# The relationships between money and financial markets in France. 1880-1914.

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" Oh ! Toutes mes réflexions sont faites ; je suis lasse de n'entendre parler que de reports, de fins de mois, de hausse, de baisse, de fonds espagnols, de papier haïtien. "

Alexandre Dumas père, Le Comte de Monte-Cristo, third part (1845)


" À cette époque, il tonnait contre toute spéculation, il haussait les épaules de colère et de pitié, en parlant des pauvres imbéciles qui se font dépouiller, dans un tas de voleries aussi sottes que malpropres. Mais, vers ce temps-là, une somme importante lui étant rentrée, il avait eu l'idée de l'employer en reports : ça, ce n'était pas de la spéculation, c'était un simple placement. "

Emile Zola, L'Argent (1891)

## General Introduction

This thesis deals with the relationship between the money market and the financial market. The essential feature that differentiates the two markets is time. Money markets are designed to attract short-term loans, to which they offer remuneration, a certain degree of safety, and the possibility of liquidating the investment quite easily and quickly. Financial or capital markets deal with the long run, and are usually riskier, less liquid, and as a consequence more profitable.

Whenever the long-term financing of the economy employs short-term funding, the two markets interact. Said differently, any relationship between money and capital markets implies a maturity transformation. Historically, short-term deposits have frequently been used to finance longer-term investments. The task of transforming maturities is one of the main functions of the financial sector as a whole. The actors assuming this risk can be, according to the context, banks, stock exchanges, and other financial institutions.

The period studied in this work covers the end of the nineteenth and the beginning of the twentieth century. In France, the period preceding World War One is known as the "*Belle Epoque*". It is associated with an idea of generalized wealth and wellness, economic growth and social peace. Recent studies have criticized this myth, focusing in particular on the high inequality in the distribution of wealth typical of this period (Piketty 2014). It is true, nonetheless, that the period 1890-1914 was a golden age at least for the financial market. The total market capitalization of the French stock exchanges in 1913 represented 54.1% of the GDP. This proportion fell after WW1 and a similar level was only achieved in 1998[1].

Another incontrovertible evidence deals with the French growth rate during the first 13 years of the twentieth century. Yearly growth rates reached levels of 9% in 1907 and 1911 and even 11% in 1912. Globally, between 1900 and 1913 the French GDP increased by 40% (Piketty 2006). This thesis builds inside the historical topic about how the "*Belle Epoque*" growth was financed. This issue has been addressed by taking separately into account the two main actors of the French financial system of the time.

On one hand, a large body of literature has been devoted to the fundamental role of the banking sector. This literature focuses in particular on short-term financing. The peculiar

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[1] Bozio (2002). The U shape of the financial development curb in several developed countries has originally been noted by Rajan and Zingales (2003).

characteristics of the banking sector of the time, mainly lead by four large deposit banks, was that of attracting as much short-term deposits as possible and to invest them in short-term activities[2]. The predominant role played by the commercial bill as the main financial instrument in use by deposit banks is clearly indicative of the short-term temporal horizon of this sector.

Another strand of literature has been dedicated to the role played by the stock exchange in the long-term funding of the economy (Hautcoeur 1994). This literature was mainly produced by economists. It focused on one side on testing the market efficiency hypothesis on different segments of the financial market (stocks, corporate bonds, French Government bonds, forward markets)[3], and on the other on accounting for the multi-polar architecture of the French and Parisian financial market, and on the microstructure elements determining its historical evolutions[4].

My thesis is precisely devoted to the articulation between these two aspects. Money and financial markets are never sealed off compartments. They always interact, as maturities transformations are one of the primary functions of financial markets and financial intermediaries. One of the main tools used to perform maturity transformation in 19th century's France were short-term loans against securities. These instruments attracted short-term capital investments and were backed by assets negotiated on the stock exchange, such as long-term bonds or private companies' stocks.

In France, the market for short-term loans against securities originally developed inside the stock exchange. Since the beginning of the 19th century, Paris stock exchange brokers began using *reports*, collateralized loans, as a way to finance forward markets[5]. In the stock exchange, forward contracts were centralized and cleared once a month, during the end-of-the-month settlement. In 1844, the stock exchange switched from a monthly to a bi-weekly settlement to reduce the risks of forward operations at each settlement date (Hautcoeur and Riva 2012).

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[2] See the works of M. Lescure, A. Plessis, and the second chapter of this thesis, for more precisions.
[3] The PhD theses of P. Arbulu, J.-M. Vaslin, A. Viaene, D. Lebris and A. Rezaee are examples of this recent literature.
[4] A non-exhaustive list of papers includes Riva and White (2011), Hautcoeur and Riva (2012), Lagneau-Ymonet and Riva (2017).
[5] Flandreau and Sicsic (2003) provide a seminal study of this market during the period 1870-1914. I am grateful to both authors for highly useful insights and suggestions.

Forward buyers were committed to fulfill their purchase obligation at the settlement date. *Reports* were created in order to bypass this duty and keep their position open up to the new settlement (after two weeks or a month). *Reports* coupled a sale of a security with the agreement to repurchase the same security at a fixed price on the following settlement.

At a settlement date, a forward buyer could be unwilling or unprepared to take possession of the security she purchased. Money lenders, such as banks and liquidity holders in trade and manufacturing, substituted forward buyers by purchasing assets at their place. Original buyers committed themselves to repurchase the security from lenders on the next settlement. The price of this transaction incorporated a remuneration, under the form of an interest rate, to the original price of the asset.

This way, *reports* resulted in short-term investments for banks as well as for trade and manufacturing firms. They invested their liquid assets for fifteen or thirty days and they made profits out of them. For forward buyers, *reports* were a way to finance their speculation and to postpone the moment of the final payment for two weeks or maybe for several months. At each settlement they only had to pay the interest rate asked by capital lenders for providing them with liquidity. Short-term lending financed long-term positions.

Evidence of *reports* in the Paris stock exchange dates as back as 1817[6]. The aftermaths of the 1818 crisis brought to the establishment of a Common Fund among stock exchange brokers (Hautcoeur and Riva 2012). The fund was created as a means to mutualize losses in moments of idiosyncratic shocks, and to provide single brokers with help in case of trouble. No later than 1819, brokers decided to invest the receipts of the Common Fund in *reports*[7]. This habit lasted throughout all the nineteenth century, becoming a potential source of issues in moments of generalized crisis, such as in 1882 and 1914[8].

*Reports* gained a particular importance during the 1870s bubble, when they accompanied the *Coulisse* rise and its fundamental role in financing the government debt issues of those years[9]. After the 1870 Franco-German war, the government relied on sovereign debt to

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[6] Compagnie des Agents de Change Archives (A-CAC), Minutes of the Chambre Syndicale's Meeting (PV-CS), November 6th, 1817.
[7] A-CAC, Minutes of the General Assembly (PV-GA), March 3rd, 1819.
[8] For 1882, see White (2007). For 1914, see the third chapter of this thesis.
[9] The Coulisse was the Parisian OTC-like market, a riskier segment of the financial market specialized in providing with liquidity and opacity informed investors (Hautcoeur and Riva 2012).

repay the war debt. In 1878, the so-called "Freycinet plan" financed an ambitious program of public works, especially in infrastructures, once again funded through the issue of debt. In both these situations, the liquidity gathered on the *reports* market was essential for the government to successfully perform the issue.

Since at least the 1870s, *reports* became the true pillar of the French money market. Literature focusing on London has often considered that the Parisian financial place lacked a truly developed money market (Michie 1999). This belief is based on the fact that the commercial bills market, which was the core of the European money market of the time, especially in London, was highly segmented in France.

On one hand, top deposit and private banks based in Paris participated to a small and selective interbank market in which they lent to each other against certain kinds of the best paper (White, 1978). On the other, regional and small banks that did not have access to this market had as primary source of financing the central bank discount window (Bazot, 2014). Therefore, they did not participate to a money market in the sense of a commercial bills market.

The interest rate practiced on the Parisian interbank market represented the lower bound of French interest rates, as only a few selected banks could trade on this market. These institutions also had access to the London money market through British offices (*Crédit Lyonnais* or *Société Générale*) or family networks (like in was the case for Rothschilds). This overseas connection had two consequences.

Firstly, interest rates practiced on the Parisian interbank market showed strong co-movements with the London money market rate (Bazot, Bordo, and Monnet 2016). Second, the existence of the Parisian interbank market was very well known in London, where it was considered "the" French money market. "The Economist" magazine published every week the interest rate done on this market, under the name of "Paris open market". The very existence of the reports market was disregarded.

Nonetheless, during the period 1880-1914, the French reports market negotiated much higher volumes than those exchanged on the small interbank market. It represented the primary outlet for short-term investments not only of banks, but also of industrialists and

liquidity holders in trade and manufacturing who wanted to invest their treasuries taking low risk (Allix, 1901).

The natural intermediaries were obviously the official brokers and the *Coulissiers*, the brokers-dealers operating on the unofficial exchange. At the same time, the 1870s and 1880s witnessed the development of a bunch of non-banking financial institutions especially dedicated to collect funds and invest them in reports (and, later, in advances against securities, as I show in chapter 1).

The 1880s and early 1890s were marked by the *Union Générale* crisis in 1882, the *Comptoir d'Escompte* crisis in 1889 and the Gold Mines crisis in 1895. In this thesis (chapters 1 and 2), I show that the market for short-term loans against securities became surer at the end of the Nineteenth and the beginning of the Twentieth centuries, and it evolved outside the stock exchange where it was originally born. These two aspects are strictly connected one with the other.

During the 1880s and especially the 1890s, large deposit banks and the Bank of France developed a collateralized borrowing instrument called advance on securities, and started competing on this market. The operation consisted in granting loans by demanding stocks and bonds as collateral. The clients of these transactions were mainly private individuals as well as industrialists, and trade and manufacturing firms. The Bank of France advanced only on very sure collateral – such as French state bonds – while deposit banks accepted almost every security negotiated on the French stock exchanges, though applying different margins according to the riskiness of the asset.

In 1898 a reform was passed, regulating the stock exchange and granting to the *Compagnie des Agents de Change* (CAC), the guild of official brokers, the monopoly of transaction on listed securities. One of the points of the reform involved that *coulissiers* and bankers had to pass through the intermediation of the official market for each transaction undertaken on listed securities[10]. The fiscal administration committed to enforce this particular point by suing those who illegally traded this kind of assets (Lagneau and Riva, 2017).

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[10] On December 31st, 1897, more than 1,700 securities were listed on the stock exchange, representing a market capitalization of approximately 11 billion francs, about a half of the French GDP.

As a consequence to the reform, banks had an incentive in reducing their repo investments and developing their advances on securities. The former were considered as stock market operations, and were therefore subject to the new law, while the latter were banking operations. No specific law regulated the banking system at the time: the only regulation applied was the general commercial law applied to any limited liability company.

Another aspect of the 1898 reform, studied in detail in the first chapter of this dissertation, deals with the reduction of risk in the repo market. By introducing a central clearing party together with a monitoring mechanism, the reform strongly reduced counterparty risk in the market. This resulted in a consolidation of the reputation of the Parquet and in an increase of its stability.

In the first decade of the Twentieth century, therefore, the market for short-term loans against securities became a two-leg market, both dominated by the main deposit banks. A part of the funds they collected among their numerous depositors were lent to stock exchange brokers under the form of repos, and another part to firms and individual clients under the form of advances on securities. The first leg allowed stock exchange brokers to keep the forward market functioning, the second allowed banks to expand their portfolio of short-term assets.

In the second chapter of this thesis I show that during this period, if a shock hit the economy, individuals and firms in need for liquidity for transaction or even precautionary motives could borrow against securities at deposit banks branches. This resulted in a sterilization of shocks, which had no negative effect on aggregate demand. The market for short-term loans therefore became a complete money market, useful not only to finance the economy in normal periods, but also to reallocate resources in periods of liquidity shortage. Nonetheless, this complex architecture, though carefully designed, did not resist to the arrival of World War 1, as I show in chapter 3.

The rest of this introduction is organized as follows. Firstly I broadly present the literature linked to this thesis. Second, I explain in detail the functioning of the French Historical Repo Market. Third, I present the data used in this thesis, and in particular data on repo rates and on volumes invested in repos and advances on securities. Finally, I briefly present each chapter.

## Literature

To the best of my knowledge, the only contemporary studies dedicated to the relationship between money market and financial market in history – that is, how short-term funds financed the stock exchange in the past – are the Flandreau and Sicsic (2003) article on the reports market, and two seminal articles by Rappoport and White (1993 and 1994) studying the role of brokers' loans in the emergence of the 1929 Wall Street crisis.

The two latter papers show the presence of a bubble on this market, finding a potential explanation to the abrupt collapse of the New York Stock Exchange. Flandreau and Sicsic (2003) find that on the contrary the repo market was a segment of the money market, barely influenced by the fluctuations of the stock exchange. A type of instrument similar to the French *reports*, even if quite different under many respects, was the Dutch *prolongatie*, to which Jonker (1997) dedicates a brief account.

A much wider literature can be found if we focus on contemporary money markets and their relationship with financial markets. Repo markets have become trillion dollars markets in the US, in Europe and in China, and are considered by both academics and policymakers as crucial for the financial market to get the liquidity they need to operate efficiently. The financial crisis of 2007-2009 has shed light on the key role played by the repo market freeze in the transmission of the shock from the subprime loans to the rest of the financial system.

The seminal works in this literature are the ones by Gary Gorton and co-authors (Gorton 2010, Gorton and Metrick 2010, Gorton and Metrick 2012, Dang, Gorton and Holmstrom 2013). These authors present the panic of 2007-2008 as a run on the repo market, arguing that repo finance was at the nexus of the crisis. Beyond discovering the fundamental role of repos during the crisis, this literature is characterized by the uncommon feature of having imposed a vocabulary. Repos and haircuts (a haircut is the difference between the market value of an asset used as loan collateral and the amount of the loan) are now, because of these authors, commonly used terms and concepts in finance and economics.

Subsequent literature has widely studied the repo market, mainly with respect to its relationship with the crisis. Copeland, Duffie, Martin and McLaughlin (2012), Begalle, Martin, McAndrews and McLaughlin (2013), Martin, Skeie, and von Thadden (2014), as well as Copeland, Martin and Walker (2014) study a segment of the repo market called "tri-party"

repo. This is a market in which the lender and the borrower do not directly interact: all transactions are mediated by a third party.

These authors find that, with respect to the bilateral repo market studied by Gorton and coauthors, the tri-party repo market did not experience the same level of distress during the 2007-2008 panic. Nonetheless, this literature also documents a sharp decline in tri-repo funding of Lehman brothers in September 2008. Moreover, it finds that this type of market can be subject to fire sales, that can have disruptive consequences on the financial market and on the overall economy.

Mancini, Ranaldo, and Wrampelmeyer (2015), Ebner, Fecht, and Schulz (2016), as well as Boissel, Derrien, Ors and Thesmar (2017) have the merit of focusing on the European repo market, that was resilient during the 2007-2009 crisis, mainly because it involved the presence of a clearing house. Nonetheless, this same market showed signs of distress during the European sovereign crisis of 2011.

The interest in studying financial crises and how to design financial market to be resilient to shocks lays well beyond the academic fields of financial economics or financial history, and has to do with the real effects of financial crises and their economic impact. The 2007-2009 crisis has played an important role in reopening the debate about such effects.

Building on the seminal contribution by Fisher (1933) and its re-elaboration by Bernanke (1983), recent literature has extended the so-called theory of debt-deflation to explain how financial crises can affect output. Schularick and Taylor (2012) and Jordà, Schularick and Taylor (2013), studying a panel of 14 advanced economies from 1870 to 2008, find that credit growth is a powerful predictor of financial crises, and that more credit-intensive expansions tend to be followed by deeper recessions and slower recoveries.

