

Waterloo: a Godsend for French Public Finances?

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Abstract

Following Waterloo managing French public finances represented a daunting task. Defeated France had lost a substantial part of its population and of its territory. Part of the country was occupied and France was to pay huge amounts as reparations to the victors. Furthermore France's reputation had been tarnished by the partial default on its debts in 1797. Despite all these elements, in the ten years between 1815 and 1825 not only did France manage to place a huge amount of debt on the market (resulting in a threefold increase) but it did so with a spread, compared to the British consol, falling from more than 400 basis points to a meagre 100 basis point. Based on an econometric analysis of the yields of the French rentes, we show that the improvement in French institutions explains the dramatic decrease in yields.

Keywords: Sovereign debts, bond pricing, France, default, financial history, Waterloo

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I. Introduction

Following the seminal paper by North and Weingast (1989), institutions and property rights are often presented as key to understand the development of economic growth. Not only should the right rules be set, but the government should credibly commit to consistently enforce these. To signal its commitment, the government might either show its good will by its actions or it may agree to be bound by rules and institutions which limit its ability to behave in a less responsible way. According to North and Weingast (1989), the new institutions created in England following the Glorious Revolution of 1688 rendered the government's commitment to uphold property rights credible.

In view of the imbalance between the power of the issuer (a sovereign state) and the lender, holders of sovereign bonds require, even in peaceful periods, guarantees that the state will not unilaterally decide to default on its debts. Regarding sovereign debts, the loss of reputation linked to the default is often viewed as a factor important enough to force states to respect their commitments. Nonetheless, history is replete with cases of sovereign default. Defaults have been linked, among others, to macroeconomic imbalances, overindebtedness, past defaults, regime changes and wars.

This paper analyzes the evolution of the French sovereign debt following Napoleon's defeat at Waterloo. At the end of 1815, incentives for an investor to buy French sovereign bonds were low as France's prospects looked terrible. Following the defeat, France had to come back to its frontiers of January 1st, 1790 losing 5,000 square km of frontiers (White, 2001). It was furthermore forced to pay 700 million francs as war reparations for the Hundred Days War. On top of that, additional expenses were imposed, most notably occupation costs for the part of France where an Army of 150,000 men was stationed. The track record of French public finance was also terrible. France had defaulted on its debt in 1797 and had had to rely on a forced loan levied on the wealthy to meet financial obligations in 1814. Interest rates on traded debt had jumped to 8.6% in 1815, whereas comparable yields on British consols did not even reach 5%. Eventually, and as stated by White (2001), "the collapse of the Empire threatened the credibility of government borrowing".

In view of all these elements, one would expect France to have had trouble issuing debt and, if it did manage to do so, to have had to pay dramatically high interest rates to compensate

bondholders for their risks. Empirical evidence however is completely at odds with these reasonable expectations. As shown in Figure 1, between 1815 and 1825 not only did France manage to issue so many bonds that its debt increased threefold, but it did so while paying lower and lower coupons. Bondholders' confidence increased so much that by 1825 the spread between the French and British sovereign bonds was only 1% (100 basis points) (Figure 2).

Insert Figure 1 and 2 about here

This paper aims at understanding how France managed to resurrect its public finances following Waterloo. Only the firm commitment to honor its debt could have lead investors to revise their vision of French public finance. We argue that the institutions created following the defeat and the actions undertaken by the government induced a revision of investors' expectations regarding French public finances. The credibility of France's commitment was in the first period guaranteed by the occupation of part of the country which would only be freed if reparations were paid. Forced to act in its investors' interest, France managed to regain its reputation. Waterloo, by imposing reforms and a credible commitment to honor its debts, led paradoxically to an improvement in French public finances.

In order to develop our point, the paper is organized as follows. The first section reviews the literature on institutions and sovereign debts. The second section presents the historical context. The third section describes the data and the methodology. To determine which events changed investors' perception of French public finance, the paper relies on a structural break approach. Results confirm the preeminent role of institutions. The last section concludes.

II. Institutions and Sovereign Debts

Sovereign bonds are peculiar financial instruments: whereas finance textbooks tend to present sovereign bonds as risk free assets, a large part of the literature has tried understanding states' motivations to repay. The imbalance between the power of bondholders and any given state is indeed such that bondholders should in theory be powerless if a state wishes to renege on its debt. Nonetheless, and even if defaults occur, states tend on average to repay their debts.

The literature has emphasized several reasons which could explain why states eventually repay their debts. The willingness to maintain a good reputation is often presented as the key to understanding states' good behavior (see for example Eaton and Gersowitz, 1981; Bulow and Rogoff, 1989; and Rogoff and Zettelmeyer 2002). Military interventions (Mitchener and Weidenmier, 2005), trade sanctions (Rose, 2005), or supersanctions (Mitchener and Weidenmier, 2010) have also been shown to play a role in many cases. In the 19th century, sovereign bonds were not only financial instruments; they had often a role to play in international relations. Diplomacy and relationship between borrower and lender could also have an impact on bond issues and prices (Feis, 1930; Ivanov and Tooze, 2011; Oosterlinck and Ureche-Rangau, 2012).

Another strand of the literature, in which this paper fits, has attempted to determine to which extent good institutions could increase the probability of reimbursement. As pointed out by North and Weingast (1989) having good rules is not sufficient if a sovereign can easily overthrow these rules. The conjunction of adequate rules and credible commitment is thus required. North and Weingast (1989) argue that the constitutional changes following the Glorious Revolution dramatically altered the balance of power between the British Parliament and the Crown of England. By imposing limits on the power of the Crown, the new institutions protected property rights and reduced the likelihood that the state would renege on its obligations. North and Weingast (1989) attribute the decline of the long-term borrowing rate (from 14% in 1693 to 3% in 1739) to these institutional changes.

The role of institutions has since been investigated in many other instances. Acemoglu et al. (2005) argue that institutions exported from colonizer to colonies are instrumental in understanding economic growth. La Porta et al. (1997 and 1998) link investor protection to the origin of the legal system in a given country. They argue that countries whose legal system has been inspired by the British common law benefit outside investors. Rajan and Zingales (2003) have revisited this interpretation. They show that there is no obvious mechanism linking legal system and financial development. At the beginning of the 20th century, common law countries' financial markets were not more developed than the civil law ones. The reversal observed at the end of the 20th century is attributed not to legal origins but to the ability of incumbents to oppose financial development. In the same vein, Musacchio (2008) convincingly shows that there is no strong relationship over time between creditor protection and the development of bond markets. Indeed, the supposed link between a legal "family" and creditor protection cannot be established on the long run. Regarding sovereign debts and institutions, Sussman and Yafeh (2006) have reassessed the case of the Glorious Revolution. They find that new institution did

not lead immediately to lower cost of government borrowing. They conclude that the rewards from institutional reforms take a long time to materialize. For the same historical episode, Cox (2011) has stressed the importance of ministerial responsibility. Indeed, other elements play certainly a role in the development of public finance and institutions are only part of the explanation. As pointed out by Dincecco (2009) and Gelderblom and Jonker (2011) sound institutions and a credible commitment are necessary but not sufficient conditions to see interest rates decline and public debt grow.

The literature seems thus to have diverging views regarding the importance of institutions. The impact of legal origins is debatable and has seriously been questioned lately. On the other hand, the impact of institutions seems better established even though there are opposite views regarding the speed at which their impact is noticeable on sovereign borrowing. Sound institutions and credible commitment may emerge in different settings. In the Dutch case, changes were gradual (Gelderblom and Jonker, 2011) whereas for the English case in 1688, it was the Glorious Revolution which brought about the changes (North and Weingast, 1989). In both cases however, the changes were the result of endogenous evolutions. Following the Glorious Revolution, the institutional changes were nevertheless not enough to guarantee reimbursement. If political parties in power favoured default, then one could question the credibility of the commitment. Indeed, as stressed by Stasavage (2007, p.150), “Great Britain’s revolution in public finance may have been initiated during the Glorious Revolution of 1688, but the British state’s credibility as a borrower was only consolidated after 1715, once the Whig party established lasting political supremacy”. New institutions didn’t thus directly lead to an increase in credibility.

In contrast to other papers in the literature, this paper focuses on a case where the government was forced to regain credibility in a matter of months. Following Waterloo, defeated France signed the Second Treaty of Paris on November 20th, 1815. The Treaty was a means for the Allies to guarantee their safety but also to make France pay for the Napoleonic episode. France was to pay reparations amounting to 700 million FF, an amount close to the total yearly revenues of the country in 1815 (White, 2001). On top of that, France had to pay the costs of the occupation Army stationed on its soil. The Treaty provided that a large part of the country would remain occupied (from Calais to the Swiss border). The Army of occupation was meant to guarantee that France would faithfully honour the Treaty. If France was to pay ahead of schedule, occupation forces could be reduced and the actual occupation could even be stopped by 1818.

The heavy-handed approach devised by the Allies meant that defaulting on reparations was not an option. Financing reparations was not an easy task. This paper argues that the threat of a long-lasting occupation forced France to implement reforms to improve the state of public finance¹. These reforms allowed France to regain its credit. The renewed credibility remained even when the threat of occupation had subsided. Whereas in a first phase the threat of military intervention guaranteed repayment, in a second phase the institutional changes took over the role of reassuring markets.

III. Historical Context

To set into perspective the changes in public finances implemented following Waterloo, this section provides a short overview of the management of French public finances for a period stretching from the end of the Ancien Régime to the 1815-1825 period.

The Ancien Regime

The financial crisis of 1788/1789 is often presented as a factor which accelerated the end of the Ancien Régime. However, even though France never came close to enjoying the credit rating of Great-Britain or Holland, its public finances were less dramatic than often argued (White, 1989). The government relied on a budget distinguishing between recurring expenses and so called extraordinary ones. The fiscal system relied on a series of agents (fermiers, receveurs...) who had a contract to collect taxes in the name of the state. They provided the state with ordinary revenues meant to cover the recurring expenses of the government. If needed, additional taxes could be imposed to cover extra expenses. If this did not suffice, the state could turn towards borrowing. Many forms of state loans existed at the time: consols, life annuities, loan hypothecated on the state revenues but also non-interest-bearing promissory notes and, of course, short-term debt often under the form of tax anticipation (White, 1989). Deficits were a common feature of French public finances. Despite this, attempts were made at the end of the 18th century to improve the state of French public finances. Several Finance Ministers (Terray, Turgot and Necker) tried to set up sound policies. They were however replaced by less

¹ This is close to the ideas developed by Mitchener and Weidenmier (2005) who show that the threat of a US intervention had a dramatic impact on prices of sovereign bonds issued by the countries subject to the Roosevelt Corollary.

competent successors (d'Ormesson and Calonne) whose reforms precipitated the collapse of French public finances (White, 1989).

