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BRITAIN'S FIRST EXPERIENCE WITH PAPER MONEY

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How Fiscal Policy Affects the Price Level: Britain's First Experience with Paper Money*

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Banque de France

Preliminary

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Abstract

Between 1797 and 1821, Britain suspended the gold standard in order to finance the Napoleonic Wars. This measure was accompanied by large scale debt accumulation and inflation: After Napoleon's final defeat at Waterloo in 1815, the debt to GDP ratio climbed to 226%; the price level exceeded its 1797 level by 22.3%. Under these circumstances and given institutional settings that allowed excluding the possibility of strategic default, I will show that expectations of how debt would be stabilized in the future shaped the observed evolution of the price level. My contribution, thus, establishes the importance of fiscal factors for the determination of the price level.

Keywords: Debt monetization, sovereign debt, inflation, structural breaks.

JEL: N13, N23, N43, C22.

Résumé français

Entre 1797 et 1821, la Grande-Bretagne a suspendu l'étalon-or pour financer les Guerres Napoléoniennes. Cette mesure était accompagnée d'augmentations importantes en termes de dette publique et d'inflation: après la défaite définitive de Napoléon à Waterloo en 1815, la dette publique avait atteint 226% du PIB; le niveau des prix avait augmenté de 22,3% par rapport à son niveau en 1797. Dans ces circonstances, et étant donné que l'environnement institutionnel permettait d'exclure un défaut stratégique, il est démontré que de l'évolution observée du niveau des prix dépendait de l'appréciation de la charge budgétaire future. Ainsi, cet article établit l'importance des facteurs budgétaires pour la détermination du niveau général des prix.

Mots clés: Monétization de la dette publique, inflation, ruptures structurelles.

Code JEL: N13, N23, N43, C22.

1 Introduction

In terms of a sovereign's reputation and, hence, market access, some types of default are worse than others. Default may be excusable when it occurs in bad states of the world, which are unforeseeable and beyond the sovereign's immediate influence (Grossman and Van Huyck, 1988). Unjustifiable repudiation and strategic default, on the contrary, may hamper the sovereign's prospects to borrow or allow it only at prohibitive costs. In a setting in which unjustifiable repudiation can be excluded, default occurs in equilibrium and agents price its probability based on fiscal prospects. This establishes a link between agent's expectations in terms of fiscal sustainability and certain asset prices.

This paper documents a historical case in which institutional settings, among which the Bank of England's restrictions on the uses and abuses of public debt (North and Weingast, 1989), allowed excluding the possibility of strategic default. I will show in the following that under these particular institutional circumstances, expectations of how debt would be stabilized in the future shaped the observed evolution of the price level.

Between 1797 and 1821, the so-called Restriction Period, Britain under George III suspended the convertibility of Bank of England notes in order to finance the Napoleonic Wars. This exceptional measure was accompanied by important degrees of debt accumulation and inflation. After Napoleon's final defeat at Waterloo in 1815, the debt to GDP ratio had climbed to 226%; the price level exceeded its 1797 level by 22.3% (Officer, and Williamson, 2013; Gayer, Rostow, and Schwartz, 1953).

Given these circumstances, returning to the pound's prewar parity would come at high deflationary costs. Thus, getting back to the gold standard at a devalued pound was by no means excluded a priori (Acworth, 1925; Fetter, 1965; Kindleberger, 1982). Not only would devaluation have spared the war-ridden economy from deflation and its detrimental effects on activity. By decreasing the purchasing power of the pound, it would also have alleviated the burden of outstanding debt.[1]

[1]Not paying back all or part of someone's debt or doing so in a currency that suffered an engineered decrease in its purchasing power are two different types of default, but default after all (see section 7).

Contemporaries knew of this possibility and attached probabilities to it as the Napoleonic Wars and debt accumulation dragged on. In particular, to get an idea regarding valuation induced future inflation agents would assess what fiscal sustainability came across as in the future. If, for instance, the fiscal outlook looked grim, because hostilities intensified and public spending increased, debt relief by devaluation and, hence, inflation would become more likely.

The type of information that mattered at the time for fiscal sustainability and, hence, anticipated inflation was related to war finance. War was not only a costly endeavor. It could, in the worst of cases, render otherwise solid public finances unsustainable and induced in every case a great deal of uncertainty regarding the prospects for government finances. Given these uncertainties, agents would try to incorporate all available information that could help assess the probability of an unfavorable outcome of war and its implications for the sustainability of public finances and the aggregate price level.

I demonstrate this nexus by identifying structural breaks in the price level. These break dates reflect the historical events that shaped market sentiments. I find that significant changes in prices coincide with events that command a reassessment of Britain's expected military fate. In particular, unfavorable news - concerning a battle lost by the British, for example - has an inflationary impact, as it potentially makes a British victory less probable and, hence, public finances less sustainable. On the contrary, favorable news causes inflation to recede.

My results are further corroborated by the analysis of interest rates on long-term public debt. In particular, the evolutions of the latter during the Restriction Period were affected by anticipated inflation rather than the default premium. These pieces of evidence are in line with the statement that the monetary policy regime in place determines the type of debt stabilization agents anticipate for the future, if ever the economy's fiscal limit is attained.

Thus, in terms of the long standing debate attributing evolutions in the price level during the Restriction Period to either real or monetary factors, I propose a novel, third explanation. This one is based on the fiscal determinants of the price level. These results

are of timely relevance, since they corroborate the effects of mounting fiscal pressure on prices in a fiat currency regime with flexible exchange rates, the mode of economic organization chosen by most industrialized economies today.

The remainder of the article is organized as follows. Section 2 lays out the analytical background linking evolutions in public debt and the price level. Section 3 outlines links to the relevant literature, after which section 4 briefly recalls the events that led to the suspension and resumption of the gold standard in 1797 and 1821 respectively. Section 5 then details the econometric procedure used to detect the events shaping fiscal anticipations and, hence, asset prices. The following section 6 comments on the results. Section 7 discusses the hypotheses underlying my interpretation of events, while section 8 concludes briefly.

2 Background

Understanding macroeconomic evolutions and notably price movements during the first long restriction of the gold standard does less hinge on knowing what happened when Britain initially suspended convertibility or why it did so. What really matters for such an understanding is to comprehend the economic and political circumstances that prevailed when Britain came to resume the gold standard.

By the time discussions regarding the gold standard's resumption started after Napoleon's final defeat at Waterloo in 1815, the debt to GDP ratio had climbed to 226%; the price level exceeded its 1797 level by 22.3% (Officer, and Williamson, 2013; Gayer, Rostow, and Schwartz, 1953).[2] Under these circumstances, getting back to the pound's prewar parity would come at high deflationary costs. In particular, wartime inflation had to be made undone by peacetime deflation in order to peg the paper pound to its pre-war gold content.[3]

[2]Both metrics would reach 260% and 20.6% respectively when resumption was finally decided in 1819.

[3]A functioning gold standard relies on precisely this adjustment mechanism. Inflationary outbursts are countered by deflationary episodes, guaranteeing the stability of the price level. As Meltzer and Robinson (1989) have pointed out, the gold standard's perceived long-term stability, thus, masks high

Thus, the debate surrounding the resumption of cash payments was very vivid and another option, namely getting back to the gold standard at a devalued pound, was by no means excluded *a priori* (Acworth, 1925; Fetter, 1965; Kindleberger, 1982). Not only would devaluation have spared the war-ridden economy from deflation and its detrimental effects on activity. By decreasing the purchasing power of the pound, it would also have alleviated the burden of outstanding debt.[4]

Policy makers, therefore, had two options, both of them characterized by a trade-off between the nominal value of the pound and the real amount of outstanding government debt. One choice entailed getting back to the pound's pre-war parity and price level but would come at the cost of deflation and an increased debt burden. The other option implied devaluing the pound; while alleviating the debt burden, this would also have been inflationary.

Contemporaries knew of these alternatives and attached probabilities to each of them as the Napoleonic Wars and debt accumulation dragged on. In particular, to get an idea regarding future inflation – i.e. regarding the policy choice between valuation induced de- or inflation – agents would assess what fiscal sustainability came across as in the future. If, for instance, the fiscal outlook looked grim, because hostilities intensified and public spending increased, debt relief by devaluation and, hence, inflation would become more likely.

The type of information that mattered at the time for fiscal sustainability and, hence, anticipated inflation was related to war finance. Roughly two thirds of Britain's budget were dedicated to war fare; the same was true for most other European countries during that period (O'Brien, 1988; Hoffman, 2012). Moreover, war was not only a costly endeavor. It could, in the worst of cases, render otherwise solid public finances unsustainable and induced in every case a great deal of uncertainty regarding the prospects

short to mid-term volatility in prices and activity (see also section 7).

[4]A third option to cope with the war's legacy would have been to default on some of the outstanding debt. As did contemporaries, so do I exclude outright default from the politically feasible. Section 6 and a companion paper of mine (Antipa, 2014) provide narrative and quantitative evidence for this claim.

for government finances.

For instance, severe territorial losses and their impact on an economy's tax base or imminent reparation payments (Oosterlinck, 2012) could become prohibitive. A war could, hence, push an economy to a point, its fiscal limit, were the government would not be able to finance its expenditures any more. Once an economy's fiscal limit was reached, default or devaluation induced inflation would become inevitable.

Rather than being a fixed point, an economy's fiscal limit could be thought of as a distribution affected by various factors. The latter included contingencies that were beyond a government's domain of influence and that a government, thus, could simply not commit to (Bi, 2012; Trabandt and Uhlig, 2011). Moreover, as the outcome of a war was often well be beyond a government's will, it was difficult to convince people that public finances would remain sustainable under all circumstances.[5]

The above did not necessarily entail that governments or central banks were not credible in their policy commitments. On the contrary, the soundness of British institutions at the time was broadly established (Bordo and Kydland, 1995). Yet, given the economic, political, and institutional uncertainties induced by war, agents would nonetheless try to incorporate all available information that could help anticipate the future state of public finances, and, hence, the aggregate price level. This was a rational strategy irrespective of the government's initial commitment to sound fiscal and monetary policies.

3 Related Literature

Two analytical frameworks have been put forward in the economic literature to formalize the link between people's expectations of how debt will be stabilized in the future and price evolutions today. The first one goes back to seminal contributions by Sargent (1982) and Sargent and Wallace (1981) and has freely been dubbed the 'unpleasant monetarist arithmetic'. The second approach is owned to Leeper (1991), Sims (1994)

[5] A similar strain of argumentation could be applied to financial crises or any other circumstances that entail a surprisingly large burden to an economy's budget.

and Woodford (1995 and 2001) and is called the Fiscal Theory of the Price Level (FTPL henceforth).

Paraphrasing Keynes, Sargent (1982) points out that the size of a government's gold reserve is not the determinant of whether it can maintain or, for that matter, return to convertibility with gold; its fiscal policy is. According to this view, a government is like a firm, for which the value of its debt equals the present value of current and future surpluses. Thus, in order to assign a value to public debt, it is necessary to anticipate the government's revenue streams as a function of the state of the economy now and in the future.