Focusing on more recent periods, Chava and Purnanandam (2011), Chodorow-Reich (2013), as well as Chaney, Sraer, and Thesmar (2016), study the effects of shocks in the financial market respectively on firms outcomes, employment outcomes and corporate investments. All these studies contribute to shaping the certainty that financial systems are not irrelevant in the understanding of economic outcomes.

This review of the literature is far to be exhaustive, and is thought to provide a general idea of the research streams this dissertation is related to. Each chapter of my thesis is then

specifically linked to a particular literature. Chapter 1 deals with tri-party repo markets, and the consequences of introducing central clearing houses in these environments. Recent reform proposals aiming at implementing CCPs in the US repo market have been advanced by Martin (2015), Baklanova, Dalton, and Tompaidis (2017), and Duffie (2017).

Chapter 2 is related to the literature on the so-called "credit channel" of monetary policy transmission. The most recent papers linked to my contribution are those by Kashyap and Stein (2000), as well as Ciccarelli, Maddaloni, and Peydrò (2015). Finally, the third chapter of my thesis deals with the literature on the role of Lenders of Last Resort (LOLR). Freixas and Parigi (2014) is a recent and complete review of the literature on the subject.

### A Brief Introduction to the Repo Market

In this section I technically describe the financial instrument called *report* or historical repo, and how it was negotiated and priced in France during the long Nineteenth century. A repo or repurchase agreement is a contract that couples a sale on the spot market with the commitment to repurchase the same assets at a fixed price on a fixed future date.

A *report*, repurchase agreement, or repo, has two legs[11]. Figure 1 represents a typical repo transaction. In the opening leg, the money borrower sells stocks or bonds to the money lender in order to get cash. This first part of the transaction takes place on the spot market, that is to say for immediate delivery. The closing leg of the repurchase agreement takes place at a future date, fixed at the beginning of the transaction. On this future date, the money borrower must repurchase the stocks or bonds she originally sold, at a price equal to the original asset value plus a repo price that incorporates the interest rate.

A repurchase agreement is therefore a loan. But it is a particular type of loan, during which the ownership of collateral is transferred from the borrower to the lender, who enjoys full ownership rights over the assets. In case of default of the borrower, the lender can dispose of the collateral security and sell it on the market. Repos, therefore, provide lenders with an additional guarantee with respect to a typical loan.

The *report* was the French historical equivalent of a repo. It was a financial instrument that in the Eighteenth, Nineteenth and part of the Twentieth century was used to provide with

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[11] In this thesis I use the three terms as synonyms.

liquidity the stock exchange. It was the short-term segment of the financial market: the contracts lasted 15 or 30 days at most. At the end of the period, they could be rolled over. Therefore, reports can be considered monetary assets. They were used by large and small investors who wanted a short-term and not too risky outlet for their savings. Money lenders were mainly banks, industrial firms and retailers investing their liquid assets, and individual investors[12]. Money borrowers were mainly bullish forward traders willing to roll over their open positions, and needed liquidity to do so.

All operations in the Paris official stock exchange were mediated by pure brokers. The latter were called *agents de change*. They collected sale and purchase orders in behalf of their clients, and performed multilateral netting among them. Brokers were responsible for payment to their clients and fellow brokers. As a consequence, they were exposed to bankruptcy if their clients defaulted (Hautcoeur and Riva, 2012).

*Agent*'s responsibility involved their personal wealth, as well as their seat's. Every seat had its own capital, shared by the broker with his associates. Number of brokers was fixed by the government[13]. They were organized in a guild-like organization called *Compagnie des Agents de Change* (CAC). They were not allowed to undertake financial trade for their own sake, and made profits through commission fees.

The Paris market was primarily a forward market. Forward trading on the stock exchange was highly developed at the time. It represented three times the French GDP (Lagneau-Ymonet and Riva, 2017). Forward contracts were done on the basis of central settlements. At the settlement date, forward buyers were committed to fulfill their purchase obligation.

Central settlements had been created as a way to perform net multilateral compensations and to reduce the need for liquidity of the exchange. The official stock exchange organized 24 settlements per year, at the fifteenth and at the end of each month. Forward contracts could be concluded for delivery in two weeks to six weeks at most. Surest securities, such as those issued or guaranteed by the State, were only subject to the end-of-the-month settlement. The *agents de change* considered that it was not necessary to assess and net positions on these securities more often, because of their nature.

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[12] Archives Nationales, Alexandre Ribot personal archives, Lettre de M. Ribot à M. Pallain, November 7, 1914, 563/AP/16. See also François Marsal (1930).

[13] There were 60 of them up to 1898, and 70 afterwards.

Every 15 or 30 days, according to the riskiness of the asset, sellers and purchasers on the forward market were committed to fulfill their obligations and delivery the assets, or pay their price. *Reports* were created in order to bypass this duty and keep investors positions open up to the new settlement (after two weeks or a month). By means of a repo, investors coupled a sale of a security with the agreement to repurchase the same security at a fixed price on the following settlement.

When the settlement approached, bullish forward traders transmitted their orders to their *agents de change* or *coulissiers*. They could either fulfill their purchase obligation and put an end to the transaction, or roll over their position to the following settlement. In the latter case, the broker had to find counterparty for his clients. In other words, he had to find someone providing the amount of cash needed to postpone the final repayment by 15 or 30 days.

To do so, he matched at first opposite orders among his own customers. In the second place, he compared his net position with those of his colleagues, looking for positions of opposite sign. Typically, forward purchases outnumbered forward sales, leaving a need for cash.

In order to raise this money and clear the market, the first step consisted for *coulissiers* to invest a part of their own liquidity, and for *agents de change* to use a fraction of their seat's capital. Then, brokers at an individual and at an aggregate level called in another type of actor. Among brokers' clients there were banking, trading, and industrial firms, as well as individual investors, in possession of liquidity. This kind of customers acted as repo lenders. They entered the transaction by coupling a purchase on the spot market with a sale of the same asset on the following settlement.

From their point of view, this double operation was nothing but a money-lending transaction lasting the time of a settlement, 15 to 30 days according to the riskiness of the security. Remuneration was given in the form of an interest rate. This way, *reports* resulted in short-term investments for banks as well as for trade and manufacturing firms. They invested their liquid assets for fifteen or thirty days and they made profits out of them. For forward buyers, *reports* were a way to finance their speculation and to postpone the moment of the final payment for two weeks or maybe for several months. At each settlement they only had to pay the interest rate asked by capital lenders for providing them with liquidity.

## Data

In this section I present the datasets I constructed and used in this thesis. Firstly I describe the database collecting interest rates done on the repo market from 1880 to 1913. Second, I take into account two series of volumes. One deals with the total amount of funds that the official brokers received by their clients to be invested on the repo market. The other presents the series of short-term investments by the four main deposit banks on the overall short-term collateralized lending market, that is repos and advances on securities, on a monthly basis from 1890 to 1913.

## Rates

I have all repo prices and settlement prices done on the *Parquet* for all end-of-the-month settlements from January 31$^{st}$, 1880, to December 31$^{st}$, 1913. I personally hand-collected most of them from the original source, the Paris Stock Exchange Official Lists. I deeply thank the Equipex DFIH for providing me with the remaining data. All data are now in the DFIH Database. (Hautcoeur and Riva, 2012). I exclude mid-month settlements in order to have homogeneous series, as surest collateral assets were only negotiated once a month.

Repo prices were published at each settlement on the Official List in a specific column. The official list was an essential element in the functioning of the Parisian market at the end of the Nineteenth century. This publication had its origin on September 24th, 1795 (more precisely, on 2 vendémiaire, an 4) and it was published at the end of every stock market day following the prescription of the law. Before 1867, only public-owned securities (state and city bonds, railways stocks) were present on the cote, together with the bonds and stocks of those companies which had received the authorization of the government.

On the official list, the agents de change had to write all the spot prices at which a security had been negotiated during the day, while for forward markets the procedure was to publish only four prices a day: the first negotiated, the last one, the lowest and the highest. The official list contained other pieces of information on the securities and their issuers. The prices of reports began to be published on the cote in 1825, twenty years before the appearance the forward market prices: this gives an idea of the importance of this market.

The daily publication of an official list containing information on all prices done on the stock exchange (and among them repo prices) had the aim of protecting small investors. According

to contemporary authors, the official list contributed to the well-functioning of the stock exchange by publicly revealing prices, otherwise opaque (Leroy-Beaulieu 1897).

Repo prices were the prices paid by repo borrowers to roll over their position from a settlement to the following on each collateral security. Settlement prices were used to clear all forward contracts, not only repo transactions. They were created to balance out different forward orders placed at different prices for the same security.

In the repo market, settlement prices were used to fix the market value of each security. In case of repo chains, when a forward position was rolled over from a settlement to the following, the settlement price of the collateral asset worked as the reference price over which the interest rate was calculated. In case of a new repurchase agreement, coupling a sale on the spot market with a repurchase on the forward market, settlement prices were the spot market prices used as a reference for repo spot sales.

Figure 2 shows how information was organized on the Paris stock exchange official list. For each security used as collateral in at least one repo transaction, the official list published the repo prices and the settlement price. The number of total collateral assets, and therefore repo rates, ranges from 64 on January 31st, 1880, to 289 at the end of 1913. The average over the period is 144 rates, and the total sum over the 408 months is 58,786 rates. Figure 3 presents the evolution of the total number of collateral assets that were used for at least a repo negotiation over the period. In Table 1 I present some descriptive statistics of my database in seven points in time, from 1880 to 1910 included. This table can be read as follows.

At the settlement of the end of December, 1880, 69 securities were used as collateral on the repo market. 40 of them were French private stocks, representing 57,97% of the total amount. 12 of them were foreign private stocks, representing 17.39% of the total amount. As a whole, the repo market was therefore done on stocks as collateral assets in 1880. Stocks represented three fourth of the market.

In the 1890s and at the beginning of the 20th century, the number of foreign securities progressively outnumbered that of French assets used as collateral. At the settlement of the end of December, 1900, 105 out of 184 assets used as collateral on the repo market were foreign stocks or bonds (57.06% of the total). Ten years later, at the settlement of the end of

December, 1910, foreign assets represented the 62.02% of the total. This tendency was due to the admission on the forward market of an increasing number of foreign railways bonds, as well as bank stocks and public debt certificates.

(Table 2)

Table 2 presents how volumes invested in the repo market were shared among different types of collateral assets. This type of information was not public, and only thorough archival research has allowed me to disclose it for two dates, in 1906 and 1914. During this period, 5% to 10% of the overall volumes were invested on different types of French *Rente*. This was the surest part of the market. Most of the market was done on foreign stocks and bonds (67% in 1906, leaving only a 33% to French securities). Each of the two groups was characterized by a strong heterogeneity. Not necessarily French securities were surer than foreign ones.

In Figure 8 I plot all the rates I have in my database. The graph has to be read as follows. The scale on the ordinate axis is logarithmic, but the legend shows actual interest rates (.032 = 3.2%; .316=31.6%). The Tukey box plot represents in green, for each end-of-the-month settlement, the range including the reports rates between the first and third quartile (the 50 % central rates). In grey, the two ranges obtained starting from the two quartiles and then adding ± 1,5 Interquartile Ranges (once again, the difference between the third and first quartile). In blue, all other rates.

Volumes

To the best of my knowledge, there exists no study providing estimates of the volumes exchanged on the reports market. Using a new entirely hand-collected dataset and a novel method, I manage to compute approximations for the volumes exchanged on the Paris Stock Exchange reports market on 16 dates between May 1900 and October 1912. I provide for the first time an order of magnitude for this market.

Data on volumes come from the accounts entries verifications of Parisian brokers. Starting from the settlement of the January 1901, the syndic (the head of the CAC) imposed to each agent de change to provide to his deputies precise information on the total amount of the

funds invested in reports by their offices[14]. This piece of information had to be supplied twice a year, at variable dates depending on the occurrence of special events.

The syndic, Maurice de Verneuil, had put in place this practice as a means to control his fellows and reduce moral hazard. Riva and White (2011) show that Verneuil, elected in 1896, passed in the first years of his mandate several measures addressed at fighting moral hazard. This eventually resulted in a major reduction of the dispersion of repo rates in the market, as I show in Chapter 1, associated to a strong reduction of the risk perceived by investors.

Unfortunately, archives are incomplete, and this piece of information is not always available for each agent's file and for each date. For some cases, information on the total amounts is there but without any date. Nonetheless, for 16 dates I have information on 70% or more of the Parisian brokers, with a peak of 87.14% of agents covered for the settlement of the end of February, 1904. I discarded all dates for which I have information on less than 70% of the agents de change. Table 3 presents a summary of the number and percentage of brokers covered for each of the dates I used.

Using these data, I compute estimates of the total funds invested on reports market on the Parquet for each of the 16 dates. The idea at the basis of the procedure is that of respecting as much as possible the distribution of the volumes across agents de change. At the end of the procedure, I have 70 observations for each date, composed by the original sample and by randomly selected observations to fill the missing data.

The method I use is the following. First, I plot in Figure 4 the distribution of the volumes by broker, for each of the 16 retained dates, and I represent the distribution by histogram and by kernel density distribution. Figure 4 compares the Parzen-Rosenblatt distribution with a normal distribution for each of the 16 dates. It clearly shows that funds employed by each agent's office were far to be normally distributed. Therefore, it makes no sense to multiply the sample mean on each date by 70 (the total number of brokers) in order to obtain the total amount invested in the market.

Second, using the Epanechnikov (1969) method, I determine the smoothing bandwidth of the kernel-density (Parzen-Rosenblatt) distribution for each date. The algorithm divides the distribution in bandwidths, that is in segments that include portions of the distribution of

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[14] CAC's CS meeting minutes (A-CAC, MCS), January 9th and January 25th, 1901.

funds. Third, for each date I split the original sample into groups according to the bandwidth determined by the algorithm.

Fourth, I let a statistical software randomly select n observations from the sample, respecting the relative weight of each group, where n = 70 – (dimension of the original sample). I sum the 70 observations for each date and find the results presented on Figure 4. Over the period 1900-1912, the agents de change negotiated from a minimum of 870 million francs to a maximum of 1500 million francs per settlement in the official repo market.

These figures are consistent with several historical sources. Allix (1900) distinguishes between funds employed by agents de change on the account of "normal" clients, and funds invested by bankers. The first ones represented between 350 and 370 million francs each settlement, the second between 250 and 300. For the period around 1900 the total sum should therefore be between 600 and 670 million francs. The figure I find for the end of May, 1900, is 764 million francs.

Estimates by Tennenbaum (1919) speak of 650 million francs invested in the reports market at the moment of the outbreak of World War One. An official speech at the Parliament on September 1915 by Alexandre Ribot, the Minister of Finance, confirms this figure. In this same context, the Minister admits that before the 1912 Balkan crisis, the total amount was a lot higher. On December 2, 1907, a newspaper article critical towards the "corporation" of Parisian brokers recognizes that the one billion francs per settlement estimate provided by the agents de change is "a bit exaggerated" but credible[15]. This figure is consistent with the figures I find.

It is worth noticing that this figure only deals with the amounts negotiated on the official stock exchange. A part of reports (a half of them in 1898, according to Charousset 1898) were exchanged on the OTC market, the Coulisse. Moreover, these figures relate to the 20th century only. As I show in Chapter 1 of this dissertation, before the 1898 reform the volumes exchanged on this market were much higher.