During the Ancien Régime, institutions meant to guarantee the reimbursement of the public debt were created. The first public debt amortization fund was created in 1749, the Caisse générale d'amortissement. The Caisse was to be financed by some specific taxes and the revenues raised could only be used to redeem the existing debt (Jèze, 1925). In practice however, most of the collected revenues were used to pay interests and the reimbursements made never came close to matching the new debt issues (Jèze, 1925, p. 264). This Caisse remained active up till 1759 when its actions were stopped because of the Seven Years War. In 1764, two new institutions were created: the Caisse des arrérages (meant to cover the expenses of the consols, tontines and life annuities) and the Caisse des amortissements (meant to reimburse the consols). This Caisse d'amortissement served its purpose during 4 years. In 1770, when l'abbé Terray became finance minister, the amounts of the Caisse were affected to the reimbursement of the short term debt. Terray also modified the terms of existing debt contracts, in what amounts to a partial default (Jèze, 1925). The Caisse d'amortissement was suppressed in 1775 only to be recreated in 1784 by Calonne. According to Calonne, the new Caisse would allow reimbursing most of the public debt by 1809. The King himself solemnly swore that the funds from the Caisse were the property of the states' creditor and would never be used by the state even in case of war. Again, in practice, the results were extremely limited since yearly reimbursements amounted to 4 or 5 million to be compared with new loans worth 100 million or more (Jèze, 1925).

The eve of the revolution was marked by difficulties for French public finances. In early 1787, Calonne presented a budget largely in deficit. He was forced to resign but the situation was already so rotten that his successor, Loménie de Brienne, could not avoid the imposition of a one-year moratorium on the government obligations. He resigned in August 1788 to be replaced by Necker. Necker managed to cover part of the deficit by borrowing but had to rely on money creation to fill the remainder of the deficit (White, 1989). This difficult situation was exacerbated by the outbreak of the French revolution.

Revolution

The difficulties experienced by the French public finances only grew with the revolution. Indeed, the revolution limited the ability of the state to tax and borrow. Unwilling to create new taxes or raise the existing ones, the National Assembly nationalized in November 1789 the lands of the Church (White, 1995). In view of the liquidity problems faced by the National Assembly, a

means had to be devised to be able to get the funds of the nationalization before the actual sales of the confiscated lands took place. In December 1789, the National Assembly issued an amount of 400 million livres of assignats, notes backed by the proceeds of the future sales of the Clergy and the Crown properties (White, 1995). To retire the assignats, the National Assembly created yet another fund: the Caisse de l'extraordinaire. At first, markets believed the scheme would be successful and interest-rates came back to their pre-revolution level in 1791 (Bordo and White, 1991). By the mid-1792 however, the original optimism had disappeared with the war outbreak and the huge increase in money creation. To cover the deficit, the state relied more and more on the issue of assignats. The attempt to balance the budget by increasing taxes, imposing a forced loan and price controls, failed and by 1795 France was experiencing hyperinflation (White, 1995). In 1796, the assignats were withdrawn and the Directory issued a new form of paper money: the Mandats.

Military successes and war indemnities imposed on defeated enemies brought some resources to cover part of the military expenses. However, these funds provided only a short-term relief (White, 1995). The budget remained in deficit and the Directory declared bankruptcy on September 30th, 1797. The law simply erased two-thirds of the perpetual debt (hence its name in French "banqueroute des deux-tiers"). Yearly interest payments for the debt dropped from 110 million to 34.615 million (Jèze, 1925, p. 378). On top of that, debts held by the émigrés (French aristocrats and defenders of the Monarchy) and the convicts were completely cancelled. These operations considerably reduced the burden for the state (Bordo and White, 1991; Jèze, 1925; White, 1995). Despite this reduction however, the government was unable to pay its obligations in specie. As stressed by Bordo and White (1991), "revolutionary France had squandered its modest endowment of credibility". In June 1799, the French government once again had to impose a forced loan leading to spikes in required yields (White, 1995).

Napoleon

On November 9th, 1799 a coup lead by Napoleon Bonaparte ended the Directory. The new regime, the "Consulat", was in theory ruled by three consuls but was in practice run by the First Consul, Napoleon Bonaparte. As in many other fields, Bonaparte imposed his mark on French public finances. By 1800, two new institutions had been created: the Banque de France and the Caisse d'amortissement (Plessis, 2006, p. 45). Under the direct authority of the First Consul, the Caisse d'amortissement had the mission to restore the credit of French public finances. To do so, the Caisse was to guarantee the bills issued by the state in advance of future tax receipts. Even though the Caisse was in theory supposed to amortize the existing debt, Napoleon viewed this as

an ineffective tool and preferred to use the Caisse to stabilize the price of the French rente on the stock exchange (Jèze, 1925; Gabillard, 1953; Bruguière, 1977; Kang, 2007). The objective was to maintain the price of the 5% rente above 80% of par (Plessis, 2006, p. 47). The Caisse had however very limited means and Napoleon often used it as a financial tool without taking into account its initial objectives (Plessis, 2006). To further restore the French credit, a law passed in August 1800 imposed the resumption of specie payment for the public debt (Jèze, 1925, p. 280).

The experiences of the assignats and the bankruptcy of the two-thirds had shaped Napoleon's view on credit. Mistrustful of paper money or anything which could have been assimilated to paper money, Napoleon built a very rigid monetary system. Even though the Banque de France was allowed to issue banknotes, the minimal denomination of 500 FF dramatically limited their use (Gabillard, 1953). As a result, payments thus remained mostly done with specie. Napoleon's aversion to paper extended also to the public debt (Jèze, 1925, p. 282; Gabillard, 1953). The public debt only increased from 40 million of rentes in 1799 to 63 million in 1814, and this despite the almost continuous state of war.

On the fiscal side, Napoleon managed in just a few years to improve the collection of revenues. An increase in the revenues from direct taxes was followed by the reintroduction of indirect taxes (Gabillard, 1953; White, 1995). In theory, budgets were balanced up till 1811 (Gabillard, 1953). In reality, deficits were hidden. Instead of issuing debt or printing money, the state covered its deficit by delaying payments. This led to a dramatic increase in the amounts left in arrears. Thus, even if France was not issuing long term loans, it was in fact accumulating a huge floating debt (Jèze, 1925, pp. 284-285). War expenditures increased massively during the Empire but were covered by the resources extracted from the defeated countries. According to Gabillard (1953), Napoleon was actually hoping to be able to rely on his victories to cover momentary financial troubles. This strategy worked up till the disastrous Russian campaign which proved extraordinarily expensive (Bordo and White, 1991). Under the Empire, the credit of the state improved at first but "even at its apogee, Napoleon's system of finance did not engender enough confidence to permit the government to return to large scale borrowing" (White, 1995, p. 315).

The Bourbon Restoration

This section will first provide a chronological overview of the period and then describe the financial innovation and new institution set into place between 1815 and 1825.

Chronological overview

The War of the Sixth Coalition (1812-1814) began when Russia refused to apply the continental blockade, the system devised by Napoleon to attack Great-Britain's economy. To force Russia to implement the blockade, Napoleon invaded Russia in June 1812. The disastrous Russian campaign allowed the members of the coalition to drive the French out of Germany in 1813 and to invade France in 1814. To prevent the signature of separate peace Treaties, the four great powers (Austria, Prussia, Russia and the United Kingdom) signed a Treaty in Chaumont, in March 1814. The Treaty further stipulated that the signatories would pursue the war up till Napoleon's defeat and would guarantee each other's security against the French for the next twenty years. Unable to mobilize his generals, Napoleon was forced to abdicate on April 6th, 1814 and was sent into exile in Elba. The victors were then left to devise a new political order. Great-Britain and Austria envisioned a future where France would regain its place in the concert of nation but with a guarantee that its territorial ambitions would be limited. Prussia and Russia on the other hand were eager to increase their territory.

Eventually, the members of the coalition restored the throne of France to Louis XVIII. They however imposed political changes to France; most notably, the kingdom became a constitutional monarchy. Furthermore, most of the reforms implemented by Napoleon were left untouched. The terms of peace were spelled out in the First Treaty of Paris signed on May 30th, 1814. The Treaty mentioned explicitly the desire to bring a lasting peace based on a just repartition of power amongst the great powers². The Treaty was thus relatively soft on defeated France. Article 2 of the Treaty defined the borders of France as the ones existing on January 1st, 1792. Article 18 declared a reciprocal waiver on all claims related to war.

The situation of public finances inherited from Napoleon was disastrous. The finance Minister, Baron Louis, depicted the terrible state in a series of speeches held in 1814. To balance the budget, drastic cuts were made and demobilized soldiers paid only half their normal wages (regime de demi-solde). Short-term bills bearing 8% interest were issued and several domains from the state put for sale. In July 1814, Baron Louis suggested, in his presentation of the

² « Une juste répartition de forces entre les Puissances ».

situation of French public finances at the Chamber of Deputies, to resume the amortization of the public debt (Vührer, 1886, p. 101)

The new repartition of power between the European major countries was disrupted when the news broke out in March 1815 that Napoleon had managed to escape from his exile in Elba and was mobilizing to regain the control of France. French troops joined the Emperor and Louis XVIII had no alternative than to flee France again. To prevent a resurrection of an Empire ruled by Napoleon, the coalition sent troops to stop the French advance. Following his defeat at Waterloo on June 18th, 1815 Napoleon lost the confidence of the chambers and was forced to abdicate for a second time on June 22nd, 1815.

After the episode of the Hundred Days, the victorious Allies were not inclined to show mercy. Thus, whereas the First Treaty of Paris had been relatively soft on defeated France, the Second Treaty of Paris, signed on November 20th, 1815 proved to be much harder. When the First Treaty mentioned a just repartition of power, the Second Treaty emphasized the need to provide fair compensations for the past and solid guarantees for the future³. Compensations were both of territorial and financial nature. Article 1 set the borders of France as the ones existing on January 1st, 1790. Several forts were to be destroyed or ceded to the victors. Article 4 fixed the amounts to pay as war indemnity at 700 million francs. Article 5 imposed the presence of an Army of occupation. The size of this army was limited at 150,000 men for which France had to provide for. The occupation Army was to remain for a maximum of five years but could leave after three years if the Allied forces, in agreement with the French King, found that their presence was no more required. An additional convention detailed the mode of payment of the war indemnity.