In particular, in Sargent and Wallace's (1981) framework, agents anticipate that unsound fiscal policy today will make it necessary for the government to raise revenues by printing money tomorrow. However, agents' demand for money holdings declines with anticipated inflation. For a given current money supply, the value of money, therefore, declines and the price level increases. By this mechanism, fiscal profligacy today may necessitate future money supply growth, causing inflation through seigniorage.

The FTPL also explains movements in the aggregate price level by changes in government debt sustainability. Here it is, however, agents' investment, consumption, and price setting decision that induce the price level to adjust the real value of outstanding debt. Long-term debt sustainability is, hence, guaranteed by movements in the price level, rather than by adjustments in the real backing of debt through seigniorage (Leeper, 2013).

In both frameworks current and future fiscal deficits affect inflation. As fiscal policy determines prices, the central bank is incapable of controlling inflation. This hinges on the existence of a point beyond which a government's possibilities of financing its expenditures are constrained for economic or political reasons. In fact, this restriction is equivalent to relaxing the postulate that the fiscal authority accommodates the central bank's policies by keeping debt on a sustainable path.

Institutional settings of the time and observed evolutions in the price level and public

debt fit well with the FTPL. As posited by the framework, the fiscal authority was the leading one, in the sense that monetary policy decisions were subordinate to fiscal needs. At the time, the Bank of England primarily financed government expenditures and it was Parliament that made decisions regarding the suspension and resumption of cash payments (Clapham, 1944 and Homer and Sylla, 1991). Moreover, the suspension of convertibility was clearly understood as part of the Nation's war effort (Newby, 2008; O'Brien, 2010).

Another precondition for the workings of the FTPL was fulfilled by the absence of outright default on government debt. As various authors have pointed out, outright default on public debt became absent of British public finances after Parliament gained broad decisionary powers over public expenditures and taxation through the Glorious Revolution (North and Weingast, 1987; Sussman and Yafeh, 2006). Partisan constellations made hard default even less likely (Stasavage, 2007) (refer also to discussion further below).

As will be shown further below, the adjustment of outstanding government debt was operated by discrete jumps in the price level. When unfavorable news brought about a change in expectations regarding the sustainability of public finances, a higher price level increased the nominal backing for public debt. On the contrary, seignorage accounted for less than 5% of war revenues (Bordo and White, 1991). Given that seignorage contributed so little to the real backing of public debt, it seems unlikely that anticipated future money growth affected agents' inflationary expectations.

Finally, there is an inherent contradiction between Sargent and Wallace's predictions for and observed evolutions of the price level. In their framework, expansionary monetary policy reduces the need for future money growth and seigniorage, being, thus, disinflationary (Loyo, 1999). However, most scholars have put forward that around the 1813-14 price peak, the BoE's monetary policies were at their most expansionary (Duffy, 1981).

Fiscal determinants of the price level are also the principal component that differentiates my contribution from a long standing literature that has sought to explain evolutions in the price level during the Restriction Period by either real or monetary factors. This

debate can be traced back to the opposing views of Tooke (1857) and Ricardo (1817) that were linked to the Real Bills Doctrine and the Bullionists respectively. More recently, Bordo and Schwartz (1981) have taken position vis-á-vis Lewis (1978) and Rostow (1948 and 1978), emphasizing the importance of monetary factors for price level determination, in line with the quantity theory of money.

In addition, rather than picking one side, I propose a novel, third explanation, while drawing on existing research. As Bordo and Reddish (1992), I emphasize the importance of terminal conditions in order to capture the link between people's expectations of how debt will be stabilized in the future and contemporary price evolutions. Based on Arnon (1990) and Rostow (1978), I rely on financial data to capture agents's expectations regarding fiscal sustainability, avoiding the caveats of noisy data and lacking price indices. Finally, because of its duration and policy relevance, I view the Restriction Period as an integral monetary policy regime, rather than a lapse from the gold standard, much as Chadha and Newby (2013).

Other authors have treated the impact of war fare on capital markets and inflationary outcomes over the Restriction Period. The channel that Barro (1987), Barsky and Summers (1988), Benjamin and Kochin (1984), or Williamson (1984) highlight, relies on the eviction of private investment and consumption by public expenditures. As war time spending crowds out private expenditures, adjustments in the interest rate have to match the rising marginal product of capital during war times.

Over the period under consideration, the credit marked did, however, rarely reach equilibrium through changes in interest rates alone, but balanced rather through quantities (Ashton, 1959; Temin and Voth 2005). Usury laws, only abandoned in 1833, set a maximum interest rate of 5%; a market clearing mechanism based on a price signal does, therefore, not seem applicable to the Restriction Period.

Parallel to this fact, various authors do not find that mounting government debt and expenditures displaced much private investment (Clark, 2001; Heim and Mirowski, 1987). International capital flows (Neal, 1990 and 1991) and the safe haven nature of British government debt (O'Brien, 2011) certainly contributed to meeting Britain's important

financial needs during the Napoleonic Wars.

The above contributions analyze the part of the nominal interest rate that reflects the real expected interest rate. Although Bordo and Kydland (1995) demonstrate why long-term inflationary expectations could have been stable over the period, there is no series available that could definitely corroborate this hypothesis. In the absence of such evidence, movements in interest rates may also reflect changes in anticipated inflation or the default premium (Barro, 1987). This is my underlying assumption for what follows, as it has been the case for Calomiris (1988), Frey and Kucher (2000), Guinnane et al. (1996), and Webb (1986).

4 Course of Events

The Onset of Convertibility Suspension: Changing Money Demand

The Reign of Robespierre in France in early 1793 had produced a sharp outflow of capital, inducing silver and gold to leave France for Britain (Neal, 1991; Sargent and Velde, 1995). This had provided ample liquidity for the British banking system. When the assignats collapsed in France in 1795, money for ordinary payments became short and those with claims or credit in Britain drew on them to fill the gap. The ensuing outflow of capital put deflationary pressure on Britain (Kindleberger, 1984).

Gold outflows induced supply shortage and, thus, an increase in the market price of gold. Yet, under convertibility, gold still exchanged into bank notes for the same predetermined amount of pounds. In itself, this discrepancy in value (mint versus market) implied an incentive to convert even more bank notes into gold. Under these circumstances, minor French military actions triggered a bank run aiming at converting bank notes into gold specie (Chadha and Newby, 2013). The consequences of that run were felt throughout the country, putting numerous (country) banks out of business (Feavearyear, 1964).

Subsequently, on 27 February 1797 the Bank of England (BoE henceforth) was given permission, to cease payment of its notes in gold, before running out of reserves. With

the suspension, local bank notes were convertible only into BoE notes. The 1797 suspension of the BoE to convert its notes into bullion shifted Britain's monetary system from a commodity standard towards a flexible exchange rate.

Note (Over) Issue or the Lender of Last Resort

The internal and external value of the paper pound started decreasing around 1809 (figures 1 and 2).[6] Classical value theory, to which Ricardo (1817) was a major contributor, held that the equilibrium price of a good was determined by its production costs. It was believed that the production prices of gold and silver were relatively stable. A rise in the sterling price of gold bullion, and, hence, an increase in the difference between the mint and the market price of gold, was perceived as evidence for inflation (figure 3). After the suspension of convertibility of Bank of England notes into gold in 1797, a fall of the exchange rate on foreign currencies was interpreted identically (Laidler, 2000).

These evolutions induced government to appoint an investigating committee that published its work in 1810 as the Bullion Report. According to it, rising prices and falling exchange rates had a common source in the over-issue of BoE notes. The latter was undertaken to buy government debt - used to finance the Napoleonic Wars -, which would have been impossible had the BoE still the obligation to convert its liabilities into bullion.

Neal (1991) argues that it was rather the interruption of trade with the Continent that had caused the exchanges to fall. By implementing the Continental System, Napoleon had consciously sought to undermine British war financing on the Continent. In particular, by rendering it difficult to import British goods, Napoleon was attempting to constrain corresponding capital flows from the Continent to Britain.

In addition, while the BoE had indeed expanded its note issue, the peak of it was reached when the burst of the South America bubble in late 1810 induced wide spread panic and business failures (Feavearyear, 1964; O'Brien, 2010). Amid spreading commercial distress, country banks had started contracting their note issue drastically. The liquidity

[6]The price indices presented here were constructed *ex post* and not available at the time of the Bullion Report.

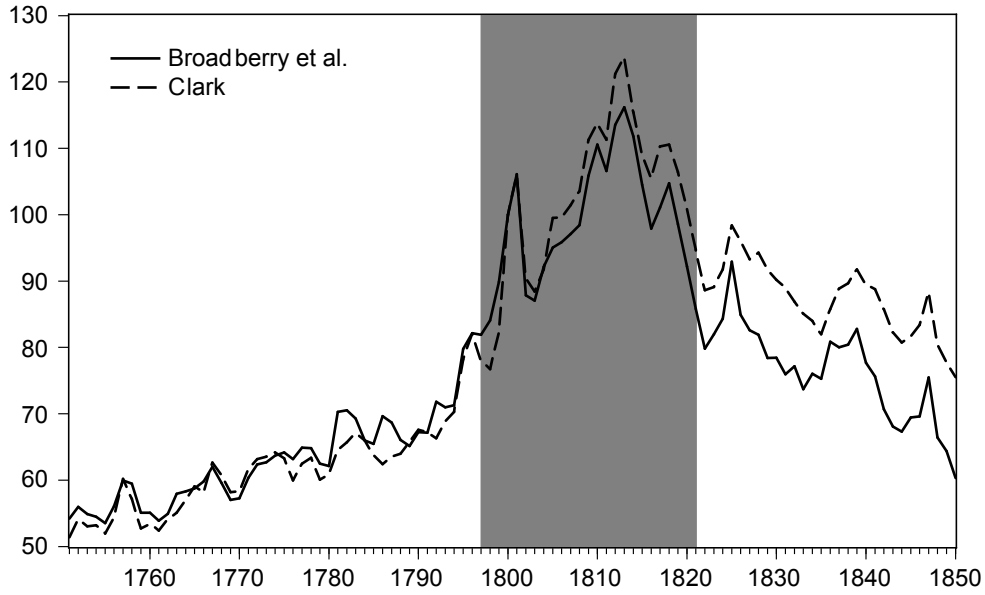

Figure 1: Price indices, 1800=100, 1750 to 1850

The shaded area marks the suspension of the gold standard from February 1797 to May 1821. Sources: Broadberry et al., 2012; Clark, 2014.

shortage had been broadly acknowledged and the authorities had attempted to overcome it by issuing commercial Exchequer Bills (O'Brien, 2010; Clapham, 1944; Flinn, 1961). Thus, at least part of it could be accounted for to its normal function as a lender of last resort, when other forms of credit disappeared.