A way to estimate the evolution of volumes invested by large deposit banks on this market, and on the market for advances on securities, from 1890 to 1913, is to take a look at their balance sheets. After the 1882 *Union Générale* crisis, the main credit establishments started

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[15] La Cote de la Bourse et de la Banque, December 2 1907.

publishing their balance sheets with monthly frequency on the economic and financial press. There was no legal duty to do so: the law only required an annual statement at the end of the year. *Crédit Lyonnais* and her colleagues opted for this practice as a form of advertisement based on transparency, in order to attract deposits. Small banks did not do so.

The main sources I use are the *Cote de la Bourse et de la Banque* and the *Economiste Français*. The former was a prominent daily financial newspaper edited by Emmanuel Vidal, previously a dealer on the *Coulisse*. The latter was an important economic and financial magazine issued weekly and edited by Paul Leroy-Beaulieu, member of the *laissez-faire* minded *Société d'Economie Politique* and Political Economy professor at *Collège de France*.

The items I collected are the ones related to the main money market instruments. The main item is "*portefeuille commercial*", which evaluates for each bank the value of the bills of exchange held by the institution and ready to be discounted at the Bank of France at in case of need. The second item I collected is "*avances sur garanties*". This item contains the amount of advances granted by the bank, against any type of pledge. Securities were by far the most employed type of collateral[16]. Let us note that the amount does not correspond to the market value of the securities, as the banks applied a margin to each advance granted.

The third item for which I collected data is "*reports*". The figure corresponds to the total amount of cash invested in the market, that is to say lent to stock market intermediaries against collateral in account for the end-of-the-month settlement.

Crédit Lyonnais started only around 1898 to distinguish in its public statements between repos and advances, which were summed in a unique balance sheet item beforehand. I therefore used internal accounting documents to separate the two before 1898. Unfortunately, the series of internal documents only starts in 1890 and presents yearly data. Given that Crédit Lyonnais was by far the main single investor in the market, no interpolation from other banks' data is possible before 1890.

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[16] A series conserved at *Crédit Lyonnais* Archives (31 AH 85 to 31 AH 310) contains precise information on the type of collateral accepted by this bank, which was by far the largest of the market. Moreover, during certain sub-periods of my study, *Crédit Industriel et Commercial* in its reports distinguishes between advances collateralized by securities and advances collateralized by other types of pledge. Securities were the main type of collateral for both the institutions.

Figure 6 shows the sum of balance sheet assets items representing short-term loans (commercial paper, advances on securities and historical repos[17]) as a fraction of total assets for the four main commercial banks of the period. During the period 1890-1913, they represent more than a half of deposit banks total assets. Figure 6 also allows to notice that, during the last ten years of this study, the amount of repos as a fraction to total assets was strongly reduced.

Figure 7 shows the total amount of advances granted against securities, the total amount of funds invested on the repo market, and the total amount of deposits at the 31/12 of each year from 1890 to 1913 in the balance sheets of the four main deposit banks plus the biggest financial institution specialized in short-term investment. The graph allows to assess the relative development of repos and advances on securities. Repos were progressively outnumbered by advances. The proportion became of 1:2.5 at the end of the period.

The banks considered in Figure 7 are *Crédit Lyonnais*, *Société Générale*, *Comptoir d'Escompte* and *Crédit Industriel et Commercial*. The financial institution is the *Société Française des Reports et Dépôts* (SFRD), founded in 1881 and considered by contemporary authors as a serious institution. The figure represents the total amount of funds invested in repos and advances by these institutions (scale on the left), and the total deposits collected by these institutions (scale on the right, in blue). The sums of balance sheet items are calculated for December 31st of each year from 1890 to 1913.

Figure 7 shows that since 1890 and until 1897, the rate of growth of repos and advances is comparable to that of deposits. Starting from the 1898 reform, advances overtake repos, a tendency that becomes even more marked in the first decade of the 20th century, once the reform was fully implemented. In 1898, each month's "place position" amounted to 3 billion francs on the *Parquet* alone[18]. In September 1911, just before the so-called Agadir crisis, the amount was reduced by a half: 1.4 to 1.6 billion francs according to different sources[19].

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[17] Flandreau and Sicsic (2003), Ungaro (2018).
[18] See Charousset (1898) and Allix (1901).
[19] The first figure is given by the CAC's *syndic* two months after the crisis (A-CAC, MCS, 11 November 1912). The second by the 1915's Finance Minister, Alexandre Ribot. (Intervention of Mr. Ribot at the *Assemblée Nationale*, in response to the interrogation of Mr. Monzie, on September 23rd, 1915).

Summary of the Dissertation

The first chapter of this thesis, drawing on a historical example, studies the introduction of a central clearing party (CCP) in the French repo market between 1880 and 1913. I build a new and large original database including hand-collected repo rates, macroeconomic variables and security-specific factors. I perform a structural break test and I apply a difference-in-differences estimator to a panel data model to study the impact of an 1898 reform introducing a CCP on the market.

I find that this regulatory change strongly reduced counterparty risk. Monitoring measures introduced to deal with moral hazard issues were crucial in shaping investors behavior. I also document a side effect of the reform. Volumes exchanged on the repo market decreased in favor of collateralized loans directly granted by deposit banks to their clients.

In the second chapter, entitled "How does the bank lending channel work? Monetary policy transmission in France, 1890-1913.", I study the instruments through which the Bank of France managed its monetary policy before WW1. I focus on the role of the banking sector. I build from archival sources the first dataset collecting balance sheets of French banks on a monthly basis over the period 1890-1913. I adopt a standard VAR methodology to account for the linkages between the banking sector and the real economy.

I find that the Bank of France developed the practice of advancing against securities in order to build a direct channel to provide with credit the economy. This practice was later adopted by deposit banks too. When a shock hit the economy, individuals and firms borrowed against securities at the central bank and at the deposit banks branches. This resulted in a sterilization of shocks, which had no negative effect on aggregate demand.

In the third and final chapter of this dissertation I study another dimension of the link between the central bank and the repo market. I show both qualitatively and quantitatively that during WW1 the Bank of France did not act as a Lender of Last Resort (LOLR), and applied credit rationing especially towards the repo market internal to the stock exchange.

The reasons of this behavior must be sought in concerns about the renewal of the monopoly of notes issue and about the possible devaluation of the French Franc. The choice of not acting as a LOLR contributed to the rise of a panic that had international repercussions and was only stopped by a series of moratoria on outstanding debts imposed by the government.

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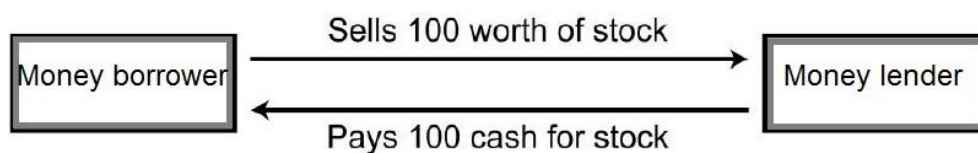Dang, T. V., Gorton, G., & Holmström, B. (2013). *Haircuts and repo chains*. Working paper.

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Figures and Tables

## Opening leg:



## Closing leg:
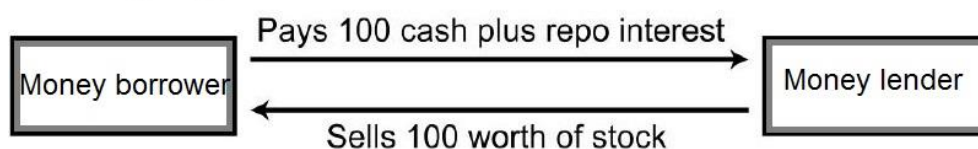


**Figure 1 – A repo transaction.**



**Figure 2 - Extract of the page 2 of Paris Stock Exchange Official List, January 31st, 1911. Courtesy of Equipex DEFIH. DEFIH database (Paris School of Economics), version 25 March 2016. Hautcoeur and Riva (2014), The Data for Financial History Database.**
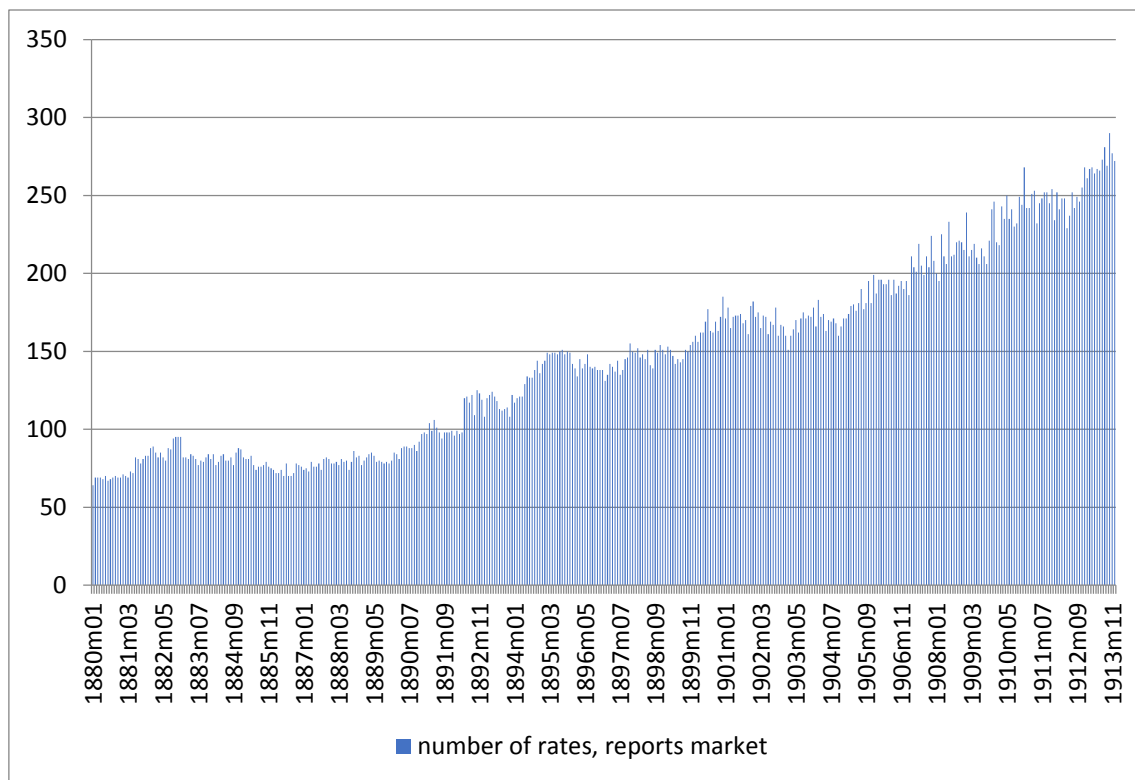
**Figure 3 - Number of rates, reports market, Paris Official Stock Exchange, 1880-1913. Source : my elaboration from data published on Paris Stock Exchange Official Lists, and collected partly by me and partly in the context of Equipex DFIH.**
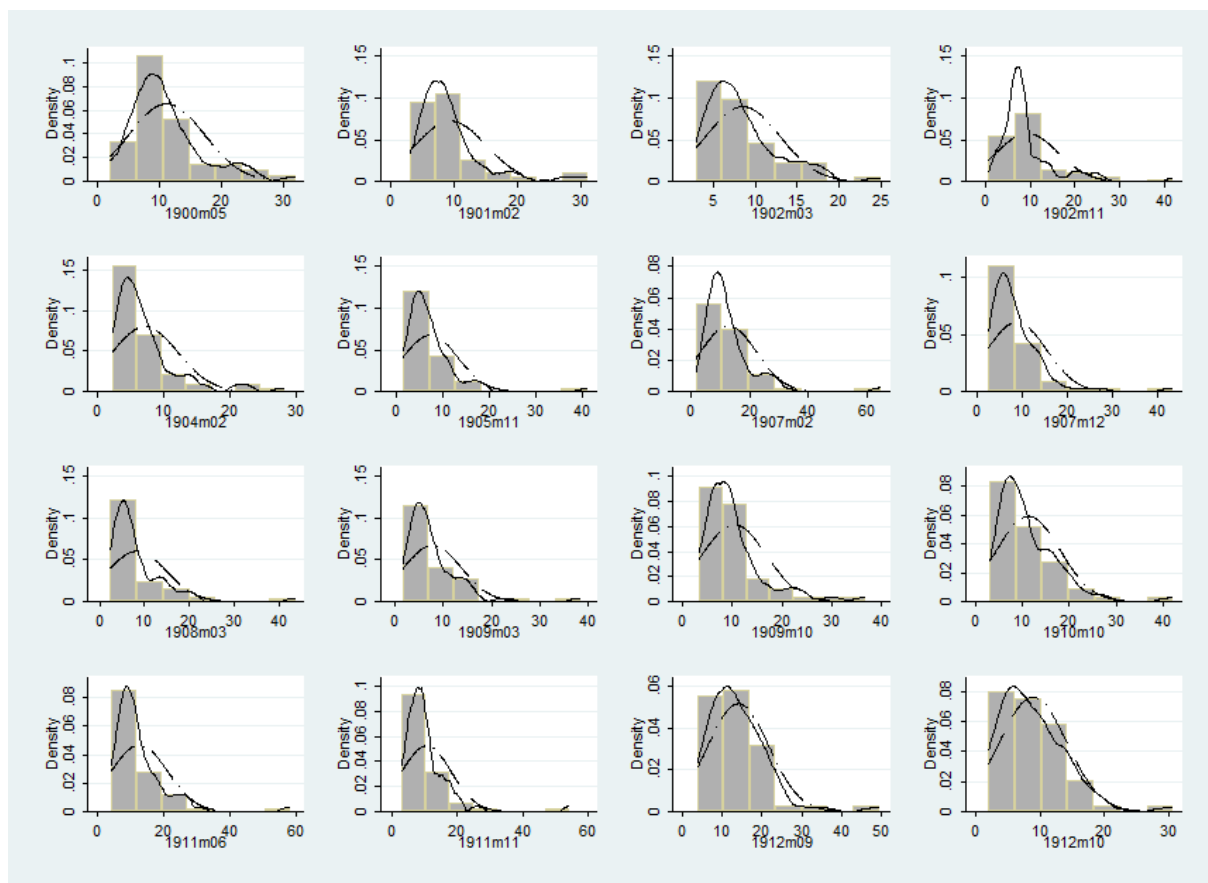
**Figure 4 - Histograms, kernel density (Parzen-Rosenblatt) distributions and normal distributions for the 16 dates. On the horizontal axes, millions of francs.**
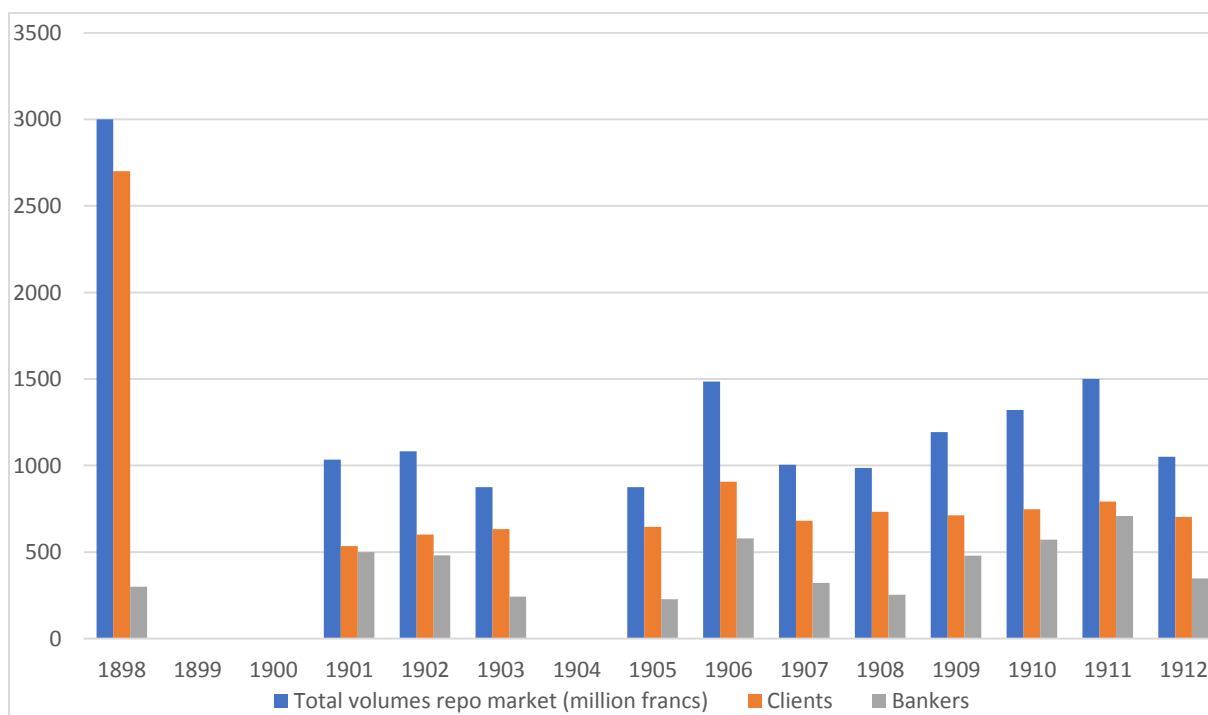