According to article 1 of the convention detailing the war indemnity, the 700 million had to be paid with bearer bonds from the French Treasury. Article 2 gave more precision regarding the timing of the payment: fifteen installments of 46 million and two-third of a million francs. To prevent a dramatic depreciation of the bonds, the Allied imposed a limit of 50 million francs of bearer bonds in circulation (article 6). The payment was interest free (article 7) but a penalty of 5% imposed in case of delay of payment (article 13). France had to give as guarantee 7 million francs in rentes equivalent to a capital of 140 million francs (article 8). Once the first 600 million francs would be paid, the Allied were ready to accelerate the liberation of the country (article 14 and 15). Eventually, an additional convention set the terms by which France would compensate the British holders of French bonds which had been defaulted upon after 1793.

³ « De justes indemnités pour le passé et des garanties solides pour l'avenir. »

The amounts involved by the Treaty were extremely high. White (2001) estimates the overall payment made by France over the years at 1,863.5 million francs. To comply with the Treaty, France had thus to find funds. Unfortunately, as pointed out by Lafitte (1824, p. 33), “Thirty years of war, two invasions, the buy-back of the territory, required treasures that France couldn’t find”. Credit was thus needed. Regarding public finances, France suffered from its terrible reputation (Lafitte, 1824; Aglan, 2006). Potential investors indeed remembered two particularly devastating episodes: the large issues of assignats which ended valueless and the two-third bankruptcy of 1797 when two thirds of the public debt were simply erased (Gabillard, 1953). On top of these elements, the budget was still burdened by the budgetary arrears inherited from the Empire and by the claims made by the Emigrés (White, 2001). Repudiating the debts from the previous regime was hardly feasible, since it would have ruined the rentiers and given a bad signal to the markets. Therefore, an order dated July 28th, 1815 explicitly recognized the debts from the Empire (Kang, 2007).

The first war indemnity payments were due on March and July 31st, 1816. Cut in expenditures and tax increases, as well as the issue of a small short term loan in London and Hamburg in April 1816 allowed the government to repay on time (White, 2001; Kang, 2007). The political climate was tense from the first day the new legislature took office in August 1815. Nicknamed the “Chambre introuvable” (the Unobtainable Chamber) because the king himself could not have wished more royalist deputies, it quickly proved to be too much dominated by Ultra royalists (Ultras) to be manageable. More royalist than the king, the Ultras wished to come back to the pre-1789 France. They attacked fiercely the law of finance presented on April 28th, 1816 (Colling, 1949, p. 188). Among other, they opposed the sale of lands previously in possession of the Church to pay for the arrears inherited from Napoleon (Boiteau, 1866, p. 158). After a series of heated debates and in view of the political impasse in which the government had felt and under the pressure of Wellington and the Allies, Louis XVIII dissolved the Chamber on September 5th, 1816 (Bruguière, 1977). These political troubles had however made a victim: France missed the November installment. The Allied refused to diminish the burden of the war indemnities and instead put more pressure on France by increasing the number of occupation troops (White, 2001). On the other hand, Louis XVIII had shown in this episode that reimbursement was a priority. The legislature was dissolved because the Ultras were unwilling to repay for the arrears. There was thus a clear commitment from the king to find a way to pay all existing debts.

Foreign credit became the only alternative to cover the liquidity shortage of the government. Indeed, royalists who had managed to recover part of their wealth were unlikely to subscribe bonds meant to repay war indemnities linked to the abhorred Revolution (Kang, 2007). On the other hand, the foreign governments had a strong incentive to support a loan since repayment of the war indemnity was conditional on France managing to get funds (Boiteau, 1866, p. 165). Negotiations with Hope and Barings were undertaken at difficult times for the French government facing food shortage, pressure from the Allies and a strong opposition from the Ultras (Bruguière, 1977). On February 9th, 1817 Baring and Hope received a green light from the Allies for their proposal. The loan would help reduce the stationed troops by 30,000 men (Colling, 1949, p. 191). The first tranche of the loan was issued on February 10th, 1817. By April 1817 the loan was almost sold out with close to 60% bought in France, the remainder being sold in London and Amsterdam. Even if the terms of the loan were extremely costly for France, the successful flotation and the signal given by Hope and Baring had a positive impact on the price of the French rentes (Kang, 2007). On March 11th a new agreement was signed to float an additional 100 million francs, followed on July 22nd by another one for 115.2 million (White, 2001). The increase in the price of the rente enabled the French government to secure better terms (Kang, 2007). Success was such that in 1818, France tapped the French market without the help of foreign underwriters. The third loan targeted the rich since it imposed buying a minimum amount of 5,000 FF of rentes. The length to manage the sale of this loan led the government to resume working with foreign underwriters for the fourth issue (Kang, 2007). This series of loans not only helped France pay its war indemnities but it also marked the revival of the Paris Bourse (Colling, 1949, p. 190).

The success of the successive loans allowed France to repay the war indemnities due to the victors of 1815. Despite the payments, France was still partially occupied at the beginning of 1818. The *Président du Conseil* (Prime Minister), the Duke de Richelieu, began negotiations with the Tsar Alexander to determine a way to liberate France as soon as possible. The Tsar, in collaboration with the Duke of Wellington, paved the way for a final settlement. In April 1818, a commission to put an end to the war indemnities and withdraw the troops was created (Boiteau, 1866, p. 170). The French legislature finally accepted to give grudging consent to the proposals of this special commission regarding the claims linked to wartime damages to allied nationals on May 9, 1818 (White, 2001). Four months later, at the Congress of Aix-la-Chapelle, a final peace settlement was agreed upon. At the time, France still owed 280 million FF to the Allies. As a result of the negotiations, this amount was reduced to 265 million FF (White, 2001; Kang, 2007). Out of this amount, Barings would pay 165 million FF in the form of bills of exchange; the

remaining 100 million FF would be settled by giving French rentes at the price (75.57 FF) of October 5th, 1818 (Boiteau, 1866, p. 171). On October 9th, 1818 the convention detailing the departure of the foreign troops was signed (Nervo, 1865, pp. 317-318). The stock exchange experienced shortly afterwards a dramatic decline. The price of the rente fell and the Minister of Finance, Corvetto, dedicated 40 million FF to buy back rentes on the market. Despite this measure, the price of the rente fell. This forced a new round of discussion with the Allies, which ended up on November 19th (de Nervo, 1865, p. 319). The protocol altered slightly the conditions of payment.

The following years (1819-1821) were not marked by any major innovation or change (Boiteau, 1866, p. 173). In October 1822, representatives of Austria France, Prussia, Russia and the United-Kingdom met at Verona notably to discuss the Spanish question. Ferdinand VII of Spain was indeed at the time struggling to retain his throne. As a result of the Congress of Verona, French troops entered Spain in April 1823 to support the king. Following their victory at Trocadero on August 31st, 1823 the French troops restored Ferdinand VII. The French intervention marked its come back in the concert of the Great Powers. The quick military victory was also perceived positively on the stock exchange (Colling, 1949, p. 199).

On March 23rd, 1824 in a speech to open the Chambers Louis XVIII stressed the need to “mend the last wounds from the revolution” and to convert part of the public debt. The restoration had brought back Louis XVIII but had left many Ultras frustrated because they considered that little had been done to address their rightful claims for the losses suffered during the revolution. The king’s speech made that clear: compensations would be paid. Politically speaking, the elections of February 1824 had led to such a landslide victory for the Ultras that the Chamber had been nicknamed the *Chambre retrouvée* in reference to the *Chambre introuvable*. To pay for the compensation, de Villèle, the *Président du Conseil*, had devised a simple scheme. The gains expected from the conversion (thanks to the reduction in interest payments) would be used to pay for the compensations. The conversion and the compensation were thus clearly linked (Vührer, 1866, pp. 109-110). The economic rationale for the conversion seemed quite straightforward. Since the 5% rentes were trading above par, the buybacks made through the *Caisse d’amortissement* were actually negative for the state finance. Furthermore, the state could borrow at a lower interest rate and should thus exchange these expensive rentes for cheaper ones (Boiteau, 1865, p. 176). The idea of the conversion was indeed quite new in France at the time, and Colling (1949, p. 204) attributes the paternity of its arrival in France to James de Rothschild who knew the British practice in this respect. The Chamber of deputies voted in favor of the law

despite strong opposition from the street and the bourgeoisie (Vührer, 1866, pp. 177-178) but the Chambre des Pairs rejected the law. Pamphlets discussing the legality and the necessity of the conversion were printed (Lafitte, 1824). This setback didn't alter Villèle's conviction that a conversion was possible. Less than a year later, he came back with a new project which would render the conversion optional. This new project passed in both Chambers. On April 27th, 1825 a law setting aside 1 billion FF for the Emigrés was voted, followed four days later by the conversion law. The amounts converted ended up however to be very small (Vührer, 1866, p. 120). The change from forced to optional conversion certainly reassured bondholders, creditors' rights had to some extent been protected.

Financial Innovations and New Institutions

As suggested by North and Weingast (1989), the states' credibility can only be improved either by actions consistent with the preservation of creditors' rights or by the creation of institutions guaranteeing that these rights will be respected. French investors were unlikely to believe words. Indeed, the many constitutions drawn up by the preceding government⁴ had all pledged to honor the public debt (Aglan, 2006). To overcome its bad reputation, the French government would show its good will by respecting creditors' rights while at the same time creating institutions to guarantee reimbursement.

In comparison to the pre-1789 period, the King's power had dramatically decreased. The absolutist rule had disappeared thanks to the constitutional monarchy. Even if in theory the King was the only one to be allowed to suggest laws, in practice, the legislative power (represented by two Chambers, the Chambre des Pairs, with members (pairs) appointed by the king for life or in an hereditary manner, and the Chambre des Députés elected for 5 years by the "wealthy") gained a greater say than ever before (Aglan, 2006). The design of the electoral system led to an alignment of interest between electors and bondholders (rentiers). Indeed, only citizens older than 30 years and paying a yearly amount of 300 FF as direct contribution were allowed to vote. In practice, the approximately 100,000 citizens fulfilling this condition were from the wealthiest class. They were thus likely to hold rentes and therefore willing to protect creditors' rights. In this respect, the French case differed from the British one and the critiques raised by Stasavage (2007) unlikely to apply. According to Aglan (2006), in the five years between 1814 and 1819, the parliament gradually managed to get the control of the states' public finance. The law of March 25th, 1817 increased the government's accountability since it required ministers to present the

⁴ The Constituante in 1789, the 1791 and 1793 Constitutions.

expenses made during the previous fiscal year (Aglan, 2006). The law of May 16th, 1818 increased further the control of parliament on the expenses.