Fiscal Pressure and the Long Path to Resumption

Fiscal pressure further delayed resumption. The Bank Restriction Act of 1797 had initially determined that specie payments would be resumed six months after the end of the war. Yet, between the end of the Napoleonic Wars in June 1815 and the resumption of the gold standard, the legal limit had to be extended several times. Cannan (1919) explains that the BoE's unfortunate financial situation in 1816 was caused by its lending to the Treasury and exacerbated by inadequately high dividend payments.[7] Clapham

[7]While a decline in the BoE's after war profits would have called for a reduced distribution, the Bank

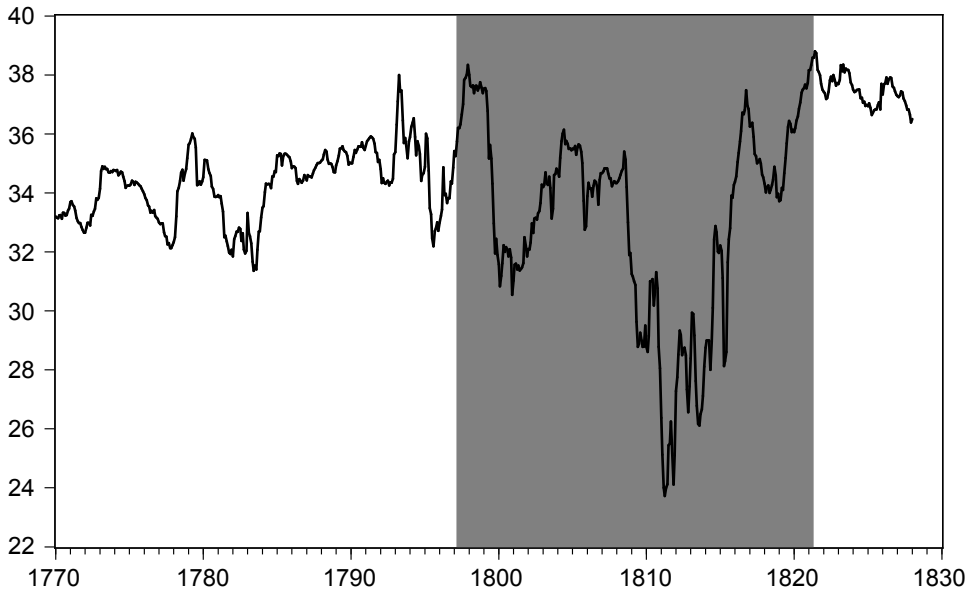

Figure 2: Exchange rate on Hamburg: Schilling per Pound Sterling, two months' usance, 1770 to 1828.

The shaded area marks the suspension of the gold standard from February 1797 to May 1821. Sources: Boyer-Xambeu et al., 1994.

(1945) emphasizes that the Bank's high average of notes outstanding in 1817 and 1818 was due to the incessant lending to the Treasury; commercial lending was abnormally low over the same period. This had contributed to the failed resumption of July 1818.

In total, the Bank's holdings of public securities, almost exclusively exchequer bills, had increased by 40% between February of 1816 and August of 1818. This evolution reflected the sizable increase of public debt over the period: by 1815, the debt to GDP ratio had reached 226%, up from 120% in 1793. The increase was of the same order of magnitude as the one caused by World War 1 (see figure 4).

Note that in terms of taxation, room for maneuver was very limited, placing the British

continued to pay its dividend at the usual 10% meaning that it paid its proprietors nearly £300,000 per annum more than it did over the 1807-15 period.

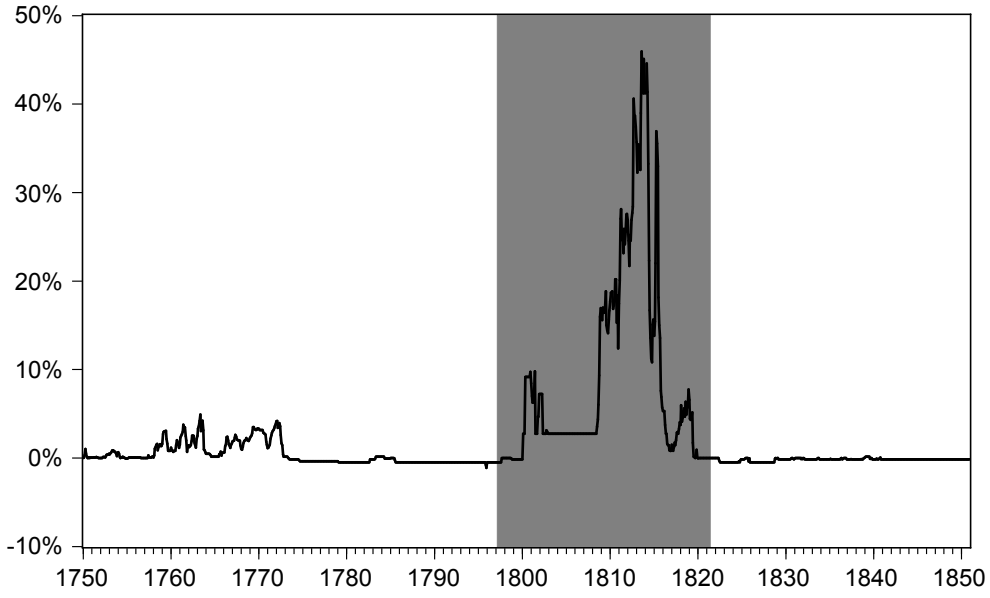

Figure 3: The agio, difference between the market and mint prices, 1750 to 1850.

The shaded area marks the suspension of the gold standard from February 1797 to May 1821. Sources: Neal, 1990.

economy close to its fiscal limit. After four years of unsuccessful warfare and with the growing perception that the war against Revolutionary France was going to be more dangerous and costly than previously thought, Pitt the Younger, Prime Minister and Chancellor of the Exchequer, was able to impose Britain's first income tax. How strong the opposition to this measure was, can be seen from the fact that it was instantly repealed at the Peace of Amiens in 1802 and after the final victory at Waterloo in 1816.

In addition, the broad social consensus entailed that it was indecent to tax the poor's necessities, taxing, hence, mostly goods consumed by the affluent. The government had, however, virtually exhausted its possibilities for direct taxation; further increases in tax rates had become self-defeating - as when notable families ceased to exhibit armorial bearings or to use hair powder (O'Brien, 2007).[8]

[8]For details on the tax incidence of the Sinking Fund, see O'Brien 2006.

Over the whole after-war period, BoE directors had insisted that an effective resumption was only possible if the government paid back a substantial amount of debt to the Bank. The legal framework governing the definite resumption of specie payments - Peel's Act, enacted 2 July 1819 - imposed the repayment of £10 million of government short-term debt and also made it illegal for the BoE to lend money to the government for more than 3 months without approval of Parliament. This paved the way for resumption, undertaken by 1 May, 1821.

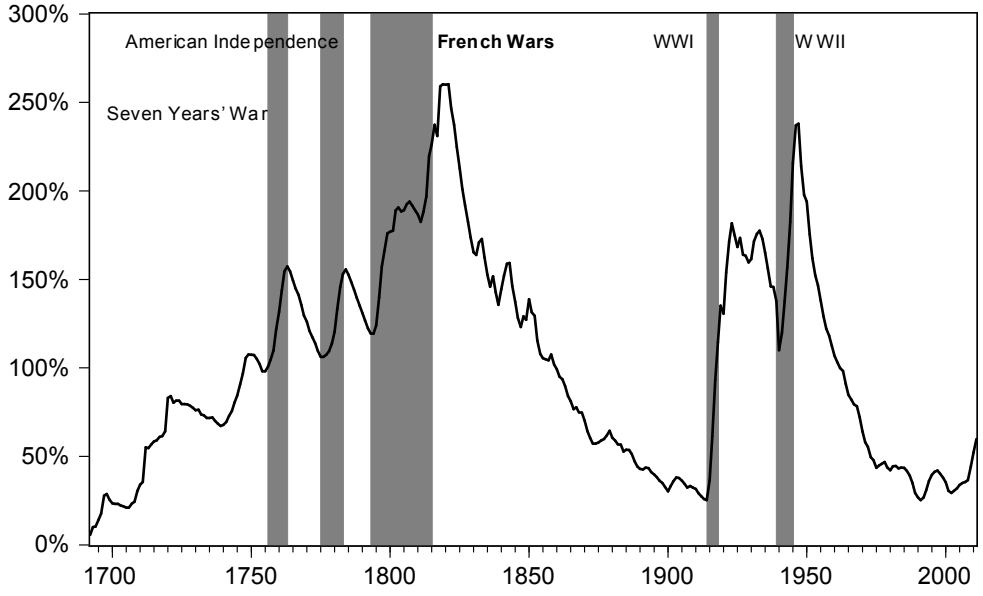

Figure 4: Debt to GDP ratio, 1692-2011

Sources: Mitchel, 1988; Officer and Williamson, 2013

5 Econometric Methodology

5.1 The Data

In order to most accurately capture the nexus between expectations regarding the sustainability of public finance and evolutions in prices, I focus here on the series that contemporaries used to assess inflationary tensions. To a minor extent, this is a tech-

nical constraint as price indices did not exist at the time and available data were not exploited thoroughly (Arnon, 1990). Primarily, this is, however, done to grant historical coherence between my findings, contemporaries' information set, and the Bullion Report's sources and basic hypotheses.

Contemporaries paid attention to prices of specific, widely traded goods, such as wheat, gold bullion and sterling bills of exchange (notably on Hamburg and Amsterdam). Of these data, I will concentrate on the difference between the market and the mint price of gold bullion[9], the *agio* (see also section 3.2), for the following reasons:

- Absent efficient storage technologies, wheat prices were affected by various real factors, such as bad harvests (Tooke, 1824) or the various trade barriers installed during the period under consideration (for the Continental System, see Crouzet, 1964; for the US embargo, see Frankel, 1982). These factors stood in no connection with agents' expectation on fiscal sustainability and would render the interpretation of thus noisy price data difficult.

- The exchange rate was affected by (real) factors that had no direct relevance for the internal valuation of the currency. When, for instance, the pound sterling depreciated on the Hamburg exchange between 1800 and 1801, this was due to bad harvests and deflation in Hamburg (Newby, 2008).

- The supply of precious metals was stable during the Restriction Period (Barro, 1987). In addition, melting down and export of British coin were prohibited. I also posit that changes in the demand for non-monetary uses of gold did not occur during the Restriction Period.[10]

- Financial data offer the advantage of reflecting subjective expectations of decision makers about the future. Therefore, their use avoids certain selection biases: fi-

[9] In 1717, Newton fixed the pound sterling at a gold price of £3 17s 10.5d. This mint price lasted with lapses for the two restriction periods until 1931.

[10] It is well known that prices for precious metals increase in times of financial or political turmoil. This reflects precautionary motives for the detention of gold or 'the flight to quality'. As this entails a hedge against future inflation, I consider that this motive for the acquisition of gold is in line with my hypothesis and that it can be understood as a future monetary use of gold.

nancial decisions have pecuniary consequences, which implies incentives to behave as a profit-maximizer. Traders attempt to pin down what did or will happen, not for its own sake or historical purposes, but in order to assess the future value of the asset they hold or intend to acquire (Frey and Kucher, 2000).

- Finally, evolutions in the *agio* reflect accurately the movements in the aggregate price level. For the available monthly and yearly price indices, correlation coefficients range from 0.65 to 0.72 and from 0.68 to 0.79 respectively during the suspension period. Table 6 in the appendix presents more detailed statistics.