**Figure 5 - Funds invested on official repo market, 1898-1912. Sources: Charousset (1899) for 1898. Accounting verifications (CAC archives) for 1901-1912 (excluding 1906). Internal study by CAC for 1906.**
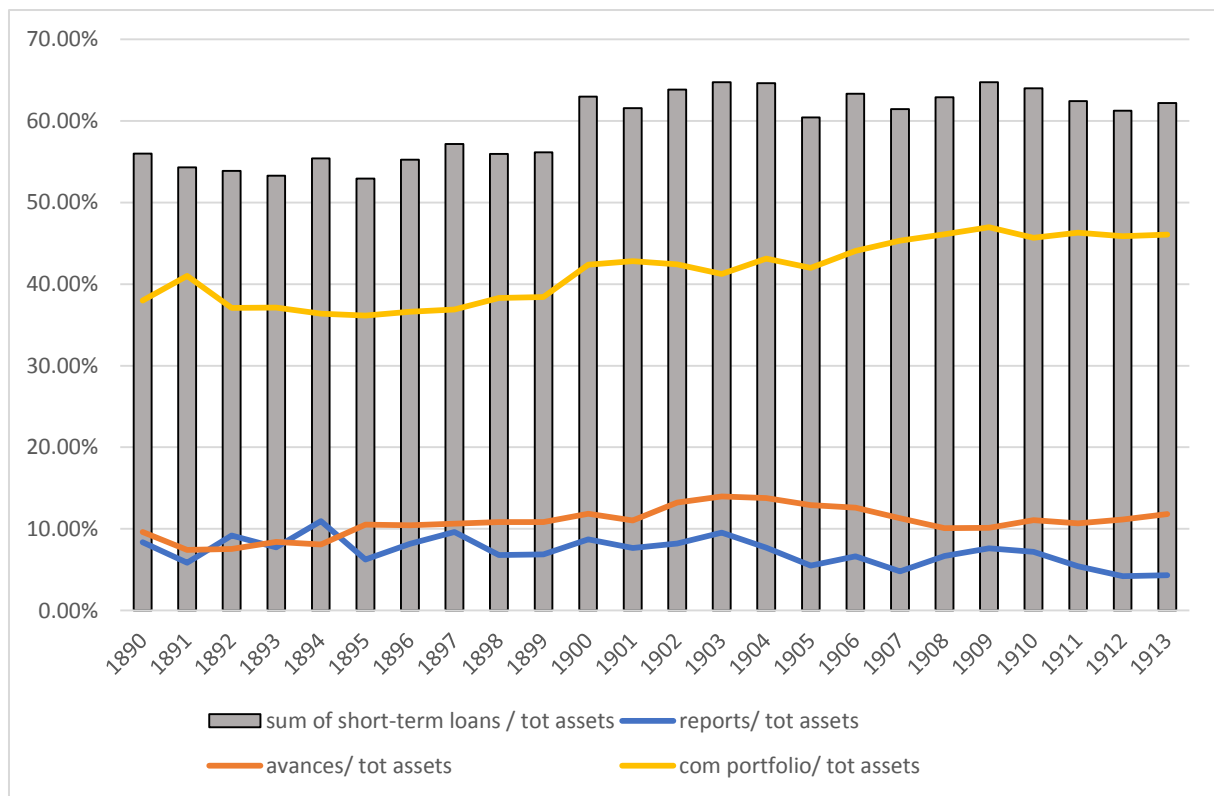
**Figure 6 - Evolution of the three items related to short-term loans published in the balance sheets of the four main commercial banks, as a fraction of total assets, and their sum. Data are based on yearly balance sheets published on December 31 of each year of the 1890-1914 period. Source: author's DB**
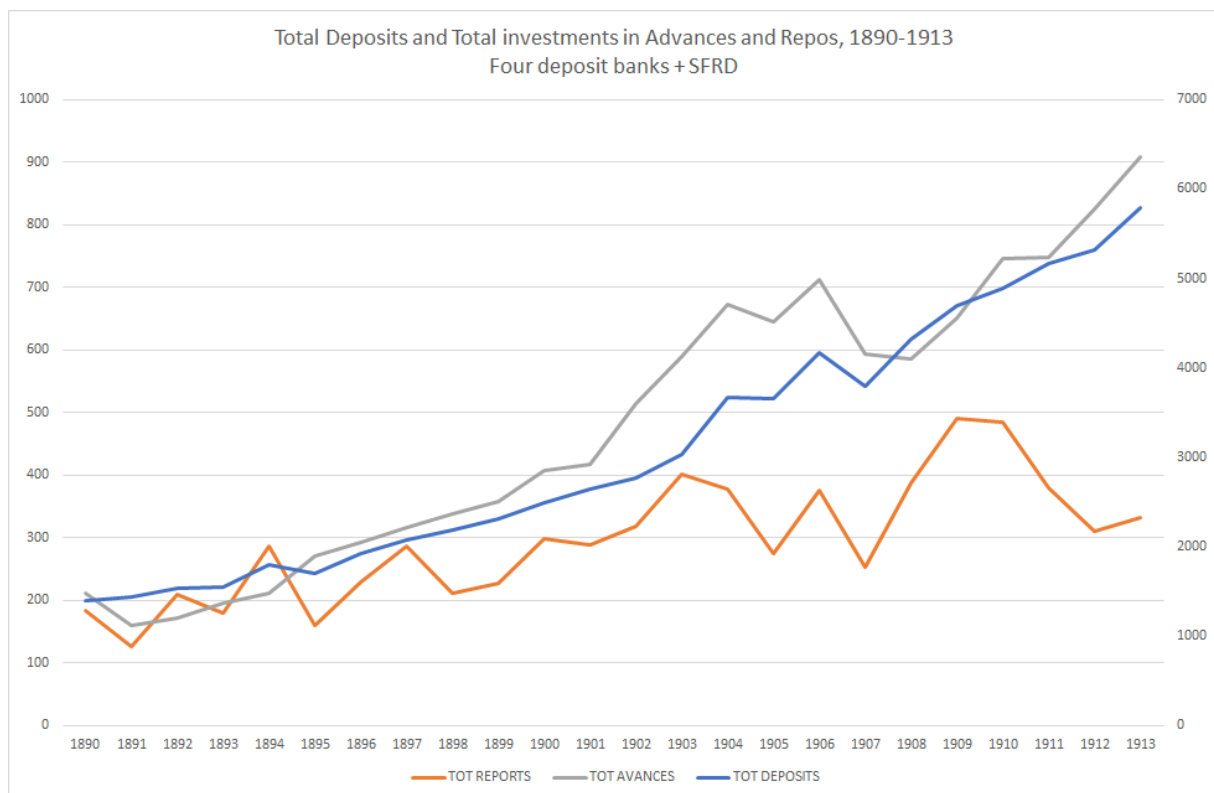


**Figure 7 - Total amount of funds invested in repos and advances, and total amount of deposits (scale on the right), by the four main investment banks and a firm specialized in short-term investment. Balance sheets data from December 31st of each year from 1890 to 1913. Source: author's DB.**
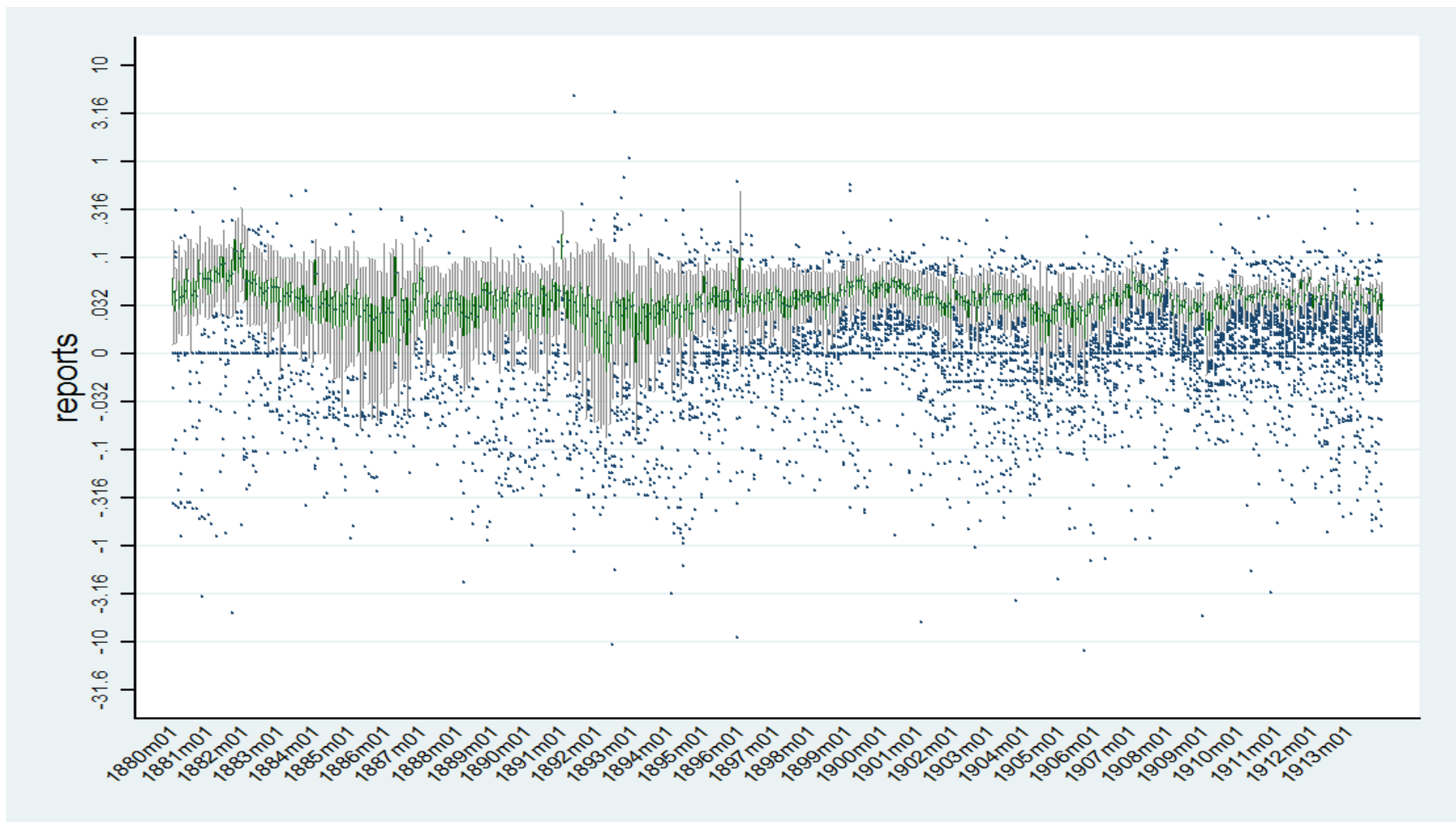
Figure 8 - Tukey box plot. In green, for each end-of-the-month settlement, the range including the reports rates between the first and third quartile (the 50 % central rates). In grey, the two ranges obtained starting from the two quartiles and then adding ±1,5 IQR. In blue, outliers. On the ordinate axis, logarithmic scale. Legend of Y axis shows actual interest rates (.032 = 3.2%; .316=31.6%). Source : my elaboration from data published on Paris Stock Exchange Official Lists, 1880-1913, and collected partly by me and partly in the context of Equipex DFIH. DFIH database (Paris School of Economics), version May 2017. (Hautcoeur and Riva, The Data for Financial History).

| Type of security/issuer | 1880 | 1885 | 1890 | 1895 | 1900 | 1905 | 1910 |
|---|---|---|---|---|---|---|---|
| French pvt stocks | 40 | 40 | 50 | 44 | 58 | 65 | 75 |
| | 57,97% | 53,33% | 51,55% | 31,21% | 31,52% | 32,83% | 28,09% |
| French public bonds | 3 | 4 | 3 | 6 | 8 | 8 | 7 |
| | 4,35% | 5,33% | 3,09% | 4,26% | 4,35% | 4,04% | 2,62% |
| French pvt bonds | 4 | 3 | 2 | 8 | 13 | 11 | 17 |
| | 5,80% | 4,00% | 2,06% | 5,67% | 7,07% | 5,56% | 6,37% |
| Foreign pvt stocks | 12 | 18 | 17 | 20 | 33 | 43 | 58 |
| | 17,39% | 24,00% | 17,53% | 14,18% | 17,93% | 21,72% | 21,72% |
| Foreign public bonds | 10 | 10 | 25 | 41 | 50 | 54 | 79 |
| | 14,49% | 13,33% | 25,77% | 29,08% | 27,17% | 27,27% | 29,59% |
| Foreign pvt bonds | 0 | 0 | 0 | 22 | 22 | 17 | 31 |
| | 0,00% | 0,00% | 0,00% | 15,60% | 11,96% | 8,59% | 11,61% |
| TOTAL | 69 | 75 | 97 | 141 | 184 | 198 | 267 |

Table 1 – Number of securities used in at least one repo transaction done on the Parquet on the 31/12 settlement, and relative proportion with respect to the type of underlying collateral asset. Source: Data collected by the author on Paris stock exchange official lists, and integrated with information coming from DFIH database, version May 2017 (Hautcoeur and Riva, The Data for Financial History).

| Type of security | 1906 | 1914 |
|---|---|---|
| French perpetual bonds | 5.39% | 9.41% |
| French shares and bonds | 27.45% | - |
| Foreign public bonds | 31.08% | - |
| Foreign shares and bonds | 36.08% | - |
| French bonds, very good quality | - | 1.35% |
| French shares, very good quality | - | 5.41% |
| Public and private foreign bonds, good quality | - | 18.89% |
| Industrial shares, good quality | - | 27.71% |
| Overpriced industrial shares | - | 34.16% |
| Bad or very bad industrial shares | - | 3.06% |
| Total | 100% | 100% |

Table 2 - Shares of volumes invested in the Paris repo market, by type of collateral asset. Sources: Figures for 1906 come from A-CAC, B-0064877/1,'L'Impôt sur les operations de bourse'. Figures for 1914 come from A-BDF, 1069200401/147, 'Note de la CAC concernant la liquidation de Juillet 1914, July 7, 1914'.

| Date | Number of brokers covered | Percentage covered |
| --- | --- | --- |
| 31/05/1900 | 49 | 70.00% |
| 28/02/1901 | 50 | 71.43% |
| 31/03/1902 | 55 | 78.57% |
| 30/11/1902 | 62 | 88.57% |
| 28/02/1904 | 61 | 87.14% |
| 30/11/1905 | 59 | 84.29% |
| 28/02/1907 | 59 | 84.29% |
| 31/12/1907 | 56 | 80.00% |
| 31/03/1908 | 57 | 81.43% |
| 31/03/1909 | 56 | 80.00% |
| 31/10/1909 | 59 | 84.29% |
| 31/10/1910 | 58 | 82.86% |
| 30/06/1911 | 56 | 80.00% |
| 30/11/1911 | 57 | 81.43% |
| 30/09/1912 | 58 | 82.86% |
| 31/10/1912 | 58 | 82.86% |

Table 3 - Information on volumes, 1900-1912. Source : My DB.

