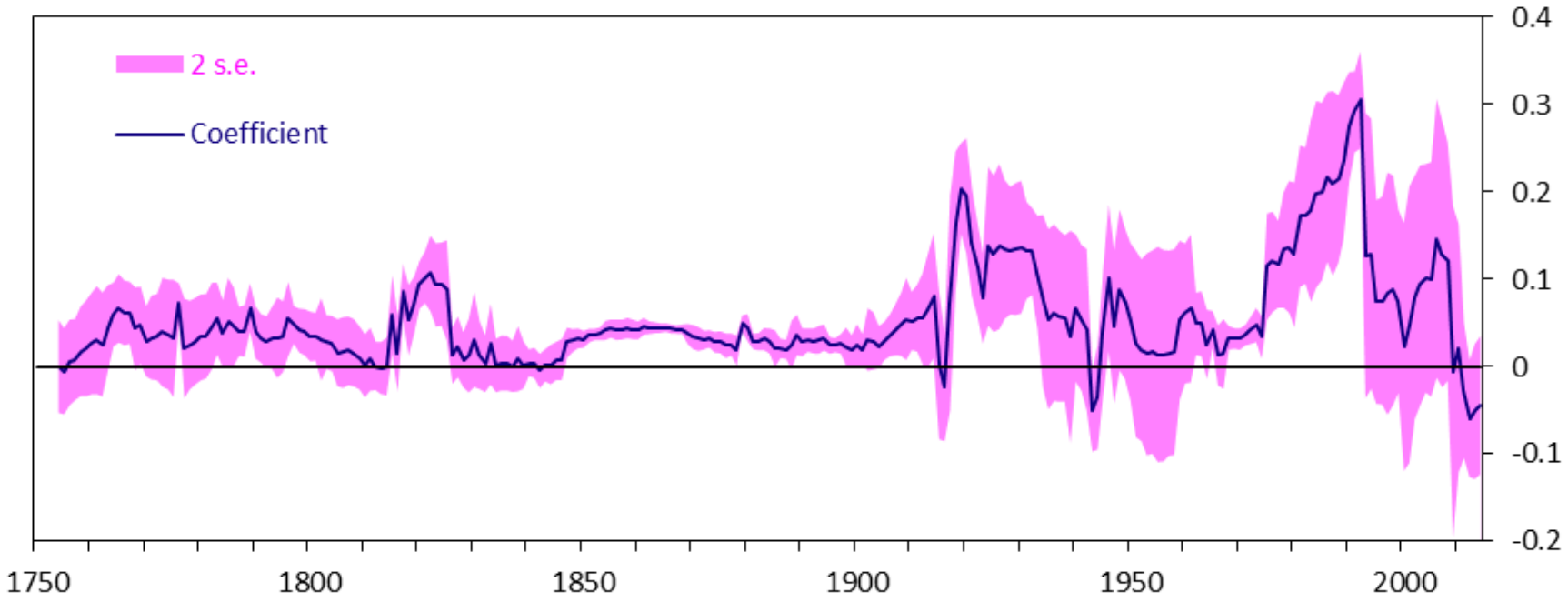
wwar: a dummy controlling for the first (1914-1918) and second (1939-1945) world wars

cpi: annual rate of consumer price inflation

Stable ratio: the long-run expected level of debt, calculated via. the approximation $E[dbt]=-\mu^*/[\rho(1+r^*)-r^*]$ (Mendoza & Ostry, 2008), where μ^* is the average effect of the control variables over the sample and r^* is the average effective interest rate on government debt.

AIC, HQ and SIC represent the Akaike, Hannan-Quinn and Schwarz information criteria respectively.

Fiscal reaction functions (iii)



Source: Bank of England “Three Centuries” dataset; Office of National Statistics

- The debt coefficient varies over time, but is nearly always positive
- It is larger in the post war period, consistent with the more aggressive consolidation we see in the data

Fiscal reaction functions (iv)

Table 2: Estimation results for "fiscal fatigue" model

	Baseline		Cubic	
c	-1.488	(0.398)	-5.38503	(0.123)
dbt(-1)	0.038	(0.000)***	0.140063	(0.073)*
dbt(-1)^2			-0.00072	(0.202)
dbt(-1)^3			1.47E-06	(0.262)
y_gap	-0.070	(0.083)*	-0.06939	(0.085)*
real_g_gap	-0.160	(0.000)***	-0.15873	(0.000)***
defence	-0.170	(0.011)**	-0.17707	(0.010)**
cpi	-0.062	(0.002)***	-0.06153	(0.003)***
wwar	-7.199	(0.000)***	-7.16321	(0.001)***
ar(1)	0.886	(0.000)***	0.883076	(0.000)***
Obs	284		284	
Adj. R^2	0.942		0.942	
s.e.	1.732		1.730	
AIC	3.964		3.968	
HQ	4.005		4.020	
SIC	4.067		4.097	

*The dependent variable in all cases is the central government primary balance relative to GDP. P-values are reported in brackets, with *, ** and *** representing significance at the 10%, 5% and 1% levels respectively.*

Variable definitions and estimation as per notes to ***table 1.***

- We test for "fiscal fatigue", following the approach of Ghosh et al (2013):
  - Fiscal fatigue arises when the *"ability to increase primary balances cannot keep pace with rising debt"*
- We estimate our baseline model with additional square and cubed terms
- But none of these additional debt terms are significant
- This is consistent with the observation that the primary balance seems to have been more responsive at higher debt levels

Conclusions (i)

- The UK has run up large debt stocks in the past, but has found ways to manage them. Indeed, **the larger the stock of debt, the more aggressive the management**.
- It seems fair to conclude that, at least on average, UK fiscal policy was conducted sustainably over a three hundred year period, with **little evidence of "fiscal fatigue"**.

Conclusions (ii)

- But, there are many ways to manage the debt stock:
  - **Primary surpluses** were more important in the 18th-19th centuries, while **inflation** played a bigger role in the 20th century
- And there were significant differences in the wider context and setting of macro policy:
  - Debt consolidation in the 19th century happened under the **gold standard** and **limited government**.
  - That in the 20th century took place alongside an **expanding role for the state**, the **fastest productivity growth in the UK's history** and a flurry of different macro regimes – in which fiscal policy was frequently used as a tool for **demand management** – from the inter-war gold standard, to Bretton Woods, a period of floating exchange rates and ultimately to the ERM and inflation-targeting.

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