The data set spans the years 1718-1873 and is based on Castaing's Course of the Exchange, published twice a week (reproduced in Neal, 1990 and Boyer-Xambeu et al. 1994). As presented in figure 3, the *agio* increased substantially after 1808 and reached a peak of 45% mid 1813. Recall that contemporaries interpreted increases in the *agio* as a metric of the pound's internal devaluation. An increase of gold's market value in terms of paper pounds entailed that more pounds were required to purchase the same commodity. Absent any significant changes in the supply of gold, an increase in the *agio*, therefore, necessarily implied a devaluation of the pound. Table 7 in the appendix provides descriptive statistics for the *agio*.

5.2 Identification Strategy and Estimation Procedure

Contemporaries' Views and Actions

Irrespective of prior policy commitments, agents could rationally be expected to incorporate all available information that could help anticipate the future state of public finances (see section 2). Based on their assessment regarding the sustainability of British public debt, agents would then adjust their consumption, investment, and pricing decisions. These, in turn, would affect the aggregate price level, through which adjustments in real outstanding public debt would operate.

The aggregate price level, therefore, reflected agents' assessment of fiscal sustainability in the future. Important changes in the price level, should, thus, convey information on the events that caused contemporaries to alter their predictions regarding public finances.

Hence, I should be able to identify these unexpected[11] events as structural breaks in the price level, measured by the *agio*.

This type of analysis is different from an event study or the narrative approach, as the starting point is not a predefined list of historically important dates with the data telling which matter. On the contrary, the methodology employed here allows detecting the events that contemporaries considered to be significant for the future course of British finances without any *ex post* bias. This pays attention to the concern that historical events are not a prequel to what ensues but have to be analyzed in their historical context.

In addition, the understanding of contemporaries' perception is enhanced by the use of financial market data. The latter are highly informative when one wishes to assess the contemporaneously perceived importance of events, since any misinterpretation of incoming information has adverse pecuniary consequences (Frey and Waldenström, 2008 and Oosterlinck et al. 2013).

The Joys of Archival Evidence

My approach bears, however, the risk of 'over-interpretation', i.e. the risk that historical events of minor importance are matched with the determined break dates at any costs. I verify the importance of events matched with the detected break dates by considering contemporary sources and archival evidence. In particular, I consult the *The London Times*, Britain's highbrow daily newspaper of the period (Bignon and Flandreau, 2014), for which archives are available over the whole period.

I also examine *The London Gazette*, government's official journal. The latter was published twice a week (on Tuesdays and Saturdays) and as a 'Gazette Extraordinary' whenever deemed necessary by the nature of news. The *The London Gazette* contained official government announcements, such as declarations of war and peace, and intelligence from different war fronts. The enclosed intelligence came in the form of dispatches, composed by the actors of war themselves (to a lesser extent that was the case for the *The London*

[11] Market efficiency entails that expected events would have been incorporated beforehand.

Times as well).

Beyond the obvious historical interest of these pieces of information, they also conveyed information regarding transmission times for news. For instance, Madrid capitulated to the French on 4 December 1808, news of the capitulation, however, only reached London on the 19th. I, thus, paid close attention to the fact that break dates had to coincide with the moment at which information concerning an event attained Britain, rather than with the timing of the event itself.

While it was rather straightforward that Madrid's capitulation made the news in December 1808, it was less easy to determine which event affected contemporaries' perceptions when there were several important battle lines. In these cases, I searched both journals for keywords in the vicinity of the break date and retained the event obtaining the highest number of references. Along those lines, I also paid particular attention to the frequency of mentions in the *The London Times* lead articles. In August 1812, for example, intelligence from neither the Russian nor the Spanish fronts made the headlines, it was information regarding the American declaration of war that occupied most news space.

In addition to these sources, I relied on evidence from the BoE archives. The publications I considered were ledgers and related publications[12] that contained prices for gold and different titles of public debt. Beyond the otherwise known price data, these publications also recorded significant events of the time. This established a direct link between observed price movements and events that had caused them. In other words, contemporaries were well aware of the fact that political and military events had their bearing on the evolutions of asset prices.

Moreover, the ledger used in particular (see figure 9 in the appendix), recorded fortnightly averages of price data and was completed over time. Together with references to *ex post* seemingly minor events this made it an adequate reflection of how the importance of events was appreciated in real time. It is, therefore, reassuring that practically all estimated break dates are also mentioned in the ledger.

[12]BoE archives, items 10A270/1 and 10A321/1.

My approach is, thus, freely inspired by Webb (1986) in that it allows detecting the events that influenced contemporaries' perceptions in real time by combining *ex-ante* agnostic break tests and the reading of contemporary sources. The appendix (subsection A2) provides an example of how this methodology forestalls detecting events that suffer from *ex post* bias.

Some Econometrics

The procedure used to estimate the break dates is based on Bai and Perron (1998 and 2003).[13] It offers the advantage of allowing for a very wide range of specifications (serial correlation and heteroskedasticity in the errors, lagged dependent variables, trending regressors, as well as different distributions for the errors and the regressors across different segments). The procedure also encompasses a whole battery of different break point tests (sequential and global methods), increasing greatly the robustness of results.

Consider the following multiple linear regression model with m breaks and $m+1$ regimes:

$$y_t = x_t^{'}\beta + z_t^{'}\delta_j + u_t \tag{1}$$

for $t = T_{j-1} + 1, .., T_j$ and $j = 1, .., m + 1$. y_t is the observed endogenous variable, $x_t(p \times 1)$ and $z_t(q \times 1)$ are vectors of co-variates and β and δ_j are the corresponding vectors of coefficients. u_t is the disturbance at time t. Given the T observations of (y_t, x_t, z_t) I attempt to estimate the unknown regression coefficients β and δ_j and break dates. For the *agio*, I will posit that all coefficients are subject to change, obtaining a pure structural change model ($p = 0$) of the following form:

$$y_t = z_t^{'}\delta_j + u_t \tag{2}$$

[13] Various other studies in the field of economic history have used break point tests; a non-exhaustive list includes: Guinanne et al., 1996; Brown and Burdekin, 2000; Frey and Kucher, 2001; Oosterlinck, 2003; Frey and Waldenström, 2008; Zussman et al., 2007; Flandreau and Oosterlinck, 2011.

Note that the variance of u_t does not need to be constant. Breaks in the variance are permitted, provided they occur at the same dates as the breaks in the parameters of the regression.

I define a break in the series as a change in the conditional mean of the series y_t, i.e. I specify that the intercept can change ($z_t = 1$). The focus is here on abrupt structural changes in the mean that reflect the advent of unexpected news affecting Britain's war fate and, hence, public finances. For that reason, I also exclude past values of the endogenous y_t. When lagged values are included, changes in the level of y_t also depend on the auto-regressive dynamics of the series; thus, the change takes effect gradually.[14] On the contrary, when specifying $x_t = \oslash$, all the dynamics are contained in the error term and the change is, hence, abrupt (Bai and Perron, 2003).[15]

In the following, I first run the break point procedure on monthly data for the 1795-1823 period. This data set is comparable to the ones used in earlier studies (Neal, 1990) and contains 340 observations. I then use the daily data, in order to detect more precise break dates. Due to data availability issues, I do only estimate daily break dates for the 1811-1823 period. The daily data set encompasses 1350 data points.

Increasing the number of observations included in the sample, also allows detecting more break dates, as the number of breaks depends on the possible size of segments, i.e. the number of observations between two adjacent breaks (Bai and Perron, 2003). A minimal segment size warrants that each segments contains sufficient observations to estimate parameters precisely.

In the presence of autocorrelation and heteroskedasticity, as it the case here, each segment should include at least 24 observations (Bai and Perron, 2003). Finally, a trimming parameter ϵ links the minimal segment size, h, to the maximal number of breaks, k, allowed: $\epsilon = \frac{h}{T}$. For a sample of T observations one obtains the maximal number of breaks, k: $\epsilon = 0.05 \Rightarrow k = 10; \epsilon = 0.10 \Rightarrow k = 8; \epsilon = 0.15 \Rightarrow k = 5; \epsilon = 0.20 \Rightarrow k = 3; \epsilon =$

[14] The 1802-1807 period reflects data issues rather than persistence in the series.

[15] When no lagged variable is part of (z_t, x_t), the conditions on the residuals allow for autocorrelation and heteroskedasticity.

$0.25 \Rightarrow k = 2;$.

6 Results

6.1 Monthly Data

The monthly break dates are displayed in figure 5 and table 1 (table 8 in the appendix provides confidence intervals and parameter estimates). The events that coincide with the detected break dates are outlined below:

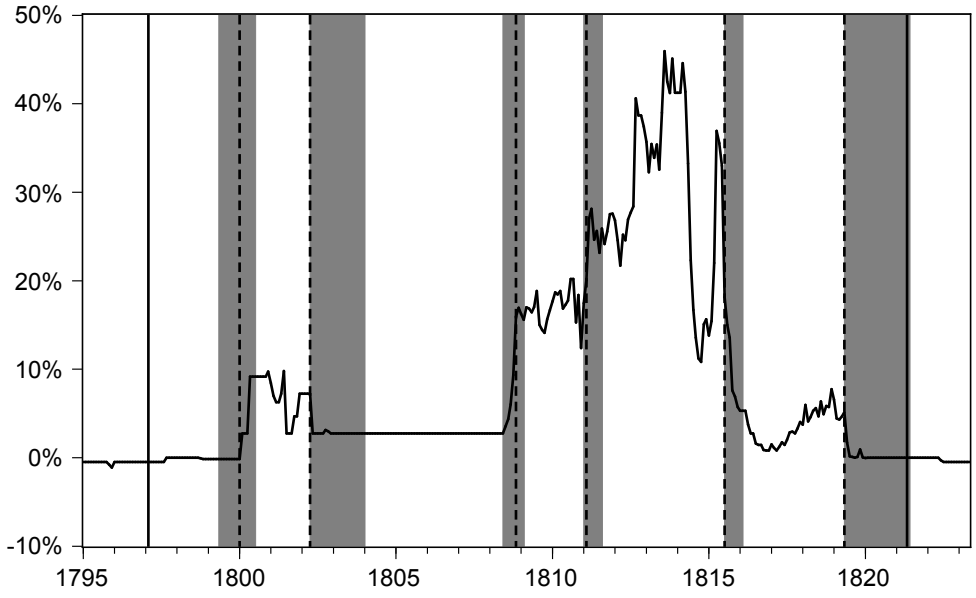

Figure 5: Break dates, monthly data, January 1795 to May 1823

Solid lines mark the beginning and end of the gold standard's suspension, February 1797 and May 1821 respectively. Dashed lines highlight the detected break dates; the shaded areas represent the 95% asymmetric confidence intervals.

- **January 1800**: The winter of 1799 brought General Napoleon Bonaparte to power as first Consul of France, a position granting him broad and unchecked authority.