# Chapter 1. Do Central Clearing Parties Reduce Risk on Repo Markets?

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Drawing on a historical example, I study the introduction of a central clearing party (CCP) in a tri-party repo market. I focus on the French repo market between 1880 and 1913. I build a new and large original database including hand-collected repo rates, macroeconomic variables and security-specific factors. I perform a structural breaks test and I apply a difference-in-differences estimator to a panel data model to study the impact of an 1898 reform introducing a CCP on the market. I find that this regulatory change strongly reduced counterparty risk. Monitoring measures introduced to deal with moral hazard issues were crucial in shaping investors behavior.

JEL codes: E43 G12 G23 N23

Keywords: Clearing House, Repo Market, Paris Stock Exchange

1. Introduction

During the financial crisis of 2007-2009, the U.S. tri-party repo market, a large funding market used by banks to raise short-term loans, played an important role in elevating and propagating risk[2]. At the same time in Europe, the central clearing party (CCP)-based euro interbank repo market displayed remarkable resilience[3]. This difference in behavior suggests that developing a CCP could help deal with repo market fragilities[4]. Nonetheless, because of a lack of empirical evidence, no study analyzes the introduction of a CCP in a repo market.

In my paper, I use a historical case to address this question. I focus on the French historical repo market between 1880 and 1913[5]. In 1895, an international crisis hit the financial market. In the aftermath of the crisis, a reform was passed and a CCP was introduced. I build a new and large original database including hand-collected repo rates, macroeconomic variables, and security-specific factors, to study the pricing mechanisms at work before and after the shock. Using a difference-in-differences estimator applied to a panel data regression, I find that the regulatory change strongly reduced risk on the market. Monitoring measures introduced to deal with moral hazard issues were crucial in this respect. After the reform, no major crisis hit the Paris market until WW1. France even became a "safe haven" for capital during the 1907 international crisis[6].

A repurchase agreement, or repo, is the sale of an asset coupled with the agreement to repurchase the same security at a specific future date at a fixed price. Said differently, it is a collateralized loan during whose validity the lender enjoys full ownership rights over the underlying security. The repo market is large. The total value of repo contracts outstanding in June 2017 was 6.5 trillion euros ($ 7.55 trillion) in Europe[7], and 4 trillion dollars in the US[8]. Put together, these figures amount to one third of the sum of US and EU GDPs.

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[2] On the role played by the tri-party repo market in relation to the failures and near-failures of Countrywide Securities, Lehman Brothers, and Bear Sterns, see Copeland, Duffie, Martin, and McLaughlin (2012), Krishnamurthy, Nagel, and Orlov (2012), Adrian, Begalle, Copeland, and Martin (2013), Copeland, Martin, and Walker (2014), as well as Begalle, Martin, McAndrews, and McLaughlin (2016) among others.
[3] See Mancini, Ranaldo, and Wrampelmeyer (2015), and Ebner, Fecht, and Schulz (2016).
[4] See Martin (2015), Baklanova, Dalton, and Tompaidis (2017), and Duffie (2017) for recent reform proposals.
[5] Flandreau and Sicsic (2003) provide a seminal contribution about this market.
[6] Flandreau (1997). See also Bank de France archives (BFA), 1069199121/9, La Crise américaine de 1907.
[7] ICMA Repo survey, October 2017.
[8] SIFMA US Quarterly Highlights, October 2017.

Repo markets clear on both a price and a quantity dimension. The first one is summarized by an interest rate, the second one by the initial margin, or haircut, associated with the loan. Repo markets are organized in three different segments: OTC bilateral, tri-party repos, and CCP-cleared. On the bilateral market, the settlement of the repo is handled by the trading parties. In tri-party repos, settlement and collateral management settings are outsourced by the parties to a third-party agent, which does not bear the counterparty risk[9]. In markets cleared by a CCP, the latter assumes counterparty risk by inserting itself between the parties and becoming seller to all buyers and buyer to all sellers. As a consequence, it sets rates and haircuts on the market.

Theory posits that in a CCP-based market, lenders do not have strict incentives to run on borrowers, due to the elimination of direct counterparty exposures (Martin, Skeie, and von Thadden, 2014). Moreover, CCPs increase trading efficiency by allowing for anonymous dealings and multi-lateral settling among participating institutions (Boissel, Derrien, Ors, and Thesmar, 2017). Finally, CCPs liquidate collateral and distribute losses in case of default of one of its members. This feature mitigates the risk of disorderly liquidation of collateral (Oehmke, 2014). As a consequence, CCPs may help increase financial stability.

Despite these advantages, there was little interest for a CCP in the US repo market until recently. The introduction of new regulation, and in particular of the Supplementary Leverage Ratio (SLR), has opened the way for a debate over introducing a repo CCP (Martin, 2015). The SLR introduced limits on leverage in banks' balance sheets. The use of a CCP, by netting long and short positions of banks, would reduce the required amount of balance sheet space. Such a measure would therefore allow banks to conduct the same amount of intermediation with a smaller balance sheet (Duffie, 2017).

Despite academics and practitioners are currently debating about introducing a CCP in the US repo market, no existing empirical study analyzes the potential consequences of this measure. In this paper, I fill this gap by focusing on a historical case. This approach allows me to analyze both the context in which the reform took place and the medium-run effects of the regulatory change. I study the introduction of a CCP in the French "*marché des reports*". The reform took place in 1898, following an international crisis originated by speculation on

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[9] See Krishnamurthy, Nagel, and Orlov (2012), Adrian, Begalle, Copeland, and Martin (2013) among others.

gold mining stocks. At that time, this market for sale and repurchase agreements negotiated each month one fourth of the French GDP[10].

To study the French historical repo market, I construct a new original database from archival sources. The database includes all repo rates published at the end of the month on Paris stock exchange official lists, from 1880 to 1913. I chose this period for its institutional homogeneity, and because it represented the heyday of the Paris financial market. The start date of my analysis was decided based on data availability. Total number of repo rates is 58,786 over the whole period. The average number is 144 rates per month. Moreover, the DB contains new hand-collected corporate governance data, such as dates of payment of interests and dividends, dates of general assemblies, and dates of issue of new capital, for a portfolio of 49 securities. Finally, I use previously unexploited data about returns and volatility for these 49 securities.

Repo market microstructure did not allow the use of haircuts. Consequently, counterparty risk was managed by applying different rates to different collateral securities. Higher rates meant higher risk. For each end of the month, I calculate the dispersion of repo rates among underlying assets and use it as a measure of risk on the market. I show that dispersion increased in periods of tight monetary conditions, as rates on safer collateral did not change while rates on riskier collateral increased.

I perform a structural breaks analysis to single out the exact moment in which rates dispersion was reduced. I find a reduction in risk perception in the moment of the introduction of a monitoring mechanism in January 1901. The introduction of the CCP itself had not been enough for investors to consider the market as safe. On the contrary, this anti-moral-hazard policy had a strong effect on decreasing interest rates. Investors were able to trust brokers more than before, as they were monitored by their peers. This reduced the incentive for lenders to ask for higher protection under the form of higher interest rates.

I then use a panel data regression to identify the determinants of repo rates. The large dimension of my data set and its high quality allow me to single out several dispersion determinants. In particular, I find that upwards dispersion is mainly explained by counterparty risk, measured through volatility of asset returns. Moreover, I explain the

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[10] Charousset (1898) and Allix (1901) for estimates on volumes exchanged on the repo market. Lévy-Leboyer and Bourguignon (2008) for estimates on GDP.

singular presence of a high number of negative interest rates in the market by focusing on market corporate governance practices. Negative rates reflect a premium paid by investors to participate to capital issues by private companies.

In order to study the impact of the reform on the repo market, I apply a difference-in-differences estimator to the panel data model. I find that the regulatory change strongly reduced the average interest rate for those assets that were previously considered risky. All the market could be now considered as a safe one. The reform was effective in lowering risk on the whole financial market. As a consequence, no major crisis hit the Paris market between 1899 and the beginning of WW1.

I finally document a side effect of the reform. By forcing deposit banks to pay commission fees and a financial transaction tax on every negotiation undertaken on listed securities, the new set of laws provided financial institutions with an incentive to develop a rival market. Using original archival data, I find that volumes invested on the repo market decreased in favor of advances on securities granted by deposit banks to their clients. Volumes negotiated in the market for these competing instruments went gradually beyond the amount of repo funding in the years preceding WW1.


2. Historical Background

In the French repo market, money lenders were mainly banks, industrial firms and retailers investing their liquid assets, and individual investors[11]. Money borrowers were bullish forward traders willing to roll over their open positions, and needed liquidity to do so. Loans took the form of a sale of an asset coupled with the agreement to repurchase the same asset on a specific future date, 15 or 30 days later. In this section I present the microstructure of the market and its 1898 reorganization.

2.1 Market Microstructure

All operations in the Bourse were mediated by pure brokers. The latter were called *agents de change*. They collected sale and purchase orders in behalf of their clients, and performed multilateral netting among them. Brokers were responsible for payment to their clients and

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[11] Archives Nationales, Alexandre Ribot personal archives, Lettre de M. Ribot à M. Pallain, November 7, 1914, 563/AP/16. See also François Marsal (1930).

fellow brokers. As a consequence, they were exposed to bankruptcy if their clients defaulted (Hautcoeur and Riva, 2012).

*Agent*'s responsibility involved their personal wealth, as well as their seat's. Every seat had its own capital, shared by the broker with his associates. Number of brokers was fixed by the government[12]. They were organized in a guild-like organization called *Compagnie des Agents de Change* (CAC). They were not allowed to undertake financial trade for their own sake, and made profits through commission fees.

Alongside the Bourse, stood an OTC market, called the *Coulisse* (the curb market), providing immediacy and opacity for professional investors. Most *Coulisse* transactions were made on bilateral basis. Its members often acted as dealers, acting under dual capacity. The Bourse enjoyed a monopoly over stock market transactions. Nonetheless, the existence of the OTC market, illegal by the law, was tolerated and even protected by the government. The *Coulisse* in fact provided the market with the liquidity necessary for its operations, and in particular for government bonds issues.

The Paris market was primarily a forward market. Forward trading on the stock exchange was highly developed at the time. It represented three times the French GDP (Lagneau-Ymonet and Riva, 2017). Forward contracts were done on the basis of central settlements taking place at the end of each month for all securities in both markets. The *Parquet* organized additional mid-month settlements for the riskiest assets.

When the settlement approached, bullish forward traders transmitted their orders to their *agents de change* or *coulissiers*. They could either fulfill their purchase obligation and put an end to the transaction, or roll over their position to the following settlement. In the latter case, the broker had to find counterparty for his clients. In other words, he had to find someone providing the amount of cash needed to postpone the final repayment by 15 or 30 days.

To do so, he matched at first opposite orders among his own customers. In the second place, he compared his net position with those of his colleagues, looking for positions of opposite sign. Typically, forward purchases outnumbered forward sales, leaving a need for cash. The difference in volume between the two, at an aggregate level, was named "place position"

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[12] There were 60 of them up to 1898, and 70 afterwards.

(*position de la place*). In 1898, it amounted to some 3 billion francs on the *Parquet* and to a similar figure at the *Coulisse* for each end-of-the-month settlement[13]. The sum of the two gives a total of 6 billion francs per settlement, representing one fourth of the French GDP of the time.

In order to raise this money and clear the market, the first step consisted for *coulissiers* to invest a part of their own liquidity, and for *agents de change* to use a fraction of their seat's capital. Then, brokers at an individual and at an aggregate level called in another type of actor. Among brokers' clients there were banking, trading, and industrial firms, as well as individual investors, in possession of liquidity. This kind of customers acted as repo lenders. They entered the transaction by coupling a purchase on the spot market with a sale of the same asset on the following settlement. This kind of operation is called today a "reverse repo" (Adrian and Shin, 2010). From their point of view, this double operation was nothing but a money-lending transaction lasting the time of a settlement, 15 to 30 days. Remuneration was given in the form of an interest rate.

On the *Parquet*, the amount of cash that lenders gave to their brokers was equal to the market value of the collateral assets, as fixed by the governing body of the CAC, the *Chambre Syndicale* (CS). These prices, called *cours de compensation* (settlement prices) did not necessarily correspond to real transactions undertaken on the spot market. They were fixed for each asset on the basis of the prices done during the settlement day, mostly around the average price. The *Coulisse* conformed to this custom.

There were two reasons for establishing a specific price instead of using the price of an actual transaction. First, brokers wanted to avoid last-minute speculation intended at altering the market. Secondly, different forward orders were placed by different clients at different prices for the same security. Settlement prices were created to balance them out. The CAC had therefore created this procedure in order to allow for an orderly clearing[14].

It should be noted here that this mechanism left no room for the applying of haircuts (or initial margins) on the value of the collateral asset. Repo transaction were only done at the

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[13] See Charousset (1898) and Allix (1901) for estimates on trade volume on the repo market before the 1898 reform.
[14] See Deloison (1890) and François Marsal (1931). More details are also provided in the Appendix.

settlement price[15]. Lenders were guaranteed by full ownership rights on the collateral asset during the whole period of the loan, as well as by the personal and office security offered by their broker[16].

As a consequence to the absence of haircuts, discrimination among different collateral securities involved applying higher interest rates to repos done on riskier collateral. The interest rates, or repo rates, were calculated on the basis of the settlement prices and the "repo prices". The latter were the prices paid by bullish forward investors to roll over their positions on that particular collateral asset up to the next settlement.

Contemporary stock markets were not all financed in the same way. Brokers in New York, as an instance, were funded by brokers' loans. The brokers' loans market was a market for collateralized loans different in several respects from the reports market. Settlement was quick in a few days, and was not centralized twice a month. Brokers' loans in the U.S. were contracted at a unique market rate, which was instantaneously adjusted. There were varying margins for different types of stock. The latter were changed less frequently.

## 2.2 The Reform

In 1898, the French parliament passed a new set of regulations reorganizing the financial market. The main measure consisted in the introduction of a Central Clearing Counterparty. The reform shaped a new institutional setting of the Paris financial market which remained unchanged up to World War 1. The reorganization intervened after a crisis in 1895 had severely hit the *Coulisse*, and tarnished the official market too.

The precondition for the 1895 crisis laid in another reform, passed in 1893. This reform, that introduced a financial transaction tax (FTT), had given the *Coulisse* a legal status. By allowing every intermediary to pay the FTT, it dismantled the *Parquet*'s monopoly on listed securities. This tax was introduced for two reasons. First, it increased government's revenues. Second, it provided information on financial market transactions (Lagneau-Ymonet and Riva, 2017). This reform resulted in the *Coulisse* taking the upper side on the *Parquet*. Figure 1 shows the annual stamp duties paid on securities transactions from 1893 to 1907. This amount can be used as a proxy for the relative importance of the two exchanges.