Collection of taxes was improved during the Restoration. Tax revenues became more centralized and better accounting methods were implemented (Kang, 2007). From 1814 on, budgets were expressed in a clearer way by using a double-entry bookkeeping. After 1817, credits were voted for each ministry, increasing transparency and accountability. The Law of April 28th, 1816 dramatically revised the structure of the state finance by regulating the Budget, the Treasury, the Brokers association (Chambre Syndicale des agents de change), the Caisse d'amortissement (Sinking Fund) and the Caisse des dépôts.

The amortization of the public debt was at the time viewed as one way to provide guarantees of the state's good faith. Even if several Caisse d'amortissements (Sinking Funds) had existed previously, their record in terms of amortization was extremely limited. Very often, the government used the funds from the successive Caisses for other purposes. For a new Caisse to work, its creators had to convince investors that the amounts set at its disposal would be used for amortization. Baron Louis had mentioned his willingness to amortize the debt. His successor, the Count Corvetto, proposed on December 23rd, 1815 the creation of a new Caisse d'amortissement (Vührer, 1886, p. 102). In his presentation, he stressed the need to protect the funds dedicated for the amortization from any arbitrary enterprise⁵. Without surprise, the Chamber adopted the law creating the Caisse d'amortissement on March 27, 1816 with 131 out of 132 votes in favor (Vührer, 1886, p. 105). A yearly budget of 14 million was devoted to the Caisse; it was increased to 40 million in 1817. At the time, most politicians believed the theory developed by Price: compounded interests on the amortized amounts would eventually extinguish all debts (Jèze, 1925, p. 331). Under the Restoration, the Caisse d'amortissement served mostly to buy back debts. In the fall of 1817, amounts were used to support the price of the rente (Jèze, 1925, p. 332). The action of the caisse played a major role on the stock exchange (Kang, 2007). Systematic buy orders automatically lead to price increases but also had a psychological impact: investors could see that the state was serious about repaying its debts.

The other Caisse created in 1816, the Caisse des dépôts was meant to receive, guard and give back deposits given to it, voluntarily, or as a result of the application of laws or decrees, of legal contests and of administrative decisions (Kang, 2007). The amounts deposited at the caisse

⁵ « L'expérience (...) nous a révélé les prodiges opérés par l'amortissement quand une rigoureuse et imperturbable fidélité le défend contre toute entreprise arbitraire... »

gradually increased to reach very substantial amounts. Since the amounts were just deposited at the *caisse*, caution was required in terms of investment. Therefore, the asset management policy of the *caisse* was to invest only in French public funds or in securities guaranteed by the state (Kang, 2007).

Institutions alone were however unlikely to restore the state's credit. Under Napoleon, the most common way to finance deficits was to let short term debt accumulate, leaving gradually a massive amount of debts in arrears. The payment of arrears was thus a good way to show the good faith of the new French government. By the laws of 28 April 1816 and 25 March 1817, the Crown agreed to settle the arrears by issuing notes exchangeable for *rentes* in five installments beginning on January 1st, 1821 (White, 2001). Arrears came back to haunt budgets for many years. Indeed, the repayment of the debts was done gradually as creditors made their claims known and the evaluation of the amounts to pay varied from one year to the other (de Nevo, 1865, p. 186). When the first installment became due, the government honored its word by issuing a loan to cover the expenses (de Nervo, 1865, p. XVI).

Even if mistakes were made under the Restoration, major improvements in comparison to earlier periods must be acknowledged. Jèze (1925, p. 312) considers that public credit was rendered possible thanks to the political stability, the public discussion of budgets and the financial control, which appeared at the time. Even if some institutions, such as the *caisse d'amortissement* had existed before, there was at the time no credible commitment to respect the objectives given to these institutions. In this respect the Restoration marked a clear departure from previous regimes.

The next section provides an empirical investigation of the impact that these substantial improvements had on the yield of the French *rentes*.

IV. Data and Methodology

Data

In order to perform our empirical analysis we built up a hand collected original database. It consists of the weekly bond market prices published by the “*Moniteur Universel*” for the 5% French *rente* and the 3% English *consol* on the time period stretching from July 7, 1815 to January 13, 1826.

This raw data was then submitted to several adjustments to account for two important issues: missing data and conversion risk. As stated previously, we collected weekly prices, more specifically the last price of each week (i.e. Friday closing price). One problem that we had to solve was the existence of numerous bank holidays, particularly for England⁶, days over which the stock market was closed and for which the British consol was not traded. In order to fill in these gaps in our database, we reported the last quoted price, while during the coupon payment period we used either the “reduced” consol price or the price obtained from a linear interpolation based on the prices of the other consols.

The second issue was the presence of a conversion risk. Indeed, bond market prices may include a conversion risk, i.e. whenever the price gets above 100£/100F the sovereign may decide to convert which in turn implies a decrease of the nominal interest rate. As such, the bonds providing the highest nominal rates are the most likely to be converted; they will therefore record the highest yields. To avoid such a bias, we proceeded as follows. For the British market; we chose the consol having the lowest coupon, i.e. the 3% consol. An implicit advantage of this choice was that the 3% consol also happened to be the most traded sovereign bond on the London stock market, thus, a highly liquid asset. For the French market, the solution was less obvious as there was only one sovereign bond traded over the period under study, i.e. the 5% rente. Therefore, we computed an implied option price by using the Black and Scholes (1973) formula and derived the price of a non-convertible rente as the sum of the price of the convertible rente and the option price.

We end up with a homogeneous market prices database that we are able to use in the computation of the yields to maturity of our two sovereign bonds as follows:

$$S = \frac{c/2}{y} \times (1 + y)^{\frac{1}{2} - \frac{n}{365}} + \frac{c/2}{y} \times (1 + y)^{1 - \frac{n}{365}} \quad (1)$$

where S stands for the dirty price⁷, y for the yield to maturity, c for the annual coupon and n for the number of remaining days until the next coupon.

Methodology

The objective of our empirical analysis is twofold. First of all we want to check for the presence of potential fundamental changes in the evolution of the French yields, to identify the exact timing of such changes as well as their cause. Second, we aim at measuring the potential

⁶ About 33 saints' days and religious festivals, to which we also have to add the different royal celebrations and the coupon payment time periods, i.e. around 1 month, twice a year.

⁷ Price including accrual interest.

short-term impact of specific events/decisions on the evolution of these yields. To reach these objectives, we apply a structural break methodology completed by a regression with dummies.

The most commonly encountered method for detecting the number and location of structural breaks that might appear in a time series is the one introduced and developed by Bai and Perron (1998, 2003). More specifically, we estimate the following general model subject to m breaks ($m+1$ regimes):

$$y_t = \delta_j z_t' + u_t \quad t = T_{j-1} + 1, \dots, T_j, \quad j = 1, \dots, m+1 \quad (2)$$

where y_t represents the dependent variable, in our case the French yields, $z_t(q \times 1)$ is the vector of covariates, u_t is the error term at time t , δ_j is the corresponding vector of coefficients and the indices (T_1, \dots, T_m) stand for the unknown break points. In this approach, the unknown coefficients and the endogenous breakpoints are estimated simultaneously; moreover, this general approach allows the coefficients to change while also taking into account potential breaks in the variance of the disturbance term provided they occur at the same dates as those in the parameters of the regression. The algorithm computes the estimates of the break points based on the minimization of the sum of OLS squared residuals segment by segment (Bai and Perron, 2003) and convergence of the estimation is obtained under a large set of assumptions (however precluding variables with autoregressive unit root), namely different distributions both for the regressors and the errors⁸.

In testing for multiple potential breaks we use a supF test of no structural break, i.e. $m = 0$, versus $m = k$ breaks. The choice of the trimming parameter ε will determine the minimal length h of a segment, i.e. $\varepsilon = h/T$, with T being the number of observations. Following Bai and Perron (1998), first we apply the double maximum tests of the null hypothesis of no structural break against an unknown number of breaks, UD_{\max} and WD_{\max} ⁹ and use their reported critical values for $\varepsilon = 0.05, 0.10, 0.15, 0.20$ and 0.25 (with the corresponding maximum number of breaks, i.e. 10, 8, 5, 3 and 2 respectively). Then we implement a test for l versus $l+1$ breaks, i.e. $\sup F_T(l+1|l)$, applied to each segment that includes observations from T_{i-1} to T_i , $i = 1, \dots, l+1$. The model with l breaks is rejected in favour of a model with $l+1$ breaks whenever the overall minimum value of the sum of squared residuals is larger than the sum of squared residuals of the

⁸ Potential serial correlation and/or matrix robust heteroscedasticity are taken into consideration and corrected in order to obtain consistent estimators.

⁹ UD_{\max} is an equal weighted test while WD_{\max} applies weights to the individual tests in order for the marginal p-values to be equal across values of m .

$l+1$ breaks model. Finally, we use the Bayesian Information Criterion (BIC) and the modified Schwartz criterion (LWZ) to select the dimension of the model¹⁰.

The structural break approach has been used in many papers in economic history (Guinane, Willard and Rosen, 1996; Brown and Burdekin, 2000; Frey and Kucher, 2001; Weidenmier, 2002; Brown and Burdekin, 2002; Oosterlinck, 2003; Frey and Waldenström, 2004; Zussman et al., 2007; Flandreau and Oosterlinck, 2011; Oosterlinck and Ureche-Rangau, 2012). Its main advantage is that breaks are determined endogenously, hence allowing to understanding the perceptions at the time of the events, excluding any ex-post bias. This advantage is enhanced by the use of financial market data, highly informative when one wishes to assess the perceived importance of given events at the moment they happened, as any misinterpretation of information could heavily penalize the market operators (Waldenström and Frey, 2007). However, this approach also presents some limits, namely a risk of “over-interpretation” (i.e. econometrically determined break for which one seeks a historical reason at any costs) and a risk of omission, particularly in the presence of simultaneous events producing opposite effects.