Table 1: Break dates, monthly data, January 1795 to May 1823

Break date	**Event**	**Agio**
January 1800	Coup of 18 Brumaire and ensuing constitution install Napoleon as sole ruler over France	↗
April 1802	Treaty of Amiens ends hostilities between France and Britain	↘
November 1808	French victories at Tudela and Somosierra enable Napoleon's brother Joseph to become King of Spain (Britain's ally)	↗
February 1811	Outnumbered French forces nearly destroy Spanish Army of Extremadura	↗
July 1815	Prussians seize Paris, Napoleon surrenders to the British	↘
May 1819	Peel's Act definitely fixes details and timing for resumption of convertibility	↘

Given his military successes during the war of the First Coalition (1792-1797), his accession to power was thought to reestablish France's place in the concert of nations (Mignet, 1826). When Britain declined Napoleon's offers to begin peace negotiations - as announced in the *London Times* on 6 January 1800 - the *agio* increased.[16]

- **April 1802**: The Treaty of Amiens ended hostilities between the French Republic and the United Kingdom and, thus, the war of the Second Coalition (1798-1802). The Bank Restriction Act would have expired six months afterwards, and the Bank of England had signaled its readiness to resume convertibility at several occasions (Clapham, 1944; Newby, 2012).[17] At the announcement of these to Britain favorable events,[18] the *agio* decreased.

- **November 1808**: The battle of Burgos (10 November, announced in the *London*

[16]Market sentiment was right in that the following months would play out unfavorably to Britain. The battles of Marengo (14 June 1800) and Hohenlinden (3 December 1800) sealed Austria's defeat, leaving the British as the only army opposing France.

[17]It was the government that had urged Parliament to extend the Act several times, until a new war would put an end to the discussions about the early resumption in April 1803.

[18]29 and 30 March in the *London Gazette* and the *London Times* respectively.

Times on the 26^{th}) resulted in the complete victory of the French over the Spanish, and opened central Spain to invasion. The battle preceded Madrid's capitulation to Napoleon on 4 December and the installation of his brother Joseph as the King of Spain. In line with these events, the *agio* increased.[19]

- **February 1811**: An outnumbered French force nearly destroyed the Spanish Army of Extremadura at the battle of Gebora (19 February). This victory allowed the French to seize the important fortress and well supplied town of Badajoz, opening the route to Portugal.[20] At this occasion, the *agio* increased further.

- **July 1815**: The month of July witnessed decisive military and political events, sealing Napoleon's final defeat. Wellington and the King of France enter Paris On after the Battle of Issy, won on the 3 July.[21] On 15 July, Napoleon surrendered himself to the British[22] and was in the following sent to the the island of Saint Helena, where he died in May 1821 (see section on daily data).

- **May 1819**: Peel's Act definitely fixed the details and time-line for the resumption of the gold standard (see section 3 and results for daily data further below).

6.2 Daily Data

I now turn to the results of the break date estimation on the daily data, presented in figure 6 and table 2 (tables 9 and 10 in the appendix provide confidence intervals and parameter estimates). The results for overlapping periods from the daily procedure corroborate the monthly results. The following events coincide with the detected break dates:

- **8 February 1811**: No military or political events occurred at that exact date. However, the confidence interval encompasses the battle of Gebora, on 19 February

[19] In the meantime, Napoleon had initiated the Peninsular War. In order to punish the Portuguese for not enacting the Continental System against the British, French troops were sent to Spain, France's ally. Taking advantage of the troops' presence in Spain, Napoleon had turned on his ally.

[20] Dispatches announcing the Spanish defeat at Badajoz are published in the *London Gazette* the 3 March.

[21] *London Gazette*, 11 July.

[22] *London Gazette*, 21 July.

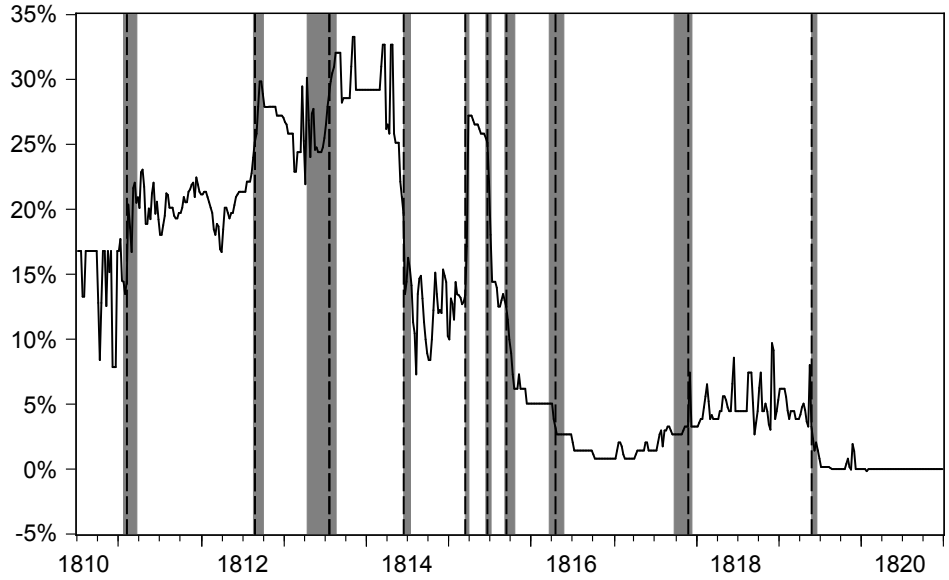

Figure 6: Break dates, daily data, July 1810 to December 1820

Dashed lines highlight the detected break dates; the shaded areas represent the 95% asymmetric confidence intervals.

(refer to monthly results) and the battle of Barrosa, on 5 March. The latter was an unsuccessful maneuver to break the French siege of the essential naval base of Cádiz. Following these events, the *agio* on gold increased.

- **25 August 1812**: During the summer of 1812, a great deal of uncertainty surrounded the state of war with America, causing upheaval in the trading community and fluctuations in the funds.[23] While the American declaration of war had reached London by the end of July, its primary cause, Britain's demand to cease trade with France, had been removed in the meantime. It was, thus, expected that Lord Liverpool's repeal of the Orders of Council would have put an end to hostilities. It came as a surprise when news regarding the American decision to continue warfare reached London towards the end of August.[24] The opening up of a new war front amid ongoing war in the Peninsular caused a rise in the *agio*.

[23] *London Times*, 21 August and 4 September.
[24] *London Times*, 21 August and 4 September.

Table 2: Break dates, daily data, January 1811 to May 1823

Break date	**Event**	**Agio**
8 February 1811	Battles of Gebora and Barrosa allow French holding on to the essential naval base of Cádiz	↗
25 August 1812	American declaration of war	↗
20 July 1813	Bad news from American and European fronts	↗
17 June 1814	Treaty of Paris temporarily ends Napoleonic Wars	↘
17 March 1815	Napoleon enters Paris after having escaped his exile on Elba	↗
17 June 1815	Napoleon suffers his decisive defeat at Waterloo	↘
15 September 1815	Ultimatum 'regarding Second Treaty of Paris	↘
16 April 1816	Currency reform and partial resumption	↘
28 November 1817	After war depression, new issuance of public debt, and political upheaval	↗
25 May 1819	Peel's Act definitely fixes details for resumption of convertibility; reimbursement of government debt	↘

- **20 July 1813**: News coming from the American front were negative. On the 25 and 27 July reports reached London that the Americans had captured two out of the three British forts necessary to defend Upper Canada.

  On the European front the situation was not more favorable either. While hostilities were interrupted, both sides primarily used the armistice of Pläswitz to rebuild their armies. Britain had also engaged in the great Russian and Prussian loans and had offered Austria sizable financial support in case it joined the Allied war effort. In order to permit Austria's complete mobilization, the armistice was extended to 16 August. Both parties knew that hostilities would resume after-wards. These events caused the *agio* to rise.

- **17 June 1814**: The Treaty of Paris, signed on 30 May 1814, ended the War of the Sixth Coalition. The peace treaty and its ratification were published in the *London Gazette* on the 2 and 18 June respectively. As restoring a strong and stable French state was part of getting back to the Pre-Napoleonic balance of power, Britain

relinquished reparation payments. The counterpart to this was eliminating the French threat to Britain's commercial interests around the world (White, 2001). At this occasion, the *agio* fell by 60%.

- **17 March 1815**: After having escaped his exile on Elba, Napoleon entered Paris on 20 March.[25] Upon reaccession of the throne, he commenced to organize his armed forces. By the end of May, he had formed 'l'Armée du Nord', consisting of approximately 200,000 troops ready for deployment in the Waterloo Campaign (Chesney, 1868).

  At the mere prospect of a new war against Napoleon, the *agio* doubles (see also Viner, 1937). The evolution of the *agio* at this particular event emphasizes that it is the expectation of future public spending that affects the price level. This is clearly a fiscal news shock, as no war-related spending has yet occurred, and allows, thus, to exclude the hypothesis that inflationary tensions are caused by monetary expansion.

- **17 June 1815**: Napoleon suffered his decisive defeat at Waterloo on 18 June, ending his Hundred Days of reign.[26] At this occasion, the *agio* declined by almost 60% (refer also to section on monthly data).

- **15 September 1815**: Negotiations for the second Treaty of Paris were truly set in motion when the Allies delivered an ultimatum to the French government for a new peace on 20 September.[27] This time around the Allies' demands included sizable reparation payments, to be disbursed over the following five years (Marion, 1914). Absent any bargaining power for the newly restored Bourbon monarchy (White, 2001), the *agio* decreased in line with this event.

- **16 April 1816**: While the Restriction Period was due to end on 5 July 1816, government postponed the resumption for another two years in mid April. The public still remained sanguine regarding resumption for two reasons: Government's prior currency reform was understood as a necessary step towards stabilization of the Pound (Clapham, 1944; Redish, 1990). In addition, as the conditions for resumption were favorable (Fetter, 1965), the BoE experimented with partial resumption

[25] The *London Times*, 24 March
[26] *London Gazette*, 22 and 24 March
[27] *London Times*, 7 and 10 October.

of small denominations. The BoE's efforts signaled a strong commitment to returning to the pre-war parity in the near future (Newby, 2008), and the *agio* on gold declined.

- **28 November 1817**: After-war depression and deflation started in Britain in early 1816 (Broadberry et al., 2011; Clapham, 1944). Due to a bad harvest, and even more so to the Corn Laws, wheat and bread prices rose, however. Eventually, this combination caused social unrest.

  The political *status quo* was called into question by riots claiming electoral reform and universal suffrage. A prerequisite for becoming a Member of Parliament were property qualifications that guaranteed an important intersection between Members of Parliament and creditors of public debt (Johnston, 2013). Since deflation increased the real value of debt to the advantage of creditors, parliamentary support for the reimbursement of public debt was strong. Universal suffrage could have seriously challenged this.[28]

  Amid this situation, a new issue of Exchequer Bills (Flinn, 1961) and the recent abolition of the income tax further increased government's outstanding short-term debt, making resumption of cash payments less probable (Clapham, 1944). At this occasion the *agio* rose again.