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[15] Allix (1901). See also ACL, 7AH2, Circulaires Direction Générale. Memorandum dressed by Adrien Mazerat, General Manager of Crédit Lyonnais on November 29th, 1902.
[16] After the reform, additional guarantee was offered on the Parquet by the existence of the CCP.

(Figure 1 here)

In 1895, the Gold Mines crash hit the financial market, affecting mostly the *Coulisse*. According to many observers, the *coulissiers* had developed the market for gold mining stocks very speculatively (Hautcoeur, Rezaee, and Riva, 2010). In particular, information on most of stocks issuers was scarce, the market was opaque and shares did not comply with French regulations. Little is known about the origins of the crisis. It was plausibly caused by the explosion of a bubble created by stock market manipulation on these securities (Graham, 1996).

The crisis facilitated a campaign by the official brokers against the *coulissiers*, accused for having imposed losses to French savings. The *agents de change* wanted their monopoly back, justifying it with financial stability reasons. The government soon re-established the dominant position of the official brokers. In exchange, the Bourse had to be completely reorganized. Therefore, the so-called "financial market reorganization[17]" of 1898 did not restore the pre-1893 situation, but went well forward in shaping a new setting.

The reform included the following main points (Hissung-Convert, 2007). First, the reorganization introduced a central clearing party. Centralization of settlement operations was already the norm, but now the collective guarantee of the Parquet was enshrined in the law. The motivation of the legislator was that of providing the Bourse with additional credibility among small investors looking for security[18]. Nonetheless, the brokers guild protested against giving legal recognition to the joint liability mechanism. Their argument lay on anti-moral-hazard grounds. If no broker could face bankruptcy, any of them could take risks without sanction. The final text, adopted after long negotiations, aimed at both introducing the CCP and limiting the moral hazard[19]. Nonetheless, it was not considered enough by most *agents de change*.

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[17] Several pieces of historical literature – doctoral theses, books, pamphlets, and journal articles – were dedicated to what was called "*La réorganisation du marché financier*". See for instance Charousset (1898); Dubreuil-Chambardel (1898), and historical press.

[18] 'Le Temps', November 20th, 1899. See also François Marsal, 'Encyclopédie'.

[19] See an undated letter from the « Syndic au Ministre des Finances », accompanying the « Note remise par le syndic des agents de change, texte proposé en remplacement de l'amendement Viviani sur la solidarité, rédaction de M. Sabatier ». CAEF, box 64895. Cited in Haucoeur, Rezaee, and Riva (2010).

Second, *coulissiers* and bankers had to pass through the intermediation of the *Parquet* for each transaction undertaken on listed securities[20]. The fiscal administration committed to enforce this particular point by suing those who illegally traded this kind of assets (Lagneau and Riva, 2017). About 70% of the *Coulisse* turnover in 1897 came from *Parquet*-listed securities[21]. Therefore, this measure was a harsh blow for the OTC market, whose market share immediately dropped to one-third of total Parisian traded volumes.

Thirdly, the commissions perceived by official stockbrokers were strongly reduced, reaching a level lower than those payed in London and New York[22]. This measure most likely helped in attracting new investors on the market. Fourth, in order to handle more volume, the government raised the number of official brokers from 60 to 70. Finally, the very same year the *Cour de Cassation* legalized once and for all forward operations, hence providing the *Parquet* with additional protection against risk[23].

In the years following the reform, the CAC took some additional measures to adapt its functioning to the new setting. In particular, it had to face increased moral hazard due the introduction of the CCP mechanism. If no broker could face bankruptcy, any of them could take risks without sanction. The measures undertaken were the following. First of all, in January 1901 the syndic imposed a biannual internal survey on the size of repo exposures by brokers. Each agent de change had to provide the CCP with precise information on the type of clients and amount of funds invested in *reports* by their offices[24]. These pieces of information had to be supplied twice a year, although not a fixed date.

Moreover, newly admitted brokers were carefully screened, and the governing body of the exchange ensured that only brokers from wealthy families could acquire a seat (Riva and White, 2011). This requirement had a double reason. First, financially healthy brokers had more capital to cover losses from defaults. Secondly, the fact that *agents de change* came

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[20] On December 31st, 1897, more than 1,700 securities were listed on the stock exchange, representing a market capitalization of approximately 11 billion francs, about a half of the French GDP. Number of securities comes from DFIH database, version May 2017 (Hautcoeur and Riva, 2016); Market capitalization figure from Arbulu (1998); GDP from Lévy-Leboyer and Bourguignon (2008).

[21] A-CAC, MGA, 30 April 1898.

[22] At the beginning of the twentieth century, the commissions to buy 100.000 francs worth of foreign securities amounted to 129.20 francs in London, 120 francs in New York, and 100 francs in Berlin and Paris (Crédit Lyonnais archives, box B.64.877, cited in Lagneau and Riva (2017).

[23] Arrêt of 22 June 1898. Cited in Hissung-Convert (2007).

[24] A-CAC, MCS, 4 and 25 January, 1901.

from the same social group helped in implementing a monitoring policy and in exercising moral suasion (Verley, 2007).

Finally, after some years of struggle, in 1901 an arrangement was found between *agents de change* and *coulissiers*, allowing the latter to act on the *Parquet* as commission brokers, or *remisiers*, in addition to trade unlisted securities and some foreign and domestic government bonds[25]. The reform, passed in 1898, was therefore completely effective three years later. The reorganization was successful in dealing with risk. No major crisis hit the *Parquet* between 1899 and the beginning of WW1. France even became a "safe haven" for capital during the 1907 international crisis.

3. Accounting for the dispersion of repo rates.

Repo market microstructure did not allow the use of haircuts. Consequently, counterparty risk was managed by applying different risk premia to different collateral securities.  For each end of the month, I calculate the dispersion of repo rates among underlying assets and use it as a measure of risk on the market. Dispersion increased in periods of tight monetary conditions, as rates on safer collateral did not change or lowered, while rates on riskier collateral increased.

I have all repo prices and settlement prices done on the *Parquet* for all end-of-the-month settlements from January 31$^{st}$, 1880, to December 31$^{st}$, 1913[26]. I exclude mid-month settlements in order to have exploitable series for surest collateral assets. The latter were only negotiated once a month. Figure 2 shows how information was organized on the Paris stock exchange official lists. For each security used as collateral in at least one repo transaction, the official list published the repo prices and the settlement price.

(Figure 2 here)

The first were the prices paid by forward buyers to roll over their positions to the following settlement; the latter represented the value of the collateral asset. Depending on the security, we can find one or two repo prices. If more than one price were agreed upon for

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[25] See Boissière (1908) as well as Vidal (1910).
[26] I personally hand-collected most of them. I deeply thank the Equipex DFIH for providing me with the remaining data. All data are now in the DFIH Database. (Hautcoeur and Riva, 2012).

the same collateral asset on the same settlement date, the official brokers published the higher and the lower. The positions were then settled at the average price. The formula used to calculate the annualized interest rate perceived by the lender was therefore, for each collateral asset (Haupt, 1894):

$$rate = \frac{average\ repo\ price\ X\ number\ of\ yearly\ settlements\ (12\ or\ 24)}{settlement\ price}$$

The number of total collateral assets, and therefore repo rates, ranges from 64 on January 31st, 1880, to 289 at the end of 1913. The average over the period is 144 rates, and the total sum over the 408 months is 58,786 rates. Figure 3 shows the variation of the repo rates on the *Parquet*. For each end of the month settlement (X axis) I plotted in green the range including the repo rates between the first and third quartile (the 50% central rates). In grey, the two ranges obtained by starting from each of the two quartiles and adding or subtracting 1,5 interquartile ranges[27]. In blue, outliers. The scale on Y axis is logarithmic, but the legend is converted in actual rates.

(Figure 3 here)

We can note three main features of the plot. The first is that lenders protection against risk involved applying different risk premia to different securities. Rates dispersion reflect this attitude. The second is given by the presence of a high number of negative rates, most of the time outside the "normal" range. The third feature is a clear reduction in rates dispersion over the period, and in particular after 1895. Let us address here the first two aspects. The empirical analysis presented in Section 4 deals with the third feature.

Cash investors, in absence of haircuts, protected themselves against collateral risk by applying different rates to different underlying collateral assets. In Figure 3 we do not observe one rate for the whole market, or one rate by type of security, but a variety of rates each depending on collateral. Figure 4 depicts the dispersion of the rates measured by the Interquartile Range (IQR). The IQR or H-spread is equal to the difference of 75th and 25th percentiles. It is a robust measure of scale, not influenced by outliers, in contrast with

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[27] The interquartile range or IQR is a measure of dispersion given by the simple formula IQR=75th percentile – 25th percentile. This kind of graphic representation is known as Tukey boxplot. Frigge et al. (1989).

variance. It can be calculated even in presence of negative values, as in our case, in contrast with other measures of dispersion such as standard deviation and Gini index.

(Figure 4)

The IQR takes values varying between 2 and 3 percentage points in "normal times" during the period 1880-1895, and between 1 and 2 percent afterwards. An IQR of 3 percent, when the average rate was around 3.5%, means that even excluding outliers, "normal" rates ranged between 2 and 5%. The high dispersion reflects collateral assets diversity with respect to risk perceived by investors.

In periods of crisis, dispersion increased. The IQR reaches levels of 6 to 8 percentage points in several moments between 1881 and 1895. The first high peak takes place in the months preceding the *Union Générale* crash and during the crisis itself. According to some metrics, the *Union Générale* crash was the worst crisis ever experienced by the French financial market (Le Bris, 2010). Speculation on the repo market played a fundamental role during the boom preceding the bust (Flandreau and Sicsic, 2003). Stock prices grew during the year 1881, especially those of the banking sector. The crisis, exploded in January 1882, threatened with failure 14 of the 60 Parisian stock brokers, and seven of them eventually proved insolvent (White, 2007). The Lyon stock market, the main regional exchange, was liquidated, and in the following years had to struggle to survive (Ducros and Riva, 2014).

The second and third moments in which the IQR reaches a level higher than 6% are in April 1886 and at the end of 1890. In these cases, new issues of government bonds were announced. Government bonds at the time were issued through the direct involvement of banks (Vaslin, 1999). Banks participated to bonds underwriting by paying a security deposit amounting to 15% of the issue price. Banks had a double incentive to participate to government bonds issues. Firstly, issue price was usually lower than the expected market price, so that banks could make profits by reselling securities on the secondary market later on. Second, the ability to distribute bonds to their clients was a signal of strength of their networks, and contributed to increase their prestige.

Banks had an incentive in providing the Treasury with all the funds they could, as at the moment of the issue, bonds were distributed to subscribers in proportion to their relative participation to the initial call. Given this mechanism, the only way for banks to satisfy their

own needs and the needs of their clients was to get a substantial share of their short-term funding back. A consistent part of it was at the time invested on the repo market. Massive withdrawals from the repo market led to marked rate hikes.

The fourth and last high peak in the IQR series takes place in 1895, during the Gold Mines Crisis. This crash, originated by the explosion of a bubble in South African gold mining stocks, hit primarily the *Coulisse*. Banks withdrew their funds from the OTC repo market, worsening the crisis. Because of the strong interactions between the two markets and the international dimension of the crisis, that partially hit the London Stock Exchange too, the *Parquet* was not spared (Hautcoeur, 2007).

All these periods have in common a sudden shock that hits investors' willingness to lend. In 1882 and 1895, repo lenders were reluctant to take possession of collateral, as artificially-inflated asset prices were bound to drop. In this tri-party-like repo market, investors did not directly face their counterparty. Therefore, they did not negotiate the terms by which the repo chain could continue, for example by applying a haircut. As a consequence, they preferred to withdraw funding rather than continue their lending.

In 1886 and 1890, lenders needed cash to subscribe to government loans issues. In all these cases, the repo chain was interrupted. Withdrawals resulted in an increased risk-premium associated to the riskiest collateral and consequently in the rise of repo rates dispersion. The French historical repo market represents therefore evidence on the hypothesis drawn by Copeland, Martin, and Walker (2014). According to them, tri-party repo cash investors, reluctant or unwilling to take possession of a collateral asset losing its value, do not use margins to mitigate risk. Rather, they prefer to withdraw funding and leave the market.

It shall be noted here that in similar circumstances taking place after the 1898 reform, the repo market experienced a rise in the general level of rates, but not an increase in dispersion. This was the case in 1901, when the government issued another loan, as well as during the international crises of 1906-1907 and 1911-1912.

Let us get back to Figure 3. The second feature of this plot is the presence of a high number of negative rates, the most of the time outside the "normal" range. Negative rates, or *déports*, can be explained by three main factors. Typically, these were particular cases in

which a given collateral asset was highly demanded on the market. The usual example is that of an issue of new capital reserved to stock-holders.

Other instances include willing to own an asset in order to receive the payment of coupons (dividends or interests), or the need of holding a minimum quantity of stock to participate to the general assembly (GA). Remember that money lenders enjoyed full ownership rights over the asset during the period of the repo contract.

Let us think of the repo price as the difference between the forward and spot prices of the collateral asset at time t. Spot prices were increased by high short-term demand. Forward prices usually were not touched: at the time of the following settlement the period of subscription was over, the date of the GA was already passed, or the interest had already been paid. In other words, demand of securities was higher than demand of money for that particular stock on that particular date. The negative rate can therefore be interpreted as a premium for cashing in a coupon, participating to the GA or to the issue of new capital.

A second factor explaining negative rates is still security-specific, but deals with the medium run. Sometimes bad news about the issuer of the security lasted several months. In those cases, bears outnumbered bulls on the market for that particular asset. As a consequence, at each settlement forward prices were lower than spot prices, displaying expectations of further price reduction. This was the case for the Panama stock during the 1887 to 1889 period (Allix, 1901), as well as for the *Compagnie Générale Transatlantique* in the second half of the 1890s. In this case, the negative rate can be interpreted as a sign of bad health of the issuer.

4. Data

In order to take into account negative rates due security-specific factors, I hand-collected data on dates of capital issues, dates of General Assemblies, and dates of payments of dividends and interest. I chose to limit data entry to a portfolio of 49 securities. The sources I used to collect these data are the CAC's official yearbooks. This publication starts in 1880. This is the reason why this study starts at this particular moment.

I developed the portfolio in order to represent as much as possible any different kind of security and issuer. Repos in Paris were negotiated on a variety of assets. They could be negotiated on all securities admitted on the forward market. Specific regulation applied to these securities, as they needed to satisfy some additional requirements with respect to assets only admitted to spot transactions. At every settlement, if at least one bullish forward trader decided to rollover her position on a specific asset to the following settlement, at least one repo price for that collateral security had to be done.

On the official list, the official brokers published no prices in case of absence of negotiations, one price if one only transaction had been done, and two prices – the min and the max – in case of more than one repo transaction. In this latter case, repos were settled at the average price between the two (Haupt, 1894). As a consequence, we know how many collateral securities were used in *at least one* repo transaction at the Bourse. We can do so by counting the number of collateral securities displaying one or two repo prices at every settlement date on the official list.

(Table 1 here)

Table 1 shows the evolution of the different types of collateral used in the repo market, from 1880 to 1910. At the settlement of the end of December, 1880, 69 securities were used as collateral on the repo market. 40 of them were French private stocks, representing 57,97% of the total amount. 12 of them were foreign private stocks, representing 17.39% of the total amount. As a whole, the repo market was therefore done on stocks as collateral assets in 1880. Stocks represented three fourth of the market.