In order to infer more information regarding the response of the French yields to the implementation of several institutions with direct link to public debt management as well as to decisions leading to an enhancement of their credibility, we test the changes in the French yield at the dates these decisions were made. Thus, we are able to capture a short-term effect in the yield, at the dates for which there is an a priori. To do so, we apply a two steps procedure. First of all, to take into account market trend, the French yields are detrended by using the British consol as the benchmark for the sovereign bonds market at that time, i.e.

$$y_t = c_0 + c_1 trend_consol_t + e_t \quad (3)$$

where y_t represents the French yield, $trend_consol_t$ is the Hodrick-Prescott trend¹¹ of the British consol over the same time-period, c_i are the coefficients and e_t the residual. In a second step, residuals are described by a GARCH(1,1) model with dummies in the mean as proxies for the chosen dates as follows:

$$e_t = \alpha_1 e_{t-1} + \sum_{i=1}^N \alpha_{2i} D_i + \varepsilon_t \quad (4)$$

¹⁰ In the presence of serial correlation and even when no serial correlation is present in the errors but a lagged dependent variable, with large coefficient, is present, Bai and Perron suggest using a sequential application of the $\sup F_T(l+1/l)$ test based on sequential estimates of the breaks.

¹¹ The smoothing parameter λ was chosen according to the frequency power rule of Ravn and Uhlig (2002) and a power rule of 2, following Hodrick and Prescott (1997).

$$h_t = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \beta_2 h_{t-1} \quad (5)$$

with D_i standing for the chosen N dummies, h_t is the conditional variance, α and β are the different coefficients.

The advantage of this approach is that there is no risk of over-interpretation, as the events are chosen exogenously for a specific reason. However, the reverse is that by doing so, there is potential ex-post bias (choosing events that are nowadays considered as major by most historians while they were perceived as minor at the time they arrived).

With those caveats in mind, we apply these two methodologies on our sample of French yields. Results are presented and discussed in the next section.

V. Empirical evidence

We aim at studying the presence of potential structural changes in the evolution of the French bond yields over a time period of ten years, between 1815 and 1825 as well as the impact of several identified events on the same yield. More specifically, we analyze to what extent the newly created institutions following the Waterloo defeat along with the different decisions meant to enhance their credibility, but also the occupation of the French territory by the enemy, could explain the observed decline in the French debt yields.

We start by reporting some descriptive statistics for both the French and British yields, i.e. 5% French rente and 3% British consol. Table 1 shows that the yields of the French rente are, on average, higher than those of the British consol (by almost 2.5%), while also being more volatile (e.g. higher standard deviation). The French yield culminates at almost 10%, which is twice as much as the maximum British yield. Both yields are non-Gaussian, more specifically leptokurtic and positively skewed (significantly in the case of the French one).

Insert Table 1 about here

We also check for the presence of potential unit roots in our two series, by performing the Augmented Dickey-Fuller test. Our results, as reported in Table 2, show evidence that while for the British consol we cannot reject the presence of a unit root, the French rente is stationary when we take into account an intercept and a trend.

Insert Table 2 about here

We then apply the structural break approach in order to check for the presence of potential major changing points in the evolution of the French yields. More specifically, we estimate the following version of the general model presented in (2), namely

$$y_t = \delta_{1,j} + \delta_{2,j}t_j + \delta_{3,j}\Delta y_{t-1} + u_t \quad t = T_{j-1} + 1, \dots, T_j \quad j = 1, \dots, m+1 \quad (6)$$

The choice of this model was motivated by the results of the ADF tests performed on the French yields, where the inclusion of an intercept and a trend seems to correct for the presence of a unit root. Finally, our series of yields shows significant autocorrelation up to lags as high as thirty¹²; therefore we include the lagged dependent variable in the right side of the equation.

Results are provided in Table 3 for a trimming parameter of $\varepsilon = 0.10$ and a maximum number of breaks equal to 8 which corresponds to segments with a minimum length¹³ equal to 55.

Insert Table 3 about here

First of all, both the supF tests and the double maximum tests (UD_{\max} and WD_{\max}) of no break allow rejection of the null hypothesis at the 5% conventional risk level. Hence, there is at least one break point in our yield series. Regarding the exact number of breaks the three criteria (BIC, LWZ, and sequential procedure) select 4, 6 and 5 breaks respectively. Following Bai and Perron's recommendations, namely in the presence of serial correlation, we choose to discuss the sequential estimates of the breaks, i.e. 5 breaks.

The first break falls on February 7, 1817 and has a confidence interval of one observation before and one after the exact location the observed break. Historically, this date corresponds to Baring and Hope & Company issuing the first tranche of a loan which made the payment of the indemnity possible and may therefore explain the descending pattern of the yields.

The loan was important in many respects. First, it allowed France to pay the due installment of the war indemnity. Second, this payment was also linked to the withdrawal of 30,000 troops from the occupied part of the country. Third, it showed that foreign investors were recognizing the improvement in French public finances and future prospects. The fact that foreign

¹² For space reasons, we choose not to report the results of the Ljung-Box Q-statistics; they are however available upon request.

¹³ The choice of these trimming parameters was dictated by Bai and Perron recommendations; as our sample is composed by 550 weekly observations we chose segments long enough to provide statistically significant evidence and avoid short lived noise being treated as a break. Meanwhile, the use of too long periods potentially leads to missing "true shifts" in the series. However, we performed our computation with several other values for the trimming parameters and the results are similar.

underwriters had agreed to take interest in the loan was regularly mentioned (Aglan, 2006). This was the case even though Barings was not yet one of the leading underwriters (Flandreau and Flores, 2010). Eventually, this issue lifted the Paris stock exchange from its apathy (Colling, 1949, p. 192). With a more active market, the government could expect a decline in interest rates for future issues of the rente.

The second break is detected on November 27, 1818 and is also characterized by a very thin confidence interval, i.e. one observation on each side of the break point. Historical evidence shows that at this date the Allied troops quit France, which determines a definitive change towards a continuous decrease of the yield, after a period of downside but also upside variations of the same yield.

The impact of the final departure of foreign troops from the French soil was certainly a major event at the time. This departure was indeed the sign that France had managed to repay all its war indemnities. The country was now back to a normal track. The massive amounts paid as reparations were part of the past. According to Colling (1949, p. 193) investors were betting on the results of the Congress of Aix-la Chapelle and on the future liberation of the territory. The liberation of the territory was a central element in Louis XVIII's speech for the opening of the Chambers on December 10th, 1818. During the same speech he insisted on his willingness to reduce the public debt (de Nervo, 19865, p. 326).

The third break is the most controversial; detected on **May 25, 1821** it has the largest confidence interval and is the one missing when applying the BIC criteria. The only potential explanation could be Napoleon's death on May 5th, 1821; however, it can also fall under the risk of over interpretation.

The fourth break appears on January 10, 1823 and has a confidence interval similar in lengths to the one reported for the first two breaks. The corresponding events that might explain this change in the evolution of the yields, namely a switch towards an increase of their level, could be the outbreak of the war with Spain (*Expédition d'Espagne*) associated to an extraordinary credit voted by the legislature in order to sustain this war. Colling (1949, p. 199) attributes the sharp decline of the rente in January 1823 to the prospect that the war would break out.

Finally, **the last break is detected on March 27, 1824** with the same thin, one observation around, confidence interval. After a period of new decrease in the yield, the victory of the Ultras at the new elections (*Chambre retrouvée*) that followed the dissolution of the legislature in December 1823 determines a new upside move in the French yield.

The increase in the yield is likely due to the announcement by Louis XVIII at the opening session of the Chambers that measures would be taken to convert existing bonds and to close the last wounds of the revolution (Boiteau, 1866, p. 175¹⁴). This speech was a clear announcement of two major changes: the conversion of the rente (leading thus to a reduction on the interest rate) and the payment of an indemnity to the Emigrés who had been “despoiled” by the revolution. Both elements could only have a negative impact on the price of the rente: the first one because there were at the time debates regarding the legality of the conversion and because it paved the way for future conversions; the second one because the indemnity would have to be somehow financed. The heated debates related to the conversion show that many viewed the conversion as a direct threat, an element which would put into question the faith one could have in the French rente (Aglan, 2006).

Insert Figure 3 about here

We enlarge the former analysis of the structural changes in the evolution of the French yield (long term perspective) by a study of the short-term effects in the same yield produced by several major decisions regarding the implementation of institutions aimed at managing the public debt as well as political and fiscal decisions that contributed to enhancing French state’s credibility. To do so, we proxy these dates for which there is an a priori by dummies and run a GARCH(1,1) model. It is nowadays well-established that financial time series’ volatility is time-varying¹⁵; therefore, one cannot ignore this important stylized fact and consider it unchanged, particularly during troubled times and over such a long time period (10 years) as the one under study. This issue is even more stringent as we show evidence that there are structural changes in the pattern of the financial variable that we are modeling, i.e. the French yield. Therefore we favored a GARCH framework instead of the simple OLS regression.

Table 4 provides the list of nine dummies chosen based on Vaslin (1999) and White (2001). Some of these dates were already mentioned in the description of the historical context (e.g. the Second Treaty of Paris, the reintroduction of a Caisse d’amortissement, the Chambre introuvable, the settlement of debt arrears by the crown, the acceptance of wartime claims). To these, we add three more events that shaped the credibility of the French government in fulfilling its debt obligations and maintaining sound public finances. The first one is the payment of debt arrears

¹⁴ « Des mesures sont prise pour assurer le capital des rentes créés par l’état dans des temps moins prospères ou pour obtenir leur conversion en des titres dont l’intérêt soit plus d’accord avec celui des autres transactions. Cette opération qui doit avoir une heureuse influence sur l’agriculture et le commerce permettra, quand elle sera consommée, de réduire les impôts et de fermer les dernières plaies de la révolution ».

¹⁵ For syntheses of the literature on ARCH-GARCH modeling please refer to Bollerslev et al. (1992), Bollerslev et al. (1994) among others.

by the Banque de France. Introduced in 1800 following Gaudin's proposal, (Finance minister of that time), this practice was seen as a major measure for restoring public finances and France's credibility with respect to its creditors (Vaslin, 1999) as it imposed the resumption of specie payment for the public debt. However, it was implemented as a short-term measure and indeed, it only lasted for four years. As the French state continued experiencing financial difficulties, this type of intervention was used several times afterwards (following a reform of the Bank's statute in March 1806). It was namely the case on December 14, 1815 when the Bank insured the payment of the coupons pending since September 22, 1815 and on June 11, 1817, when the payment of the war indemnity created huge problems to the treasury. Corvetto insisted then on the necessity to insure the payment of the 5% rente in a "normal" delay and the Bank was again designated to fulfill this objective.