- **25 May 1819**: Parliamentary debates regarding the resumption of convertibility started on 21 May and were concluded unanimously on 26 May, stating the exact resolutions governing the resumption of specie payments.[29] The final version of Peel's Act[30] was made law by July 2 and provided for gradual resumption of payments at the pre-war parity over a period of four years (see section 3).[31] Clapham (1944) emphasized the immediate impact the new regulation had on the Paris exchange and the *agio* on gold, which fell to zero; the *London Times* made the same

[28]The most ardent proponents of maintaining the paper pound indefinitely could be found among industrialist in the North of Britain (Clapham, 1944). Not only did the Northern parts of the kingdom suffer economically, they were also lacking political representation. Manchester and Birmingham, for instance, had a population of 100,000 each but were not represented by Member of Parliament at the national level.

[29]I Hansard XL, 802-04, 26 May 1819.

[30]59 Geo. III, c.49

[31]The BoE resumed specie payments on 1 May 1821, two years ahead of schedule.

observation on 29 May.

7 Discussion

So far, I have shown that expectations regarding the sustainability of public finances affected the price level during Britain's first experience with fiat money. This interpretation of events hinges on one critical assumption, namely the absence of outright default. In the framework proposed here, it is only when outright default on some or all of government debt can be excluded that debt adjustments will occur by (devaluation induced) inflation.

Given the importance of this assumption, this section first lays out some narrative evidence that contemporaries did indeed exclude the possibility of outright default from the politically feasible. This finding is then further corroborated by the analysis of interest rates on public debt.

7.1 Hard versus Soft Default: Narrative Evidence

What I have stated so far depends on the assumption that if default there is, it will be default by inflation. In practice that means the following: suppose worst comes to worst, Britain loses the war and hits its fiscal limit. My assumption of soft rather than hard default entails that contemporaries attached a higher probability to the event of getting back to the gold standard at a devalued par than to the event of government not reimbursing some or all of outstanding public debt.

Many authors have pointed out that contemporaries indeed excluded the possibility of outright default (Acworth, 1925; Neal, 1990). O'Brien (2010) states that 'neither domestic nor foreign investors in the securities of the island could have rationally contemplated [..] that the government's debt be repudiated either as an outcome of conquest or as the result of any unmanageable fiscal and financial crisis [..]. Reasons for this certainty were numerous:

- British public finances had been in order for more than a century, ever since Parliament had gained spending and taxing power with the Glorious Revolution (North

and Weingast, 1987; Sussman and Yafeh, 2006). Partisan constellations had further contributed to excluding outright default from the politically acceptable (Stasavage, 2007).

- The credibility of British public debt was essential for the funding of war. It was part and consequence of an institutional environment that facilitated war finance, leading eventually to Britain's military and, hence, commercial supremacy over most of continental Europe (Bordo and White, 1991; Brewer, 1988).

- A broadly acknowledged national consensus entailed that national elites contributed to the war effort by holding government debt. In return, war debt would not be defaulted on, as successful wars enhanced prospects for growth and investment opportunities, thus rendering war debt self-amortizing (Ritschl, 1996).

- Due to property qualifications that guaranteed an important intersection between Members of Parliament and creditors of public debt, default became even more unlikely, given Parliament's prerogatives on the issue (Dickson, 1967; Johnston, 2013).

By contrast, alleviating some of the debt burden by increased inflation would have implied a more extensive mutualization of war losses. Moreover, this was the first long suspension of the gold standard. The discussion around resumption and its exact modalities was vivid: no options, including devaluing the pound and maintaining the paper pound indefinitely, were excluded *ex ante*. The decision to resume at the pre-war parity was, thus, by no means predetermined (Kindleberger, 2000).

The above entails also that the choice between soft and hard default was above all a redistributive one. Outright default would have entailed a capital levy on the holders of government debt, while default by inflation would have affected everybody, but to a lesser extent. Given the political circumstances of the time - 1.5% of the British population were registered to vote in Parliamentary elections (Johnston, 2013) - I have supposed that contemporaries attached a higher probability to the latter.

7.2 How Monetary Regimes Shape Expectations

The Object of Analysis: Interest Rates on Public Debt

A more formal way to test the hypothesis that default will occur by inflation rather than in an outright manner is to examine interest rates on public debt, disentangling the premia for default and anticipated inflation. The series used for this exercise is the market yield on three percent consolidated annuities, so-called consols, which were the benchmark instrument of British debt management over the period (Ashton, 1959). At the monthly frequency, this series has so far not been exploited.[32]

Consols formed the larger part of Britain's funded debt before World War I and were the focal point of the yield curve. As such they were not subject to redemption or interest rate reductions.[33] Unlike most other private debt instruments, neither were consols subject to the usury laws, imposing a five percent interest rate ceiling. The interest rate on consols, thus, freely reflected conditions of demand and supply in the government debt market.

Furthermore, consols were a perpetual bond, for which holders received an annual three percent coupon. The yield of a consol then equaled interest payments as a percentage of the market price. Yields, thus, reflected price movements on the secondary market that incorporated investors' expectations of inflation and default risk (Chamley, 2011). Figure 7 displays the evolution of market yields between 1750 and 1950.

With the above in mind, it is possible to decompose the nominal interest rate on consols, r_{nom}, into its expected real component, the marginal product of capital, r^e_{real}, expected

[32]Existing research, such as Barro (1987) relies on interest rate series at an annual frequency. These annual series are obtained by averaging monthly data, which entails potential problems of temporal aggregation, i.e. changes in the property of time series by averaging out observations (Christiano and Eichenbaum, 1987; Sims, 1971). As a matter of fact, annual consol yields are significantly different from observations for the first and last month of each year. Moreover, this phenomenon is exacerbated in years of high volatility. It is, thus, to be expected that my results differ from those found in earlier studies on the subject.

[33]From 1752 up until to Goschen's conversion in 1888, the coupon rate on consols remained indeed at three percent.

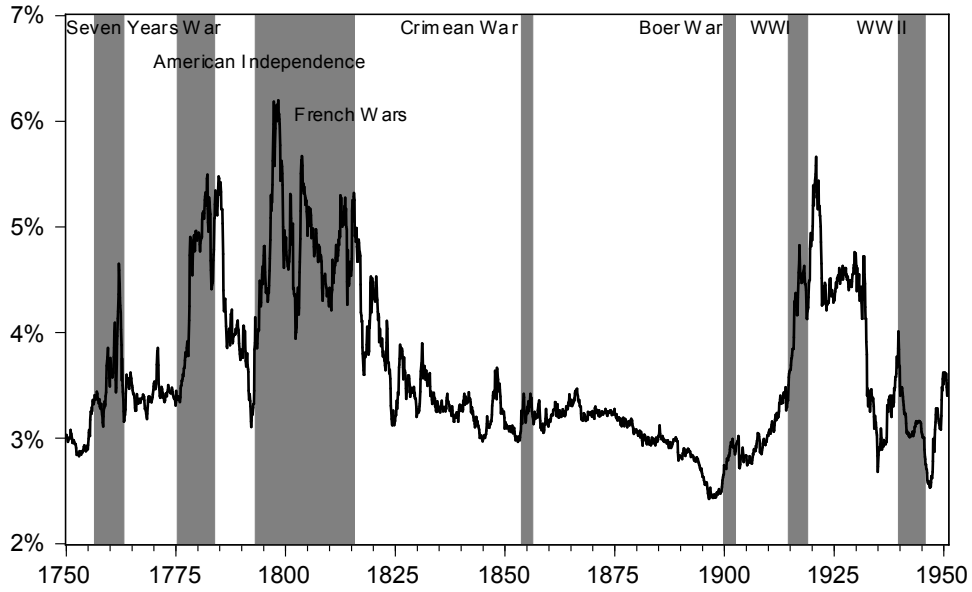

Figure 7: Market yields on consols, monthly data, January 1750 to December 1950

Sources: Neal, 1990.

inflation, π^e, and the default premium, d.

$$r_{nom} = r^e_{real} + \pi^e + d \tag{3}$$

Forecasting the (Stability) of Inflation

In a first step, I check whether expected inflation, π^e was stable during the suspension period (for a discussion see Bordo and Kydland, 1995; Rolnick and Weber, 1997). This amounts to testing whether the same rate of inflation was anticipated for the gold standard and the suspension period alike. The exact process of expectation formation is beyond the scope of this article. I, therefore, posit that agents forecast inflation using information regarding its past evolutions. Besides the simplicity of this approach, simple back-ward looking forecasts of inflation are in practice hard to beat by more sophisticated ones (Faust and Wright, 2013).

In order to account for varying lags in the formation of expectations, I compute average inflation over different time horizons (one, two, and five years). The series used for this exercise is based on Gayer et al. (1953), as it is the only one available at a monthly frequency. These averages are then compared to observed inflation during the suspension period. If anticipated inflation was the same for the suspension period and the gold standard, the residuals of these equations should be white noise.

Figure 8 depicts the residuals; for the residuals to be white noise, they ought to have a zero mean and a constant variance, while being serially uncorrelated. None of these conditions are met[34] confirming that the residuals do not follow a white noise process. I can, thus, exclude that the same rate of inflation was expected for the gold standard and the suspension period. This finding entails also that anticipated inflation was not stable throughout the suspension period.

This result hinges on the nature of the gold standard as a devise imposing the stability of the price level. In particular, a stable price level entails that rates of inflation will on average be zero over the whole duration of the gold standard. The same is true for restrictions of convertibility, when ended by a resumption at the pre-war parity, as the latter necessitates getting back to the pre-war price level. Thus, average rates of inflation will equal zero between endpoints of the gold standard and its suspension at the time of resumption. This is, however, the only feature that the operation and resumption of the gold standard allow forecasting.

Being on the gold standard or resuming it at a non-predetermined date in the future does by no means provide any useful information for forecasting short to mid-term rates of inflation. The adjustment mechanism the gold standard -and for that matter any type of price level targeting- relies on, requires that inflationary outbursts are countered by deflationary episodes. This, however, induces high short to mid-term volatility in prices and activity, making both series hard to predict (Meltzer and Robinson, 1989). In addition, the same feature of the gold standard also practically excludes cases in which inflation rates are close or equal to zero, as this only has to be the case on average.

[34]See table 11 in the appendix for descriptive statistics; autocorrelation and heteroskedasticity test results are available upon request.

Not only is predictability of inflation under the gold standard restrained to long term evolutions.[35] Forecasting inflation gets even thornier when the probability of resumption at the pre-war parity is not equal to one. To make things even worse, it is likely that the probability of resumption varies with the length of convertibility suspension and so induced inflation, since its deflationary counterpart comes at increasing economic and political costs.

Thus, any meaningful forecast of inflation under the gold standard hinges on the probability of resuming convertibility at the pre-war parity. This, in turn, reflects the probability that average rates of inflation will equal zero at the time of resumption. The timing of resumption and the inflationary overhang, finally, allow forecasting the scale of deflation to come.

It's all about Anticipated Inflation

In the following, I examine the yields' variance under different monetary regimes (the gold standard and its suspension, i.e. a commodity and a fiat currency regime) and different states of the world (peace and war). In particular, the yield series is partitioned into four segments: peace under the gold standard, war under the gold standard, peace during the suspension and war during the suspension.[36] To pin down the part in the variance of consols that is attributable to this segmentation or treatment, I conduct an analysis of variance (ANOVA). This procedure is in spirit and, under certain assumptions on the residuals, in practice close to difference-in-difference estimation (Iversen and Norpoth, 1987).