In the 1890s and at the beginning of the 20th century, the number of foreign securities progressively outnumbered that of French assets used as collateral. At the settlement of the end of December, 1900, 105 out of 184 assets used as collateral on the repo market were

foreign stocks or bonds (57.06% of the total). Ten years later, at the settlement of the end of December, 1910, foreign assets represented the 62.02% of the total. This tendency was due to the admission on the forward market of an increasing number of foreign railways bonds, as well as bank stocks and public debt certificates.

(Table 2 here)

Table 2 presents how volumes invested in the repo market were shared among different types of collateral assets. This type of information was not public, and only thorough archival research has allowed me to disclose it for two dates, in 1906 and 1914. During this period, 5% to 10% of the overall volumes were invested on different types of French *Rente*. This was the surest part of the market. Most of the market was done on foreign stocks and bonds (67% in 1906, leaving only a 33% to French securities). Each of the two groups was characterized by a strong heterogeneity. Not necessarily French securities were surer than foreign ones.

In the portfolio that I build, I replicate as much as possible the relative proportion among types of securities shown in Table 1 and 2. The choice of the specific securities was made upon the examples given in the historical literature[28]. Table 3 presents the main characteristics of the assets composing the portfolio. I have a total number of rates of 15,186, distributed over 408 months. This number represents 27.5% of the entire population over the period. The median rate is 3.42% for both foreign and French assets. The two are characterized by a high dispersion and presence of outliers, both negative and positive. The most represented assets are government bonds as well as banks and railways assets, which were also the most liquid securities according to contemporary accounts.

(Table 3 here)

For each security of the portfolio, I calculate asset returns at every date (variable capital_gain). I then compute historical volatility of asset prices over 6, 12 and 18 months (volatility_6, volatility_12 and volatility_18). I compute proxies for assets liquidity. The Paris

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[28] Descriptions of "typical" investments are found in Allix (1901), Guilmard (1913), as well as in newspapers. A quantitative assessment of volumes by type of security is possible for years 1906 and 1914. In 1906 the CAC performed a study on the FTT that can be used to estimate the distribution of forward transaction by type of security (A-CAC, B-0064877/1). During WW1, the BdF provided the CAC with a loan. One of the studies undertaken by the central bank before the loan describes the volumes invested on the repo market by type of collateral (A-BDF, 1069200401/147).

stock exchange official list published the price of every transaction done on the spot market for any security, if different from the immediately previous price done on the same day.

I can therefore use the number of prices published in the settlement day as a proxy for liquidity, as it represented the minimum number of transaction done on the spot market for that security. This variable in my database can vary between zero and twenty. I then average these "daily" liquidity measures over six, twelve and eighteen months in order to obtain historical liquidity proxies for both spot and forward markets of each portfolio asset (variables volatility_6, volatility_12 and volatility_18). Number and level of asset prices come from the DFIH database[29].

Finally, the model contains macroeconomic variables. In particular, I use the Banque de France interest rate (bdf_rate), to control for an influence of the central bank's monetary policy. Because monetary policy was implemented through quantities more than through rates during this period (Bazot, Bordo, and Monnet, 2016), I also use the first-differences of some balance sheet variables of the BdF (variables commercial_paper and advances). To take into account the influence of the interbank market, I use the so-called "Paris open market" rate, the interest rate at which main financial institutions lent money among themselves (variable open_mkt).

I then use the returns on a stock market index (Le Bris and Hautcoeur, 2010) and on a corporate bond index (Rezaee, 2012), to take into consideration the influences coming from the financial market. Finally, following Bordo and MacDonald (2005), I use the variation on the level of imports as a proxy for aggregate demand (variable imports). More detail on all these variables is available in the appendix.

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[29] DFIH database, version May 2017 (Hautcoeur and Riva, 2016).

5. Empirical Strategy

Which were the determinants of repo rates? Was the 1898 reform effective in reducing risk on the repo market? When did the investors perceive that a change had taken place? I reply to these questions in three steps. First, I run a structural breaks test on the time series of the rate dispersion. The aim is to identify whether and when the introduction of the CCP reduced counterparty risk on the market. Second, I estimate an arbitrage model on a portfolio of selected securities by using a fixed-effect panel data approach. Finally, I apply a difference-in-differences estimator to my model to quantitatively test the impact of the reform on the repo market.

The most commonly used methodology to detect the number and location of structural breaks in a time series is the one developed by Bai and Perron (1998, 2003). Following Bai and Perron (2003), I begin by estimating the following general model subject to m breaks (m+1 regimes):

$$y_t = \delta_j c + u_t \qquad\qquad t = T_{j-1} + 1, \dots, T_j, j = 1, \dots, m + 1$$

My equation specification consists of the dependent variable (the times series of the IQR) and a single (constant) regressor. $u_t$ is the error term at time t, $\delta_j$ is the corresponding vector of coefficients and the indices ($T_1$, ..., $T_m$) stand for the unknown break points. This approach estimates simultaneously the unknown coefficients and the endogenous breakpoints.

The algorithm computes the estimates of the break points based on the minimization of the sum of OLS squared residuals segment by segment, and convergence of the estimation is obtained under a large set of assumptions. In particular, different distributions are assumed for both the errors and the regressors. Wishing to allow for serial correlation in the errors, I specified a quadratic spectral kernel based HAC covariance estimation, using prewhitened residuals. The kernel bandwith has been automatically determined using the Andrews AR(1) method.

In order to test for multiple potential breaks, I used a test supF of no structural break, that is m=0 versus m=M globally determined breaks. Following Bai and Perron's (1998) approach, I applied the double maximum tests of the null hypothesis of no breaks against an unknown number of breaks, UDmax and WDmax , and used their reported critical values, which was in

both case four. Then I implemented a test for l vs. l+1 breaks, applied to each and every segment. The model with l breaks is rejected in favor of a model with l+1 breaks if the overall minimum value of the squared residuals' sum is larger than the sum of the l+1 breaks model.

The structural break approach, as noticed among others by Oosterlinck, Ureche-Rangau and Vaslin (2013), has the main advantage for economic history that breaks are determined endogenously. This means that what matters is the perception at the time of the events: ex-post biases are excluded. As highlighted by Frey and Waldenström (2007), this advantage is particularly emphasized by the use of financial market data, highly informative as they were published for the sake of market operators. It is clearly very useful in the context of this paper, as what matters is how risk was perceived by contemporary investors.

The structural break approach, either performed testing l globally optimized breaks against the null hypothesis of no structural breaks, or using the global information criteria (which compares information criteria for 0 to M globally determined breaks), gives as a result four breaks. Table 4 presents the results for the multiple breakpoint Bai-Perron tests of L+1 vs. L sequentially determined breaks. It is worth noticing that the indicated date is the first settlement of new regime.

The four breaks are the following: April, 1882; January, 1896; February, 1901; April, 1907. The break in 1882 is due to the *Union Générale* crisis, as well as the break detected between December 1895 and January 1896 is related to Gold Mines crisis. The April 1907 break detects a change in the internal organization of the repo negotiations that allowed for a more efficient management of the market[30].

The most interesting break for the sake of this analysis is the one taking place between January and February 1901. This is exactly the moment in which the syndic decided to introduce a monitoring mechanism. He imposed a biannual internal survey on the size of repo exposures by broker. Each *agent de change* had to provide the CCP with precise information on the type of clients and amount of funds invested in *reports* by their offices[31]. These pieces of information had to be supplied twice a year, although not a fixed date.

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[30] A-CAC, MCS, 28 December 1906.
[31] A-CAC, MCS, 4 and 25 January 1901.

The introduction of the CCP itself had not been enough for investors to consider the whole market as safe. On the contrary, the introduction of the monitoring mechanism as a way to fight moral hazard had a strong effect on unifying interest rates. Investors were able to trust brokers more than before, as they were monitored by their peers. This reduced the incentive for lenders to ask for higher protection under the form of higher interest rates for some collateral assets. Given the historical and statistical evidence, in the following steps I consider February 1901 as the "break date".

The second step of my analysis consists in estimating an arbitrage model using a fixed-effect panel data approach. Arbitrage Pricing Theory (APT) was originally developed by Ross (1976). The idea underlying arbitrage pricing models is that the expected return of a financial asset can be modeled as a linear function of various macroeconomic or specific factors. According to this kind of models, because of the law of one price assets that have the same risk must be exchanged at the same price. The interest of arbitrage models lies in their flexibility with respect to the standard CAPM framework. With respect to a standard APT model, I add to macroeconomic variables and market indices some security-specific and firm-specific variables, in order to take into account corporate governance practices.

The model I estimate is the following:

$$r_{it} = c + \alpha_i + X'_{it}\beta + d_t + u_{it}$$

Where $r$ is the repo rate for security $i$ at time $t$, $\alpha_i$ is the unobserved time-invariant individual security-specific fixed-effect, $X'_{it}$ is the time-variant $1 \; x \; k$ regressor matrix, $c$ is a constant, $d_t$ are time fixed effects introduced to capture inflationist movements and moments of crisis, and $u_{it}$ is the error term. It is worth remembering that I run the regression on a selected portfolio of assets, not on the whole population of repo rates.

I chose to use a fixed effect model in order to control for correlation between individual security-specific effects and the independent variables[32]. This kind of correlation is typical in financial models. Nonetheless, panel data fixed-effect models often suffer of cross-section dependence. In the context of my model, it would be the case if the behavior of one security is dependent from another.

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[32] Moreover, I perform a Hausman test to discriminate between a fixed- and a random-effect model. The test gives as a result Prob>Chi2 = 0.00. This result strongly rejects the null hypothesis of no difference between the two models, therefore rejecting the random effects model as inconsistent.

This case being highly probable, I need to correct the error term to take into account heteroskedasticity, autocorrelation, and cross-section dependence. I do so by implementing Driscoll and Kraay's (1998) covariance estimator to produce standard errors. Driscoll-Kraay standard errors are robust to general forms of cross-sectional and temporal dependence when the time dimension is sufficiently large, as in my case.

As a robustness check, I show in the appendix the results of the same fixed-effect regression with different standard errors specifications. Even if standard errors change, the magnitude and sign of the effects remain the same, as well as their statistical significance. I ran the panel regression over three periods: a pre-reform one, covering 1880 - January 1901; a post-reform covering February 1901-1913, and the whole period. I selected the periods relying on the structural break test, and on archival evidence.

In order to quantitatively test the impact of the CCP introduction on the repo market, I then apply a difference-in-differences estimator to my model. To do so, I divide the 49 securities of my portfolio in two groups. Those issued or guaranteed by the French state are the safe, or control, group[33]. The other ones are the risky, or treatment, group. The effects of the reform should only apply to the risky group, as state-owned or state-guaranteed securities were already safe assets before the reorganization. This is my identification assumption.

To apply the difference-in-differences strategy we need an assumption to hold. This hypothesis, which is called in literature the "Parallel Paths" assumption, postulates that the average change in the control group represents the counterfactual change in the treatment group if there were no treatment (Abadie, 2005). In the literature, it is common to check this assumption by testing for differences in pre-treatment trends in the two groups. If the two follow two parallel trends before treatment, results are robust to any possible confounder. In my case, safe and risky assets have to follow the same trend before the reform.

Figure 5 shows the parallel trends followed by the safe and risky assets in the years preceding the reorganization, and afterwards. In order to draw the graph, I avoid those moments of the year characterized by strong seasonality issues, such as payments of interest and dividends, or closure of accounts. I therefore take two points for each year to draw the trends, by using the months of May and November. The reform passed in 1898.

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[33] I included French government bonds, the Bank of France stock, as well as stocks and bonds issued by railways companies, which were guaranteed by the State.

From 1896 to that moment, and indeed until 1900, the two interquartile means of risky and safe assets follow parallel trends. Starting from 1901, year of the introduction of the monitoring policy, the difference between the two loses any importance.

(Figure 5 here)

Given that the parallel trends assumption holds, I can apply a difference-in-differences estimator to my model. The difference-in-differences model I run is the following:

$$r_{it} = c + \alpha_c + X'_{it}\beta + \lambda T_t + \delta D_{it} + \rho I_{it} + u_{it}$$

With respect to the previous model I added $T_t$ that are time fixed effects (pre-reform vs. post-reform), $D_{it}$ which are group fixed-effects (risky vs. safe), and the interaction term $I_{it}$ which captures the effect of the reform. In this specification I cannot use security-specific fixed-effects because they would be collinear with group fixed-effects. Therefore I substitute them with observable cluster fixed-effects, which capture common characteristics of clusters of assets such as being variable-income vs. fixed-income, issued by a public institution vs. private company, by a French company or public power vs. a foreign institution, and the sector of activity of the issuer. Finally, I substitute time fixed-effects with two sets of dummies for the months and for the years, for the same reason.

6. Findings

Upwards dispersion of repo rates was primarily due to counterparty risk, measured through volatility of asset returns, while downwards dispersion is explained by corporate governance factors. In particular, negative rates reflect a premium paid by investors to participate to capital issues by private companies. The introduction of both the CCP and the monitoring mechanism reduced the average interest rate for previously risky assets by 1.1 percentage points. All the repo market became safe.

Table 4 presents the main results of the panel data regression, run using a time span of 12 months for the calculation of historical volatility and liquidity. The complete table is shown in the Appendix. For robustness, I also present in the Appendix the results of regressions done by using different time spans (6 and 18 months). Main results do not change.

(Table 4 here)

The two variables having a statistically significant effect on the upwards part of the dispersion of rates are liquidity and volatility. Not surprisingly, more liquid assets were also considered as surer. Before the reform, having one more spot price published on the official list reduced by 0.166 percentage points the average repo rate. As expected, after the reform this variable is not anymore significant. There was no more difference between "safe" and "risky" assets.

The main explanatory variable with respect of upwards dispersion is risk, measured by the standard deviation of collateral asset's price return (variable volatility). Volatility is calculated over the past twelve months. One standard deviation rise in volatility of collateral assets prices increases the rate by 11.7 percentage points over the whole period. This coefficient means that lenders used rates to protect themselves against counterparty risk in this tri-party-like repo market without haircuts, asking higher remuneration for higher risk. It is crucial to notice that the volatility variable has an even higher coefficient (13.4) before 1901, and loses its statistical significance afterwards.

Negative rates reflect a premium paid by investors to participate to capital issues or general assemblies of private companies. Negative rates are explained by capital issues (dummy variable issue, coefficient -11.4) and presence of a general assembly in the month following the settlement (dummy variable ga, coefficient -0.43). The premium paid to participate to a GA was therefore of the magnitude of half a rate.

That for being considered a stockholder and participate to the issue of new capital was extremely high (an 11.4 % rate on average, with peaks reaching 200%). An effect of this amplitude is explained by the custom of issuing new capital at face value or slightly below it. As an instance, in May 1888, the *Crédit Foncier de France* issued 31 thousand new shares exclusively reserved to old stockholders. The issue rate was 500 francs (the face value of the stock), while the market price was around 1400 francs. The repo rate on the settlement of May 1888 reached a level of – 60%[34]. We can conclude that negative rates mainly reflected a premium paid by investors to participate to capital issues. It is crucial to notice that the reform had no effect with respect to negative rates.

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[34] Other examples are the issues of new stocks by the *Société Foncière Lyonnaise* in November 1880 (issued at face value of 500 francs, market price around 600 francs, repo rate -50%) or by the *Banque de Paris et des Pays Bas* (*Paribas*) in June 1906. The stock was issued at 1350 francs while the market price was around 1600 francs. Repo rate is - 43.7%

The fourth column in Table 4 shows the results of the panel data regression run after adding the difference-in-differences estimator. The main coefficients estimated in the regression do not change. The interaction term, capturing the effect of the reform on those securities that were considered "risky" before the reform, is highly statistically significant and takes a value of -1.08. *Ceteris paribus*, the reform reduced the repo rates by 1.08 percentage points.