The two other events that we decided to add are both the consequences of the laws introduced by Villèle from 1822 to 1827. These laws were meant to guarantee the principles of unity, integrity, specialization and periodicity of the public budget. The first one is the budgetary order of September 14, 1822 regarding the liquidation of public expenses during the 9 months following the end of the fiscal year while the second one is the financial account order of December 10, 1823 (Vaslin, 1999).

Insert Table 4 about here

Table 5 provides the results of our dummy analysis. For many dates one can observe a statistically significant negative impact on the yields. The first payment of debt arrears by the Banque de France and the dissolution of the chamber were clearly perceived positively by the markets. Both showed the state's willingness to honor the debts of the previous regimes, either by a direct intervention on the market (payment of the pending coupons) or by politically evicting any potential advocates of a moratoria on the existing debts. The different laws increasing the accountability of the government and promoting more transparency in public finances were also positively perceived, and were followed by a decrease in the yield. Restoring a sound management of the public finances was indeed one key action that contributed to restoring creditors' confidence in France's capacity to sustain its debt. Surprisingly, the creation of the Caisse d'amortissement is not linked to any decrease in yields. The previous aborted attempts in the matter might explain the reluctance of the markets, at least in the short-run, regarding the success of such an institution. Moreover, investors probably needed more time in order to assess the credibility of this institution and particularly government's willingness to support its functioning and respect its objectives. Finally, the second intervention of the Bank to insure the payment of

the debt service has an opposite effect on the French yield (e.g. increase). One potential explanation might come from the fact that by asking for a new intervention of the Bank, the French government signaled its recurrent financial difficulties. In addition, one should also mention that these interventions also raised additional expenses for the state; as an example, for the 1823 intervention, the Bank charged a commission of $1\frac{1}{2}\%$ on the amounts paid to the creditors as well as on the advances insured to the Caisse d'amortissement (110,000 FF per day) and a guarantee amounting at 2 million of FF in rentes. The guarantee was returned to the Treasury in March 1819.

VI. Conclusion

Following Waterloo, France was in a terrible situation. Public finances were in shambles and whereas victors had been inclined to show mercy in 1814, following the episode of the 100-days, they imposed harsh terms to defeated France. Despite all these elements, in the ten years between 1815 and 1825 not only did France manage to place a huge amount of debt on the market (resulting in a threefold increase) but it did so with a spread, compared to the British consol, falling from more than 400 basis points to a meagre 100 basis point.

The imposition of huge war indemnities on defeated France forced the government to take drastic measures. As pointed out by Margairaz (2006), the 100 days and Waterloo forced the persons in charge of French finances to implement laws and institutions leading to the creation of a real credit system. For White (2001), two incentives were the basis of the timely payment of reparations: the threat exercised by the Allied troops stationed in France and the risk of losing the rentes which had been given as guarantee to the victors.

The imposition of huge war indemnities together with the partial occupation of defeated France put an enormous pressure on the French government to find funds. The 100 days had shown to the world the fragility of the rule of Louis XVIII. He thus had a strong incentive to please the Allies who had twice restored him. The electoral law limiting the vote to the richest men of the nation also guaranteed a form of alignment of interests. Neither Louis XVIII nor the wealthy had an incentive to repudiate the debts inherited from the revolution and the Empire, even less to default on future loans.

The analysis of structural breaks on the spread between French and British bonds shows that Waterloo had indeed a positive long-lasting effect on French public finances. North and

Weingast (1989) stress the importance of credible institutions and of actions consistent with the preservation of creditors' rights to improve the state's credibility. Both elements were clearly present in the French case. In terms of actions, not only did France recognize all previous debts it also took measures to make sure the reimbursement of these debts would happen. Arrears which had been the tool Napoleon used to finance his regime were paid. The desire to pay all former debts faithfully was tested twice: first by the opposition of the chamber introuvable to the 1816 budget, second when the king suggested converting the 5% rentes to pay for an indemnity for the Emigrés. Both events show up in the analysis, confirming the major role played by credibility. The payments themselves appear to have had a positive short term impact on the yields. By the same token, elements linked to the repayment of the war indemnities also clearly show up in the analysis. Both the issue of a large international loan allowing the payment and the actual settlement of the war leading to the withdrawal of foreign troops induce statistically significant structural breaks.

Institutions such as the creation of the *caisse d'amortissement* don't seem to have induced a major break. This might be due to the fact that many sinking funds had been created by previous regimes and had systematically been used to other means than the debt amortization. In this case, one would expect a gradual impact as investors realize as time goes by that the restored government is serious about amortizing its debt. Laws increasing the accountability of ministers and leading to a better management of public finances appear however to have had a positive short term impact on the yields.

In most studies the credibility of the state is analyzed through the lenses of its actions or its institutions. The French case following Waterloo is dramatically different. Indeed, the credibility of the French government was in a first phase guaranteed by the military threat posed by the Allied occupation Army. Investors knew that France had no choice but to find ways to pay. During the occupation period (1815-1818), France managed to reimburse the war indemnities. As such, this fact alone would certainly have increased its credibility. However, the manner in which the repayment was made possible played probably an even more important role. Indeed, in these three years, France created new institutions to better manage its debts, passed laws dramatically enhancing the power of parliament in financial matters and increased the accountability of ministers regarding their expenses. At the same time, France recognized all of its former debts. The king and the Ultras didn't even repudiate the debts from the abhorred revolution and Empire. When Ultras attacked the sale of lands previously owned by the Clergy to pay for the inherited debts, the king dissolved the chamber and proceeded with new elections. In a second

phase, once credibility had been largely recovered, a culture of sound public finance had developed and attempts to engage in operations which could diminish the state's credibility, such as the 1824-25 conversion, were fiercely and successfully attacked. Regarding French public finances, Waterloo and the 100 days marked the beginning of a new, and better, era. Whereas previous attempts to improve French public finance had proved unsuccessful up till then, the pressure set by the defeat forced the government to act in such a way as to recover its credibility. In this respect Waterloo was indeed a godsend for French public finances!

REFERENCES

Acemoglu D., Johnson S., Robinson J., (2005), "The rise of Europe: Atlantic Trade, Institutional Change and Economic Growth", *American Economic Review*, 95, 3, pp. 546-579.

Aglan Alya, (2006), "L'invention politique de la Foi publique (1816-1838)", in Alya Aglan, Michel Margairaz and Philippe Verheyde eds, *1816 ou la genèse de la Foi publique. La fondation de la caisse des dépôts et consignations*, Droz, Genève, pp. 67-94.

Bai J., Perron P., (1998), "Estimating and Testing Linear Models with Multiple Structural Changes". *Econometrica*, 66, pp. 47-78.

Bai J., Perron P., (2003a), "Computation and Analysis of Multiple Structural Change Models". *Journal of Applied Econometrics*, 18, pp. 1-22.

Bai J., Perron P., (2003b) "Critical Values for Multiple Structural Change Tests". *Econometrics Journal*, 6, pp. 72-78.

Black F., Scholes M., (1973) "The Pricing of Options and Corporate Liabilities" *Journal of Political Economy*, 81, pp. 637-654.

Boiteau P., (1866), *Fortune publique et finances de la France*, Paris, Guillaumin.

Bollerslev T., Chou R.Y., Kroner K.F., (1992), "ARCH Modelling in Finance: A Review of the Theory and Empirical Evidence", *Journal of Econometrics*, 52, pp. 5-59.

Bollerslev T., Engle R.F., Nelson D.B., (1994), "ARCH models", *Handbook of Econometrics* Vol. IV, Robert F. Engle and D.L. McFadden, eds. Amsterdam: North-Holland, pp. 2959–3038.

Bordo M. D., White E. N., (1991), "A Tale of Two Currencies: British and French Finance during the Napoleonic Wars", *Journal of Economic History*, 51, 2, pp. 303-316.

Brown, W. O & Burdekin R. C. K., (2000), "Turning Points in the U. S. Civil War: a British perspective." *Journal of Economic History* 60, 216-231.

Brown, W. O & Burdekin R. C. K., (2002), "German debt traded in London during World War II: a British perspective on Hitler", *Economica*, 69, 655-669.

Bruguière M., (1977), « Les techniques d'intervention de la caisse d'amortissement dans le cours de la rente (1816-1824) », *Revue historique*, CCLVIII, 1, pp. 93-104.

Bruguière M., (1989), "Révolution et finances. Réflexions sur un impossible bilan", *Revue Economique*, 40, 6, pp. 985-1000.

Bulow J., Rogoff K., (1989), "Sovereign debt: is to forgive to forget", *American Economic Review*, 79, 1, pp. 43-50.

Colling A., (1949), *La prodigieuse histoire de la bourse*, Paris, Editions S.E.F.

Cox G. W., (2011), "War, Moral Hazard and Ministerial Responsibility: England after the Glorious Revolution", *Journal of Economic History*, 71, 1, pp. 133-161.

De Nervo Baron, (1865), *Les finances françaises sous la Restauration 1814-1830*, Paris, Michel Lévy Frères.

Dincecco M., (2009), "Fiscal Centralization, Limited Government and Public Revenues in Europe, 1650-1913", *Journal of Economic History*, 69, 1, pp. 48-103.

Eaton J., Gersovitz M., (1981), "Debt with potential repudiation: Theoretical and empirical analysis" *Review of Economic Studies*, 48, 2, pp. 289-309.

Esteves R. P., (2007), "Quis custodiet quem? Sovereign Debt and Bondholders' Protection Before 1914," Economics Series Working Papers 323, University of Oxford, Department of Economics.