Mean yields for every segment are presented in table 3. The means are significantly different from each other.[37] In the following, I test whether the differences in means are accounted for by the way the series is partitioned. To do so, the variation between means can decomposed following equation 4. Here SS_{total} equals the total sum

[35] Recall what Keynes said about this horizon.

[36] The minimal segment size for this partitioning is of 49 observations, ensuring the validity of the test procedure.

[37] These results are based on a host of tests, including those allowing for unequal sample variances.

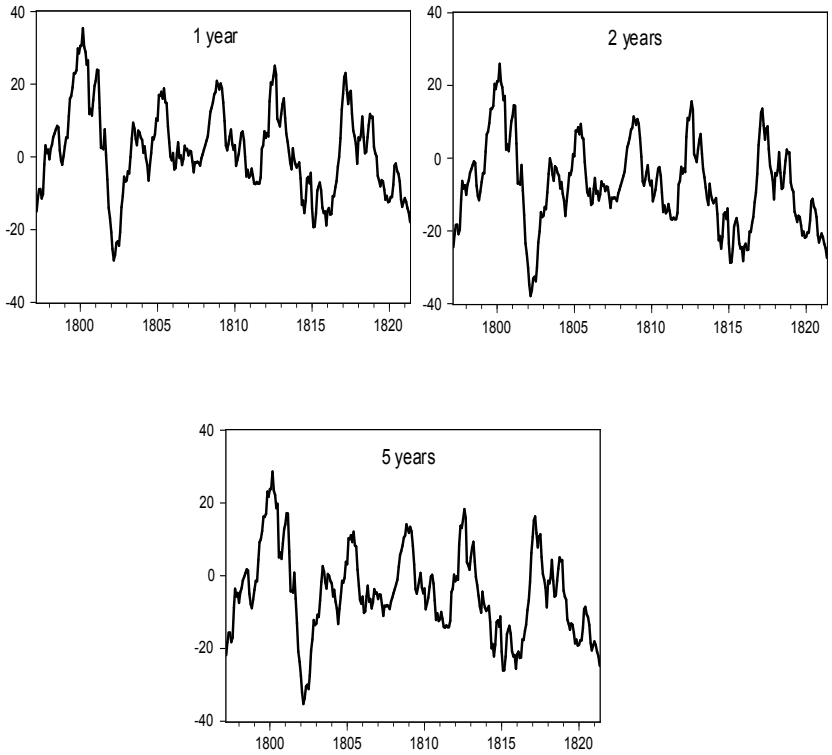

Figure 8: Residuals, difference between observed and anticipated inflation, March 1797 - April 1821

Sources: Author's calculations.

of squares, $SS_{between}$ is the part of the variance that can be attributed to the different segment assignments and SS_{within} refers to the variance that is attributed to the random error within the segment assignments. The part of the variance that is explained by the segmentation, is given by equation 5:

$$SS_{total} = SS_{between} + SS_{within} \tag{4}$$

$$R^2 = SS_{between}/SS_{total} \tag{5}$$

Table 3: Consol yields, means, 1790-1850

	Peace	War
Gold standard	3.40	4.51
Suspension	4.33	4.95

Table 4 displays the R^2 for the different segments. During peace times, switching from the gold standard to the paper pound explains the difference in mean yields well ($R^2 = 0.61$). Similarly, the difference in the average yields is well captured by a switch from peace to war times under the gold standard ($R^2 = 0.61$). On the contrary, during the suspension, little of the variance between average consol yields can be attributed to the transition from peace to war ($R^2 = 0.27$). The same is true for switching monetary regimes during war times ($R^2 = 0.12$). The evidence presented in tables 3 and 4 entails the presence of premia for default and anticipated inflation.

Table 4: R^2 for segmentation of consol means

	Peace: gold standard → suspension	War: gold standard → suspension
R^2	0.61	0.12
	Gold standard: peace → war	Suspension: peace → war
R^2	0.61	0.27

In order to check whether these premia are constant over time, table 5 displays standard deviations for the four different segments. Standard deviations are significantly different when transitioning from war to peace times under the gold standard. This is also the case when switching monetary policy regimes during peace times. On the contrary, when at war, a monetary policy switch does not significantly increase the volatility of the series. During the suspension of the gold standard, going to war did neither increase the volatility of consol yields.

What do these results entail for interest rate and price evolutions during the French Wars? When the War of the Third Coalition set an end to the Peace of Amiens and hostilities resumed in April 1803, the paper pound had been in place for five years. Switching

Table 5: Consol yields, standard deviations

	Peace	War
Gold standard	0.25	0.46
Suspension	0.42	0.48

from peace to war did not cause a significant increase in the volatility of the yield series. This is indicative of the fact that the evolutions of consols during the suspension period were influenced by anticipated inflation rather then the default premium.

These findings are further corroborated by the analysis of rolling standard deviations: increased volatility in consols commences and seizes with the onset and resumption of convertibility (see figure 10 in the appendix). In particular, mean yields remained high after the end of the war in 1815. The segmentation between war and peace does, therefore, not well account for the differences in average yields.

More broadly speaking, these pieces of evidence are in line with the straightforward assumption that default is going to happen by devaluation induced inflation or in an outright manner, but not both. When the monetary regime ties policy makers' hands, default premia increase, as outright default is anticipated in the worst case scenario. When a fiat currency is in place, premia for expected inflation augment, since outstanding public debt can now be adjusted by soft default, i.e. inflation.

The above falls short of a more rigorous analysis that also accounts for the evolutions on the marginal rate of capital. The stance adopted here is close to O'Brien (2006) and Heim and Mirowski (1987), in that I assume that the degree of crowding out was limited and could not have caused short-term evolutions as the ones observed in the monthly series used here. Given this constraint, my findings, along with the qualitative evidence presented, entail that it were inflation expectations that primarily affected yields on public debt over the period under consideration. It seems straightforward that this applied to the price level as well.

8 Concluding Remarks

I provide evidence on how expectations regarding the sustainability of public finances affected the price level during Britain's first experience with fiat money. Moreover, my results emphasize the straightforward statement that the monetary policy regime in place determines the type of debt stabilization agents anticipate for the future, if ever the fiscal limit is attained.

Thus, in terms of the long standing debate attributing evolutions in the price level during the Restriction Period to either real or monetary factors, I put forward a novel, third explanation. This one is based on the fiscal determinants of the price level, a finding in line with the predictions of the Fiscal Theory of the Price Level.

These results are of timely relevance, since the parallels between Britain then and modern economies today are striking. Britain disposed of well functioning financial markets that allowed for an ever increasing national debt: by the beginning of the French Wars in 1793, the debt to GDP ratio had stood at 120% and reached 226% when Napoleon was finally defeated at Waterloo in 1815. For a quarter of a century, Britain operated a fiduciary currency regime with flexible exchange rates, characteristics that shape how most industrialized economies are organized today. These similarities should, thus, allow drawing some conclusions for contemporary policy issues.

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A Appendix

A.1 Tables and figures

Table 6: Correlation coefficients between the *agio* and price indices

	1750-1850	Restriction Period
Monthly indices		
Gayer, Rostow and Schwartz (1953)		
Total goods	0.72	0.72
Domestic goods	0.72	0.69
Imported goods	0.64	0.65
Yearly indices		
Broadberry et al. (2012)	0.59	0.79
Clark (2014)	0.53	0.74
Schumpeter (1938)	0.66	0.69

Table 7: Descriptive statistics for the *agio*, monthly data

	Whole sample 1718-1873	Pre-restriction 1718-1797	Restriction Period 1797-1821	Post-restriction 1821-1873
Mean	0.06	0.02	0.35	-0.01
Median	0.00	0.01	0.11	-0.01
Maximum	1.79	0.19	1.79	0.01
Minimum	-0.04	-0.04	-0.02	-0.02
Standard Deviation	0.22	0.04	0.45	0.00
Skewness	5.02	1.60	1.54	-1.38
Kurtosis	30.48	5.33	4.39	6.25
Jarque-Bera	66681.45	618.78	137.89	477.76
Probability	0.00	0.00	0.00	0.00
Observations	1870	948	291	631

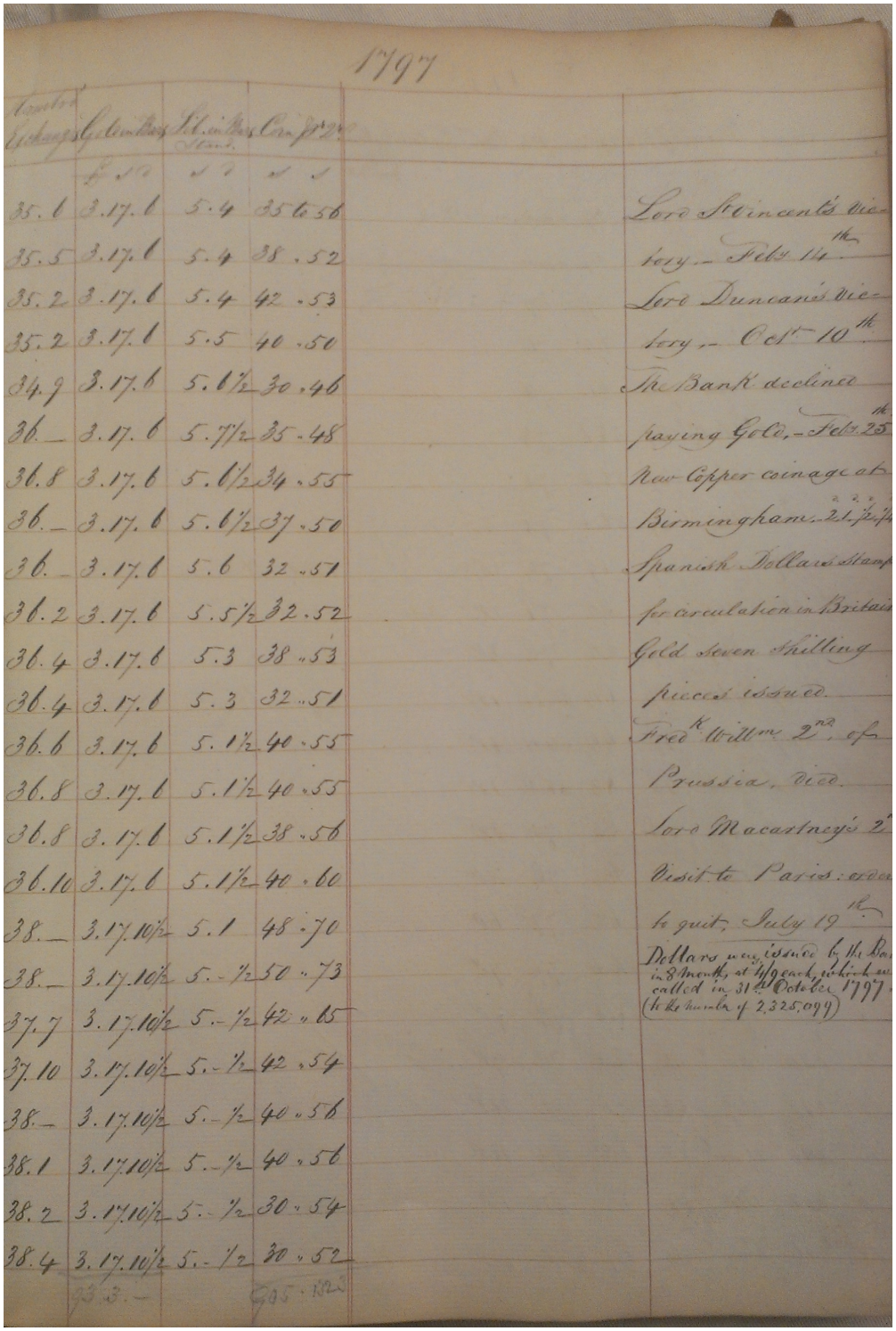

Figure 9: Ledger entry for the year 1797 containing asset prices and significant events

Sources: Bank of England Archives, item reference 10A270/1

Table 8: Break dates, monthly data, January 1795 to May 1823

Break date	1-1800	4-1802	11-1808	2-1811	7-1815	5-1819
Confidence Interval	5-1799 ; 7-1800	4-1802 ; 1-1804	6-1808 ; 2-1809	1-1811 ; 8-1811	7-1815 ; 2-1816	5-1819 ; 6-1821
Regime	1-1795 - 1-1800	2-1800 - 4-1802	12-1802 - 11-1808	12-1808 - 2-1811	10-1811 - 7-1815	8-1815 - 5-1819
Constant	-0.01	0.23	0.12	0.73	1.17	0.17
Observations	61	27	72	27	46	46

Table 9: Break dates, daily data, July 1810 to May 1823 (1)

Break date	8-2-1811	25-8-1812	20-7-1813	17-6-1814	17-3-1815
Confidence Interval	22-1-1811 ; 22-3-1811	21-8-1812 ; 2-10-1812	13-4-1813 ; 17-8-1813	14-6-1814 ; 15-7-1814	14-3-1815 ; 31-3-1815
Regime	6-7-1810 - 8-2-1811	12-2-1811 - 25-8-1812	25-8-1812 - 20-7-1813	23-7-1813 - 17-6-1814	21-6-1814 - 17-3-1815
Constant	0.68	1.00	1.40	1.59	0.56
Observations	63	161	94	95	78

Table 10: Break dates, daily data, July 1810 to May 1823 (2)

Break date	23-6-1815	15-9-1815	16-4-1816	28-11-1817	28-5-1819
Confidence Interval	13-6-1815 ; 4-7-1815	5-9-1815 ; 20-10-1815	19-3-1816 ; 21-5-1816	26-9-1817 ; 9-12-1817	25-5-1819 ; 18-6-1819
Regime	21-3-1815 - 23-6-181	27-6-1815 - 15-9-1815	19-9-1815 - 16-4-1816	19-4-1816 - 28-11-1817	2-12-1817 - 28-5-1819
Constant	1.35	0.69	0.24	0.07	0.20
Observations	28	52	61	169	156

Table 11: Descriptive statistics for the residuals from comparison between observed and anticipated inflation, March 1797 - April 1821

	1 year before suspension	2 years before suspension	5 years before suspension
Mean	2.10	-7.33	-4.69
Median	1.71	-7.73	-5.08
Maximum	35.32	25.89	28.53
Minimum	-28.42	-37.85	-35.21
Standard Deviation	11.89	11.89	11.89
Skewness	0.18	0.18	0.18
Kurtosis	2.89	2.89	2.89
Jarque-Bera	1.75	1.75	1.75
Probability	0.42	0.42	0.42
Observations	290	290	290

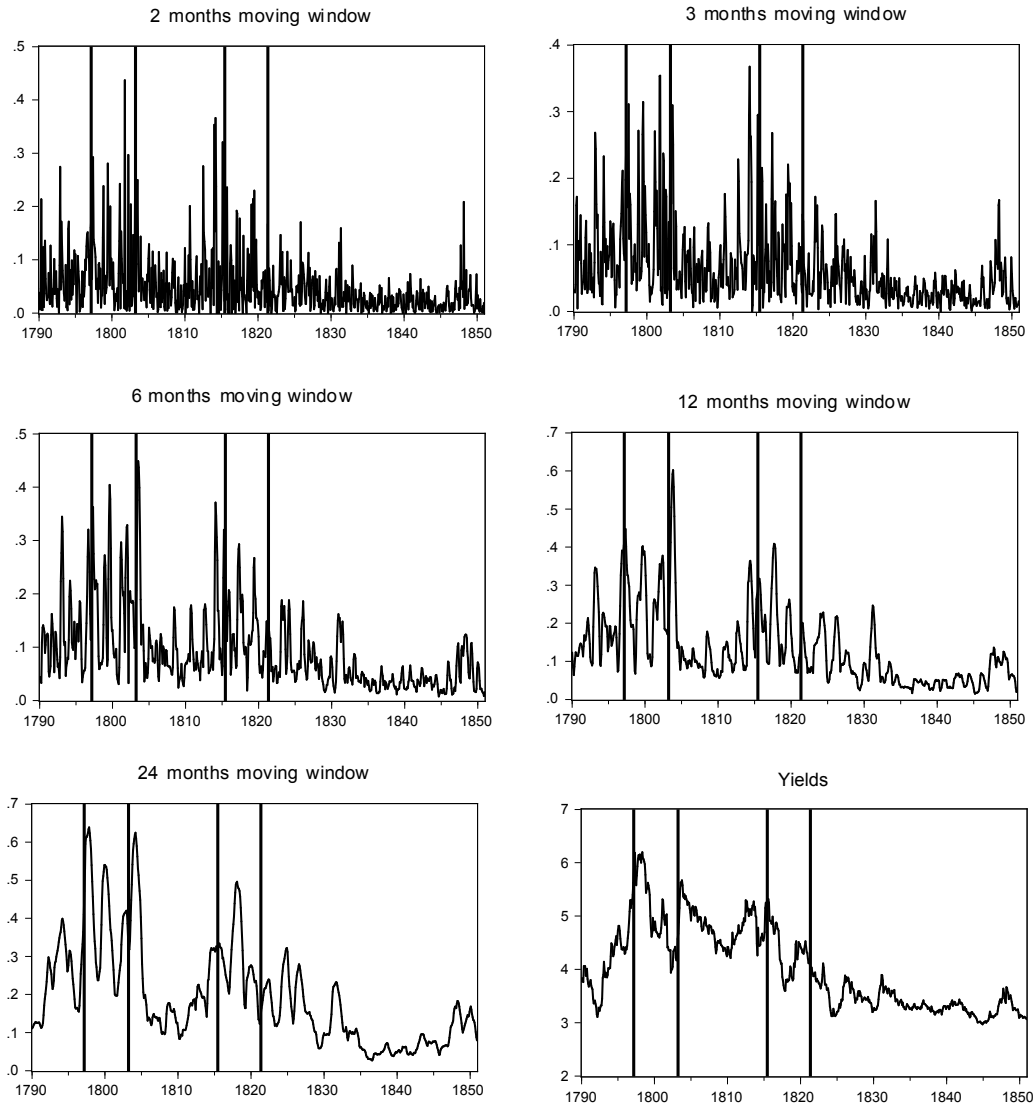

Figure 10: Standard deviations of market yields on consols, rolling windows

Vertical lines mark the beginning of the gold standard's suspension (27 February 1797), the beginning of the War of the Third Coalition (April 1803), Napoleon's defeat at Waterloo (June 1815), and the resumption of the gold standard (May 1821) respectively. Sources: Author's calculations.

A.2 A famous absentee: the battle of Leipzig

Ex-post historiography has posited that the battle of Leipzig (16-19 October 1813) sealed Napoleon's defeat well before the French surrender in March 1814. This date does, however, not show up as a break-point. The readings of contemporary sources allow understanding contemporaries' perception surrounding that event and, hence, its absence among break dates.

Not only was the outcome of the battle anticipated and, hence, as posited by market efficiency, already factored in. Uncertainty also prevailed regarding the strength of the French army's remnants, entailing the necessity to continue martial and budgetary efforts. In particular:

- **The French defeat was largely anticipated**

  "In point of fact they (the French) have, for the most part, been compelled to abandon the right bank of the Elbe; and the attempt, already thrice repeated, of penetrating into Bohemia, has every time had no other effect than the discomfiture and destruction of the troops employed.
  All accounts agree in stating, that the French army in the Saxon Erzgebirge is a prey to the most dreadful privations; that they daily, from want of forage, lose hundreds of horses; and that, the men, to satisfy the cravings of hunger, are obliged to have recourse to horse flesh." *London Gazette, 19-23 October 1813*

  "We feel little apprehension for the consequences. The chances of war are, indeed, proverbially uncertain; but neither his 160,000 men, nor his imperial title, nor his military talents, affect us with the slightest doubt as to the result of a conflict." *Times, 21 October 1813*

- **A high degree of uncertainty surrounded French strength after defeat**

  "It is difficult to calculate the diminution of the Tyrant's force, produced by these three days of heroic achievement." *Times, 4 November 1813*

  "The extent of the result of this important day cannot as yet be ascertained. Near half a million of soldiers fought in this battle, probably one of the most extensive

and most generally engaged that ever took place, at least modern history." *Dispatch from General Viscount Cathcart, dated 19 October; published in London Gazette, 23 November*

"The force of Buonaparte, as he retired on the great line of his communications, was probably augmented by troops at Erfurt, and other places on its march, and in his battles with General Wrede, he seems to have brought forward seventy or eighty thousand men, a force much beyond what we estimated him to possess, after his various losses." *Dispatch from Lieutenant General Charles Stewart, dated 11 November; published in London Gazette, 24 November*

- **It was repeatedly announced that martial and budgetary efforts needed to continue**

  "I cannot but deplore most deeply the continuance of this extended warfare, and of all those miseries which the insatiable ambition of the Ruler of France has so long inflicted upon Europe.
  The restoration of that great blessing upon principles of justice and equality has never ceased to be my anxious wish; but I am fully convinced that it can only be obtained by a continuance of those efforts which have already delivered so large a part of Europe from the power of the enemy." *Prince Regent's opening speech of Lords Sitting, 4 November; published in London Gazette, same date*

  ".. it is not yet time to lay aside our arms. The enemy is defeated; he is humbled beyond any former period; but he may, he will, rise again, should the Germans prematurely imagine that they may take rest. It ought not to be concealed, that for a time to come, ample sacrifices, as well as further efforts of our long-tried valour, are indispensable." *Letter from the Privy Councilors of the King of Great Britain, 4 November*

The above example shows that the combination of ex-ante agnostic break tests and the reading of contemporary sources allows detecting the events that influenced contemporaries' expectations, without any historiographical *ex post* bias. This pays attention to the concern that historical events have to be analyzed in their contemporary context.

Documents de Travail

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