- Feis H., (1930), *Europe The World's Banker 1870-1914*,
- Ferguson N., Schularick M., (2006), "The Empire Effect: The Determinants of Country Risk in the First Age of Globalization, 1880-1913", *Journal of Economic History*, 66, 2, pp. 283-312.
- Flandreau, M., Flores J. H., (2010), "Hamlet without the Prince of Denmark: Relationship banking and conditionality lending in the London market for government debt, 1815-1913", *CEPR Discussion Papers* 7915.
- Flandreau M., Oosterlinck K., (2011), "Was the Emergence of the International Gold Standard Expected? Melodramatic Evidence from Indian Government Securities", IHEID Working Papers 01-2011, Economics Section, The Graduate Institute of International Studies.
- Frey B., Kucher M., (2000), "History as reflected in capital markets: the case of World War II", *Journal of Economic History*, 60, 2, 468-496.
- Frey B., Waldenström D., (2004), "Markets work in war: World War II reflected in Zurich and Stockholm bond markets", *Financial History Review*, 11, 1, 51-67.
- Frey B., Waldenström D., (2007), "Using Financial Markets to Analyze History: The Case of the Second World War", *Historical Social Research* 32(4), 330-350.
- Fishlow A., (1985), "Lessons from the past: capital markets during the 19th century and the interwar period", *International Organizations*, 39, 3, pp. 383-439.
- Gabillard J., (1953), "Le financement des guerres napoléoniennes et la conjoncture du Premier Empire", *Revue Economique*, 4, 4, pp. 548-572.
- Gelderblom O., Jonker J., (2011), Public Finance and Economic Growth: The Case of Holland in the Seventeenth Century", *Journal of Economic History*, 71, 1, pp. 1-39.
- Hodrick R., Prescott E.C., (1997), "Postwar U.S. business cycles: An empirical investigation", *Journal of Money, Credit, and Banking*, 29, 1, pp. 1-16.
- Ivanov M., Tooze A., (2011), "Disciplining the "black sheep of the Balkans": financial supervision and sovereignty in Bulgaria, 1902-38", *Economic History Review*, 64, 1, pp. 30-51.

Jèze G., (1925), *Le remboursement des emprunts publics d'état (Théorie et pratique de l'amortissement des dettes publiques)*, Paris, Marcel Giard.

Kang Zheng, (2007), "L'Etat constructeur du marché financier", under the supervision of P.-C. Hautcoeur, *Le Marché financier français au XIXe siècle Vol 1. Récit*, Publications de la Sorbonne, Paris, pp. 159-194

Lafitte J., (1824), *Réflexions sur la réduction de la rente, et sur l'état du crédit*, 2^{ème} édition, Paris, Galerie de Bossange Père.

La Porta R., Lopez de Silanes F., Shleifer A., Vishny R., (1997), "Legal Determinants of External Finance," *Journal of Finance*, 52, 3, pp. 1131-1150.

La Porta R., Lopez de Silanes F., Shleifer A., Vishny R., (1998), "Law and Finance", *Journal of Political Economy*, 106, 6, pp. 1113-1155.

Margairaz M., (2006), "Les Caisses d'amortissement et des dépôts et consignations, la trésorerie, la dette publique et la genèse du système de crédit en France dans le premier XIX^e siècle ou Les paradoxes de la confiance », in Alya Aglan, Michel Margairaz and Philippe Verheyde eds, *1816 ou la genèse de la Foi publique. La fondation de la caisse des dépôts et consignations*, Droz, Genève, pp. 155-176.

Mitchener K., Weidenmier M., (2005), "Empire, Public Goods, and the Roosevelt Corollary", *Journal of Economic History*, 66, pp 58-692.

Mitchener K., Weidenmier M., (2010), "Supersanctions and Sovereign Debt Repayment", *Journal of International Money and Finance*, 29, pp. 19-36.

Musacchio A., (2008), "Can civil law countries get good institutions? Lessons from Creditor rights and Bond markets in Brazil", *Journal of Economic History*, 68, 1, pp. 80-108.

North D. C., Weingast B. R., (1989), "Constitutions and Commitment: the evolution of institutions governing public choice in seventeenth century England", *Journal of Economic History*, XLIX, 4, pp. 803-832.

Oosterlinck, K., Ureche-Rangau, L., (2012), "Interwar Romanian sovereign bonds: The Impact of diplomacy, politics and the economy", *Financial History Review*, 19, 2, pp. 219-244.

Pecquet G. M., Thies C. F., (2010), “Texas Treasury Notes and the Mexican-American war: Market responses to diplomatic and battlefield events”, *Eastern Economic Journal*, 36, pp. 88–106.

Plessis A. (2006), “Entre les caisses chargées de l’amortissement sous l’Ancien Régime et les deux caisses de 1816 : la Caisse d’amortissement de Napoléon (1799-1815) » in Alya Aglan, Michel Margairaz and Philippe Verheyde eds, *1816 ou la genèse de la Foi publique. La fondation de la caisse des dépôts et consignations*, Droz, Genève, pp. 43-64.

Rajan R., Zingales L., (2003), “The Great Reversals: The Politics of Financial Development in the 20th Century”, *Journal of Financial Economics*, 69, pp. 5-50.

Ravn M. O., Uhlig H., (2002), “On adjusting the Hodrick-Prescott filter for the frequency of observations”, *The Review of Economics and Statistics*, 84, 2, pp. 371–380.

Reinhart C., Rogoff K., Savastano M., (2003),”Debt intolerance”, *Brookings Papers on Economic Activity* 1, pp. 1-74

Rose A. K., (2005), "One reason countries pay their debts: renegotiation and international trade," *Journal of Development Economics*, 77(1), pp. 189-206.

Stasavage D., (2007), “Partisan politics and public debt: The importance of the “Whig Supremacy” for Britain’s financial revolution”, *European Review of Economic History*, 11, pp. 123-153.

Sussman N., Yafeh Y., (2006), “Institutional Reforms, Financial Development and Sovereign Debt: Britain 1690-1790”, *Journal of Economic History*, 66, 4, pp. 906-935.

Vaslin J.-M., (1999), « Les rentes françaises au XIX è siècle, le marché des fonds d’état était-il efficient ? », unpublished Ph D, université d’Orléans.

Vührer A., (1886), *Histoire de la Dette Publique en France*, Paris, Berger et Levrault.

Weidenmier, M., (2002), “Turning points in the U.S. Civil War: Views from the Grayback market”, *Southern Economic Journal*, 68, 4, 875-890.

White, E. N., (1989), “Was there a Solution to the Ancien Régime’s Financial Dilemma”, *Journal of Economic History*, 49, 3, pp. 545-568.

White, E. N., (1996), “The French Revolution and the Politics of Government Finance, 1170-1815”, *Journal of Economic History*, 55, 2, pp. 227-255.

White, E. N., (2001), “Making the French pay: the cost and consequences of the Napoleonic reparations” *European Review of Economic History* 5, 337–65.

Willard K., Guinnane T., Rosen H., (1996), “Turning points in the Civil War: views from the Greenback market”, *American Economic Review*, 86, 4, pp. 1001-1018.

Zussman A., Zussman N., Nielsen M. O., (2008), “Asset market perspectives on the Israeli-Palestinian conflict”, *Economica*, 75, pp. 84-115.

Figure 1: French Debt, 1801-1835

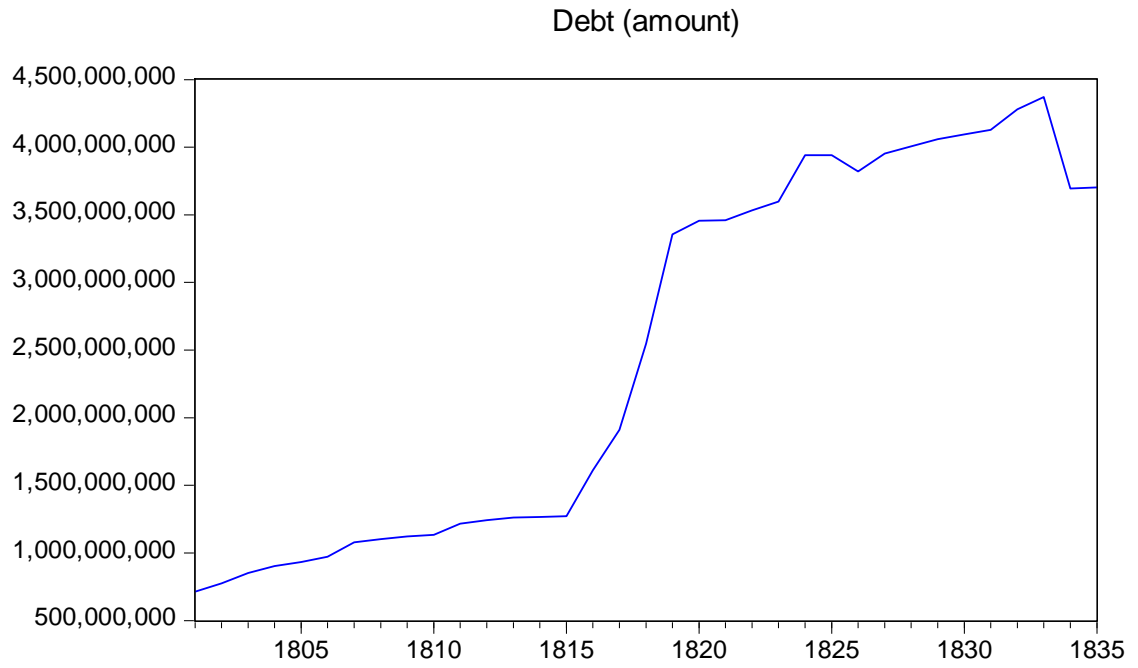
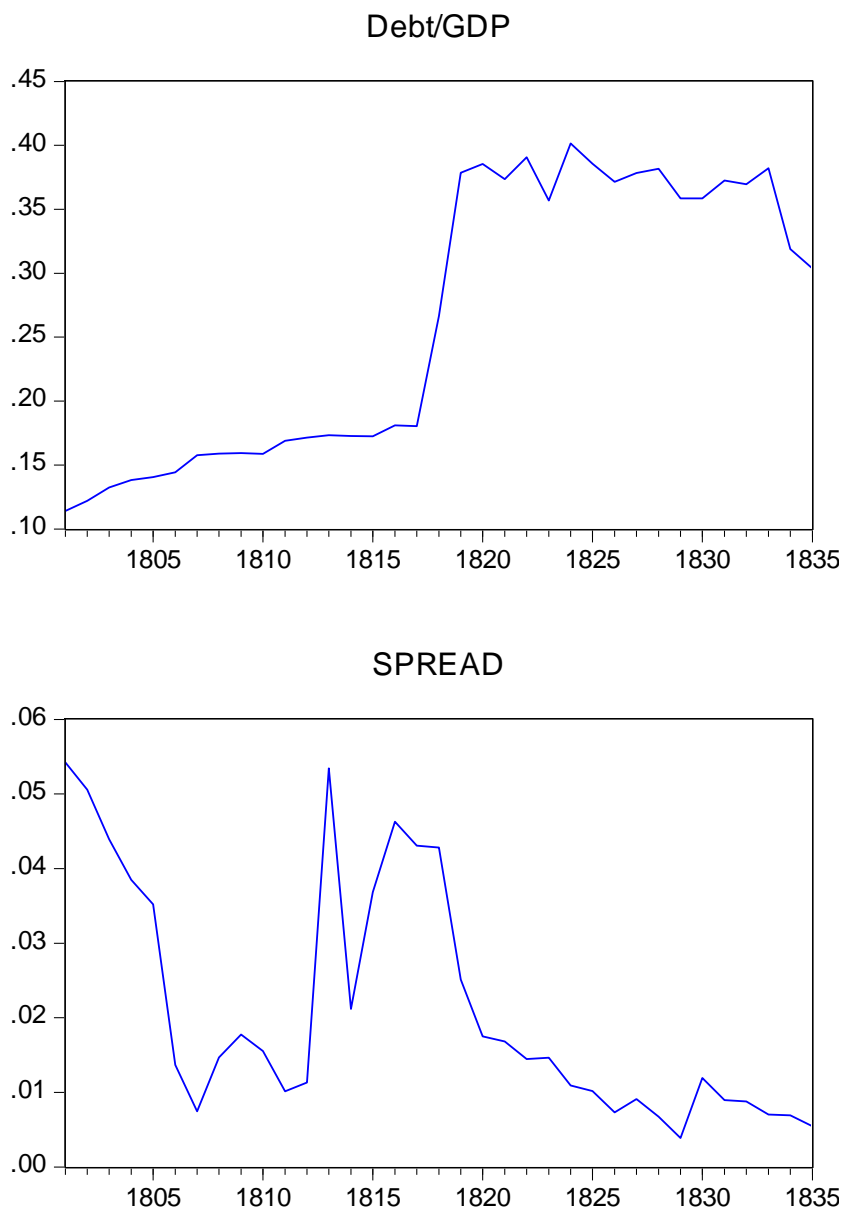


Figure 2: The French Debt-to-GDP ratio and the French 5% rente – British 3% consol spread: comparative evolution, 1801-1835



Sources: Debt amounts and yields: authors' computations. GDP: Banque de données macroéconomiques, INSEE, <http://www.insee.fr/fr/bases-de-donnees/>, Série 000870383

Figure 3: The evolution of the French yield and the detected break points

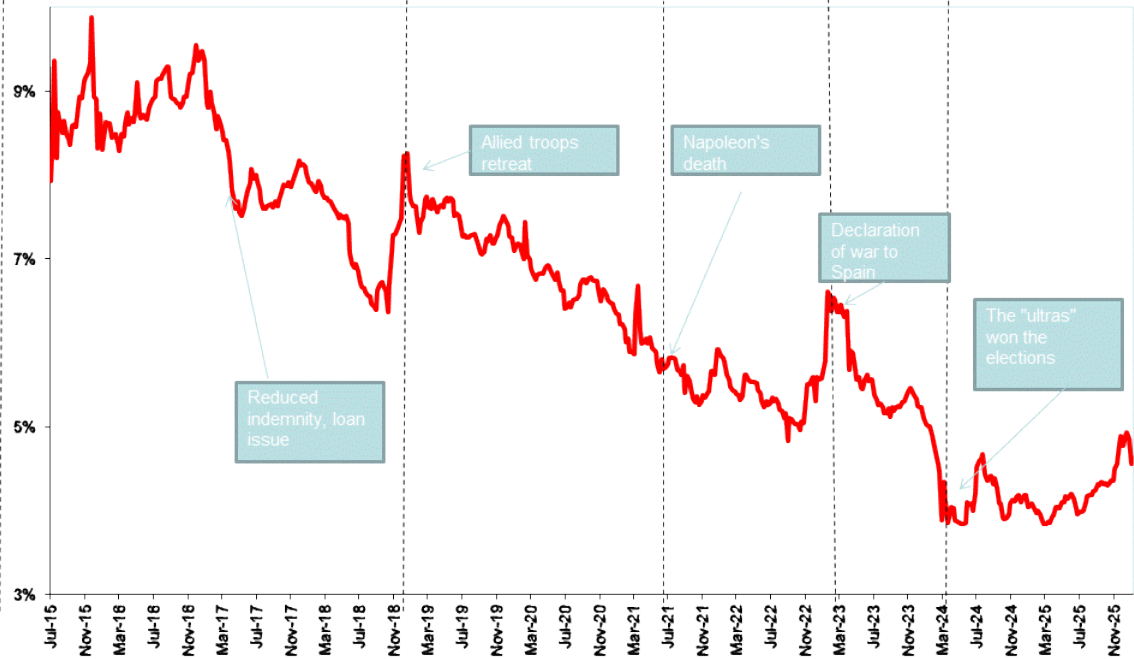


Table 1: Descriptive statistics of the French rente and the British consol

	CONSOL	RENTE
Mean	4.03%	6.47%
Median	3.92%	6.54%
Maximum	5.40%	9.88%
Minimum	3.12%	3.84%
Std. Dev.	0.54%	1.58%
Skewness	0.400*	0.027
Kurtosis	2.541*	1.903*
Jarque-Bera	19.50*	27.62*
<i>p-value</i>	<i>0.0001</i>	<i>0.0000</i>

* stands for significance at the 5% conventional risk level

Table 2: ADF unit root test on the French rente and the British consol

	ADF t-Statistic (constant, trend)	p-value
CONSOL	-1.6118	<i>0.7874</i>
RENTE	-4.4743*	<i>0.0018</i>

* stands for significance at the 5% conventional risk level

Table 3: Structural breaks analysis

Model		Specifications							
$y_t = \delta_{1,j} + \delta_{2,j}f_j + \delta_{3,j}\Delta y_{t-1} + u_t$		h = 55		m = 8					
Tests									
sup F_T (1)	sup F_T (2)	sup F_T (3)	sup F_T (4)	sup F_T (5)	sup F_T (6)	sup F_T (7)	sup F_T (8)	UD_{\max}	WD_{\max}
303.30*	304.63*	289.87*	272.81*	257.14*	242.61*	248.12*	196.19*	304.63*	452.26*
sup F (2 1)	sup F (3 2)	sup F (4 3)	sup F (5 4)	sup F (6 5)					
227.08*	216.44*	208.11*	77.71*	16.02					
Number of breaks selected									
<i>we use a 5% size for the sequential test</i> sup $F_T(l+1 l)$									
Sequential	5								
LWZ	6								
BIC	4								
Estimates with 5 breaks									
<i>t-values in italics for $\hat{\delta}_{i,j}$ the 90% confidence intervals for \hat{T}_i</i>									
$\hat{\delta}_{1,1}$	$\hat{\delta}_{1,2}$	$\hat{\delta}_{1,3}$	$\hat{\delta}_{1,4}$	$\hat{\delta}_{1,5}$	$\hat{\delta}_{1,6}$				
0.0857*	0.0976*	0.1039*	0.0745*	0.1673*	0.0208*				
<i>147.19</i>	<i>74.43</i>	<i>71.53</i>	<i>18.90</i>	<i>20.23</i>	<i>4.58</i>				
$\hat{\delta}_{2,1}$	$\hat{\delta}_{2,2}$	$\hat{\delta}_{2,3}$	$\hat{\delta}_{2,4}$	$\hat{\delta}_{2,5}$	$\hat{\delta}_{2,6}$				
0.0001*	-0.0002*	-0.0001	-0.0001*	-0.0003*	0.00004*				
<i>5.45</i>	<i>-17.15</i>	<i>-23.81</i>	<i>-5.06</i>	<i>-13.56</i>	<i>4.62</i>				
$\hat{\delta}_{3,1}$	$\hat{\delta}_{3,2}$	$\hat{\delta}_{3,3}$	$\hat{\delta}_{3,4}$	$\hat{\delta}_{3,5}$	$\hat{\delta}_{3,6}$				
-0.0049*	0.8309*	0.3872*	0.3055	0.2811	0.2906*				
<i>-2.61</i>	<i>3.55</i>	<i>2.45</i>	<i>1.29</i>	<i>1.41</i>	<i>1.39</i>				
\hat{T}_1	\hat{T}_2	\hat{T}_3	\hat{T}_4	\hat{T}_5					
02/07/1817	11/27/1818	05/25/1821	01/10/1823	02/27/1824					
<i>[01/31 - 02/14]</i>	<i>[11/20 - 12/11]</i>	<i>[03/09 - 06/01]</i>	<i>[01/03 - 01/17]</i>	<i>[02/20 - 03/05]</i>					
<i>R-squared</i>	<i>Adj. R-squared</i>								
0.975	0.975								

* denotes significance at the 5% confidence level

Table 4: Dummies and corresponding chosen events

Dummy	Date	Event
D1	20 November 1815	Second Treaty of Paris
D2	14 December 1815	Banque de France pays debt arrears
D3	28 April 1816	Creation of the Caisse d'Amortissement Law settling debt arrears
D4	5 September 1816	Dissolution of the legislature (<i>Chambre introuvable</i>)
D5	25 March 1817	Crown settles debt arrears Increase of government's accountability
D6	11 June 1817	Banque de France pays debt arrears
D7	9 May 1818	French legislature accepts wartime claims
D8	14 September 1822	Budgetary order to liquidate public expenses during the 9 months following the end of the fiscal year
D9	10 December 1823	Financial annual account order

Table 5: Regression results – short-term impact of chosen events

	Coefficient	p-value
$\hat{\alpha}_1$	0.9587*	0.0000
$\hat{\alpha}_{2,1}$	0.0046	0.2224
$\hat{\alpha}_{2,2}$	-0.0002*	0.0000
$\hat{\alpha}_{2,3}$	-0.0007	0.7703
$\hat{\alpha}_{2,4}$	-0.0032*	0.0000
$\hat{\alpha}_{2,5}$	-0.0010*	0.0000
$\hat{\alpha}_{2,6}$	0.0010*	0.0000
$\hat{\alpha}_{2,7}$	-0.00002	0.5114
$\hat{\alpha}_{2,8}$	-0.0003*	0.0012
$\hat{\alpha}_{2,9}$	-0.0006*	0.0000
$\hat{\beta}_0$	0.0000	0.0548
$\hat{\beta}_1$	0.1732*	0.0093
$\hat{\beta}_2$	0.6085*	0.0000
R-squared	0.8956	
Adj. R-squared	0.8938	

* denotes significance at the 5% confidence level