According to these metrics, the reorganization effectively decreased risk on the market. But what was the mechanism that reduced the dispersion of repo rates? According to the contemporary press, the introduction of joint liability (a CCP) among brokers reduced any incentive for the lender to ask for a particular collateral asset while investing on the repo market[35]. Before the reform, investors decided which securities to accept as collateral for their repos, demanding higher rates to be protected against higher collateral risk.

After the reorganization, lenders provided with cash their brokers, who in turn decided which collateral assets use for repo transactions[36]. Monetary conditions fully became the main determinant while negotiating repo loans. Lenders and borrowers started to think in terms of a unique monetary rate, instead of associating different rates to different securities. Particular negotiation conditions remained for highly demanded assets, those leading to negative rates, such as assets of companies issuing new stock or paying interests or dividends.

Risk was transferred from lenders to their brokers. Counterparty risk among brokers was not only managed through price adjustments, but mainly through careful selection of new agents de change, monitoring policy and moral suasion (Riva and White, 2011). Starting from 1901, the syndic imposed to each agent to provide his deputies twice a year with precise information on the total amount of funds collected by their offices to be invested on the repo market[37].

The prescribed forms even distinguished between funds invested by bankers and those coming from simple customers. Information was usually provided every six months, but in

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[35] Le Temps, November 20th, 1899. The impact of joint liability legal sanction on clients' security perception is confirmed by François-Marsal (1933).

[36] As an instance, after the Agadir crisis in 1911, brokers called for banks' help to perform the settlement. In exchange for their services, banks wanted to have a voice over the choice of collateral assets, a practice 'abandoned since the beginning of the century'. The CAC denied this possibility. A-CAC, MCS, 20 September 1911.

[37] A-CAC, MCS, 4 and 25 January 1901.

case of crisis the accounts were controlled before and after the advent of the shock in order to carefully monitor the exposure of each broker. Monitoring among brokers was therefore strictly implemented, in particular within the repo market. This latter part of the reform was crucial in diminishing the perception of risk for investors.

These results are consistent with recent theory. First of all, the presence of a CCP involves that, in case of default of one of its members, losses will be distributed. This characteristic reduces the risk of disorderly liquidation of collateral (Oehmke, 2014). At the same time, it lowers the incentive for the lender to asking for higher protection in the form of higher interest rates for riskier collateral. Second, direct counterparty exposures were eliminated, and this in turn reduced incentives to run on borrowers, as predicted by Martin, Skeie, and von Thadden (2014). The reduced risk resulted in a lower general level of interest rates.

7. A side effect of the reform

The 1898 financial reorganization resulted in a leak out of volumes from the repo market. The design of the FTT payment mechanism provided financial institutions with an incentive to favor advances on securities to repos. Using original archival data, I find that volumes exchanged on the repo market decreased in favor of advances on securities granted by deposit banks to their clients.

The mechanism was the following. Private investors, attracted by competitive offers from deposit banks, withdrew their funds from the market and placed them in their banks accounts. Commercial banks, in turn, preferred to lend this additional cash against securities to private clients, instead of investing it in the repo market.

(Figure 6)

Figure 6 shows the volumes invested on the repo market in several years between 1898 and 1912. Sources are described in the Appendix. The blue column represents the total amount of funds invested on an end-of-month settlement, according to data availability. The orange column is the total amount invested by "clients" (non-banking institutions, mainly firms), while the grey column represent at each date the total amount invested by banks. The figure clearly shows that the strong reshaping of the repo market is mainly due to a reduction in

the share of funds invested by "individual" clients. Their part is 90% before the reform, in 1898, and fluctuates between 40 and 60% in the following period.

Where did clients money go? Remember that under the new regulatory regime, *coulissiers* and bankers had to pass through the intermediation of the *Parquet* for each transaction undertaken on listed securities. This measure meant that banks had to pay a commission fee plus the FTT for each repo transaction undertaken on a listed security. This measure was adopted to provide official brokers with a sort of compensation to the adoption of the CCP. The CCP in fact, centralizing risk, required them to be jointly responsible in case of distress experienced by one of them.

Deposit banks, starting from *Crédit Lyonnais*, the market leader, decided as a reaction to boost the market for advances on securities[38]. These instruments, called in French "*avances sur titres*", were not considered as stock market operations. Therefore, they were not subject to the FTT or to brokers' stamp duties (Allix, 1901). From a legal point of view, advances were different from repos as they were loans, not involving a double transfer of ownership. Moreover, they were usually granted for longer periods with respect to repos, usually two months[39]. Nonetheless, even if repos were initially done for a 15- or 30-days period, repo chains usually extended the period of the contract to several consecutive settlements.

From a practical point of view, the two contracts were ultimately very similar. Most bank balance sheets recorded advances and repos under the same account. The only difference from a practical point of view was that in the case of repos, banks were allowed to return other stocks than the ones they had purchased, while for advances it was the contrary. Lenders did not own the collateral asset during the period of the loan, so they were obliged to return the very same stock at maturity[40]. This difference had two consequences.

First, repo lenders could in theory dispose of the asset and use it for another loan, while advances lenders could not. Nonetheless, I have no evidence of re-hypothecation on French historical repo market. Indeed, usually lenders did not take direct possession of their assets

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[38] ACL, Circulaires Direction Générale. September 17th, 1901 ; June 3rd, 1902 ; November 29th, 1902.
[39] Crédit Lyonnais Archives, Circulaires Direction Générale. November 29th, 1902.
[40] M. Ullmann, Director of the Comptoir d'Escompte bank, 'Interviews on the Banking and Currency systems, National Monetary commission of the US Senate', p. 263.

and left them in deposit with their broker (Allix, 1901). As a second effect, banks applied haircuts to their advances, not being protected by full ownership rights over the collateral asset in case of default of the borrower. Haircuts depended on the category of the security. The presence of haircuts meant that banks did not lend the whole market value of the collateral asset. In order to compensate for this "weakness", they offered lower rates with respect to those practiced on the repo market[41].

(Figure 7 here)

This type of facility, together with the widespread dissemination of deposit banks' branches in Paris and over the whole country, contributed to attract capital to banks and subtract it from the repo market and therefore the stock exchange. Figure 7 shows the total amount of advances granted against securities, the total amount of funds invested on the repo market, and the total amount of deposits at the 31/12 of each year from 1890 to 1913 in the balance sheets of the four main deposit banks plus the biggest financial institution specialized in short-term investment. The graph allows to assess the relative development of repos and advances on securities. Repos were progressively outnumbered by advances. The proportion became of 1:2.5 at the end of the period.

The banks are *Crédit Lyonnais*, *Société Générale*, *Comptoir d'Escompte* and *Crédit Industriel et Commercial*. The financial institution is the *Société Française des Reports et Dépôts* (SFRD), founded in 1881 and considered by contemporary authors as a serious institution. The figure represents the total amount of funds invested in repos and advances by these institutions (scale on the left), and the total deposits collected by these institutions (scale on the right, in blue). The sums of balance sheet items are calculated for December 31st of each year from 1890 to 1913. I personally hand-collected the data from a variety of sources, as it does not exist any complete series[42].

Crédit Lyonnais started only around 1898 to distinguish in its public statements between repos and advances, which were summed in a unique balance sheet item beforehand. I therefore used internal accounting documents to separate the two before 1898.

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[41] Crédit Lyonnais Archives, Circulaires Direction Générale. 29 November 1902.
[42] I entered and cross-checked data coming from Crédit Lyonnais Archives (129 AH 28 and the series 31 AH 85 to 31 AH 310), published on the newspapers l'Economiste Français and Cote de la Bourse et de la Banque, as well as those communicated to stockholders of SFRD, Comptoir d'Escompte and Crédit Lyonnais in the circumstance of annual general assemblies.

Unfortunately, the series of internal documents only starts in 1890 and presents yearly data. Given that Crédit Lyonnais was by far the main single investor in the market, no interpolation from other banks' data is possible before 1890.

For the 1890-1913 period, the results are the following. Since 1890 and until 1897, the rate of growth of repos and advances is comparable to that of deposits. Starting from the 1898 reform, advances overtake repos, a tendency that becomes even more marked in the first decade of the 20th century, once the reform was fully implemented. In 1898, each month's "place position" amounted to 3 billion francs on the *Parquet* alone[43]. In September 1911, just before the so-called Agadir crisis, the amount was reduced by a half: 1.4 to 1.6 billion francs according to different sources[44].

The reduction in volumes exchanged on the repo market is consistent with the tendency observed by the contemporary press, according to which by 1911 "the key regulator of the stock exchange [was] not anymore the forward market. The majority of business [was] done on spot transactions[45]". By 1914, volumes in the repo market had fallen even further. The "place position" at the end of July settlement in 1914 was some 600 million francs on the *Parquet*, plus 150 million francs at the *Coulisse*[46].

Advances investments by banks grew. Repo investments by banks remained stable. Repo total volumes decreased. The missing repo market volumes come from simple clients, capital investors that were not financial institutions. In 1898, these "individual investors" participated with 90% of the total funds supplied on the repo market (Charousset, 1898). In June 1911, according to my own estimates, they represented 53% of the market. I estimate this figure by exploiting data on 56 brokers (80% of the population) coming from the accounts entries verifications of brokers introduced by the syndic in 1900[47].

Clients' money did not vanish, though. Banks took possession of it, as shown by the increase in deposits displayed in Figure 6. Therefore, the reform stabilized and made the market

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[43] See Charousset (1898) and Allix (1901).
[44] The first figure is given by the CAC's *syndic* two months after the crisis (A-CAC, MCS, 11 November 1912). The second by the 1915's Finance Minister, Alexandre Ribot. (Intervention of Mr. Ribot at the *Assemblée Nationale*, in response to the interrogation of Mr. Monzie, on September 23rd, 1915).
[45] L'année financière du Temps, 1 January 1912.
[46] See Giraud (1918), as well as Vidal (1919).
[47] *Vérifications d'écritures*, conserved at CAC archives, CAEF. Description of the source and the estimation method is provided in the Appendix.

surer, but resulted also in the spillover of some volume to a less regulated market. At that time, the banking market was much less regulated than the stock market. The only regulation applied was the general commercial law applied to any limited liability company. No specific law regulated the banking system.

## 8. Conclusion

In this paper, I study the introduction of a central clearing party in the French historical repo market at the beginning of the Twentieth century. I find that this measure strongly reduced risk on the market, by reducing net exposures for market participants, by providing a prime counterparty and by effectively monitoring the CCP members. As a result, between 1895 and the beginning of WW1 no major crisis hit the Paris market. The repo market was resilient to the 1907 international crisis, in spite of its large size.

With respect to the current debate dealing with the introduction of a repo CCP in the US, however, some caveats must be highlighted. First of all, introducing a CCP involves transferring credit, liquidity and operational risk from market participants (banks and dealers) to CCPs. This shift implies that CCPs could themselves become sources of systemic risk. A way to moderate this type of risk consists in the implementation of supervision and monitoring practices over CCP clearing members.

Historical evidences shows that if monitoring and screening procedures are not implemented CCPs can fail, with potentially disruptive consequences upon their members (Bignon and Vuillemey, 2017). The historical case presented in this article provides an example of a CCP that successfully managed counterparty risk and fought moral hazard among its members. The introduction of a monitoring mechanism was indeed the key event drastically reducing risk on the market.

Second, a greater use of CCPs implies a higher collective reliance on a limited range of risk management techniques. The consequent synchronization of reactions to bad news can generate pro-cyclical shocks to the financial system. As an instance, CCPs demanded higher haircuts on riskier sovereign bonds during the 2011 debt crisis. Aggressive haircutting likely contributed in worsening trading conditions for Greek, Irish, Italian, Portuguese and Spanish bonds. Moreover, recent literature studying the same crisis finds that CCPs work well in

times of moderate stress, but appear to be less effective in case of greater shocks (Boissel, Derrien, Ors, and Thesmar, 2017). Once again, the key point is how risk is managed inside CCPs and among its participants.

Finally, as documented in this paper, new regulation often introduces frictions. Frictions can reduce liquidity and eventually incentivize the development of opaquer and less regulated markets. In particular, the 1898 French reform resulted in the leak out of some volume from the repo market to the banking market, which at the time was subject to less regulation. In order to avoid such spillovers, any introduction of a repo CCP should be designed to attract new clients by offering competitive services or fees.

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## Figures and tables
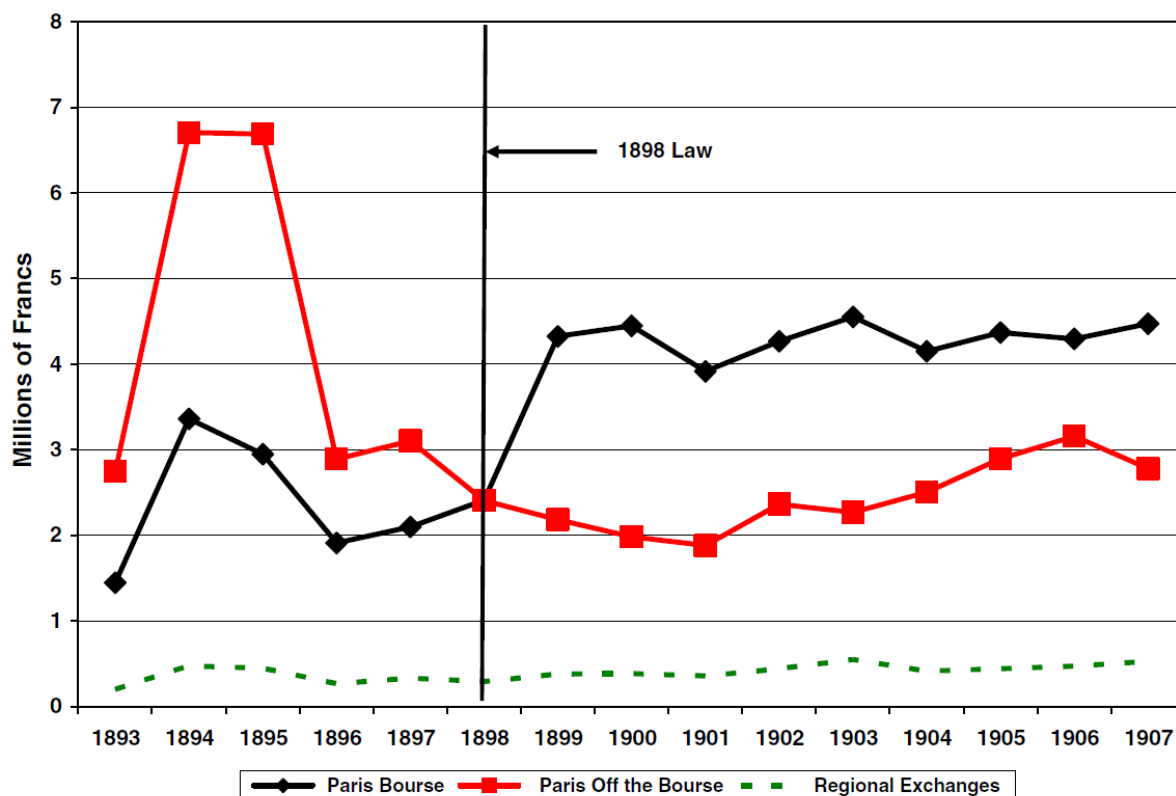


Figure 9 – Annual stamp duties paid on securities transactions, 1893-1907. Source: Riva and White, Danger on the Exchange, from data published on the Bulletin de Statistique et Legislation Comparées.



Figure 10 - Extract of the page 2 of Paris Stock Exchange Official List, January 31st, 1911. Courtesy of Equipex DFIH. DFIH database (Paris School of Economics), version May 2017. (Hautcoeur and Riva, The Data for Financial History).
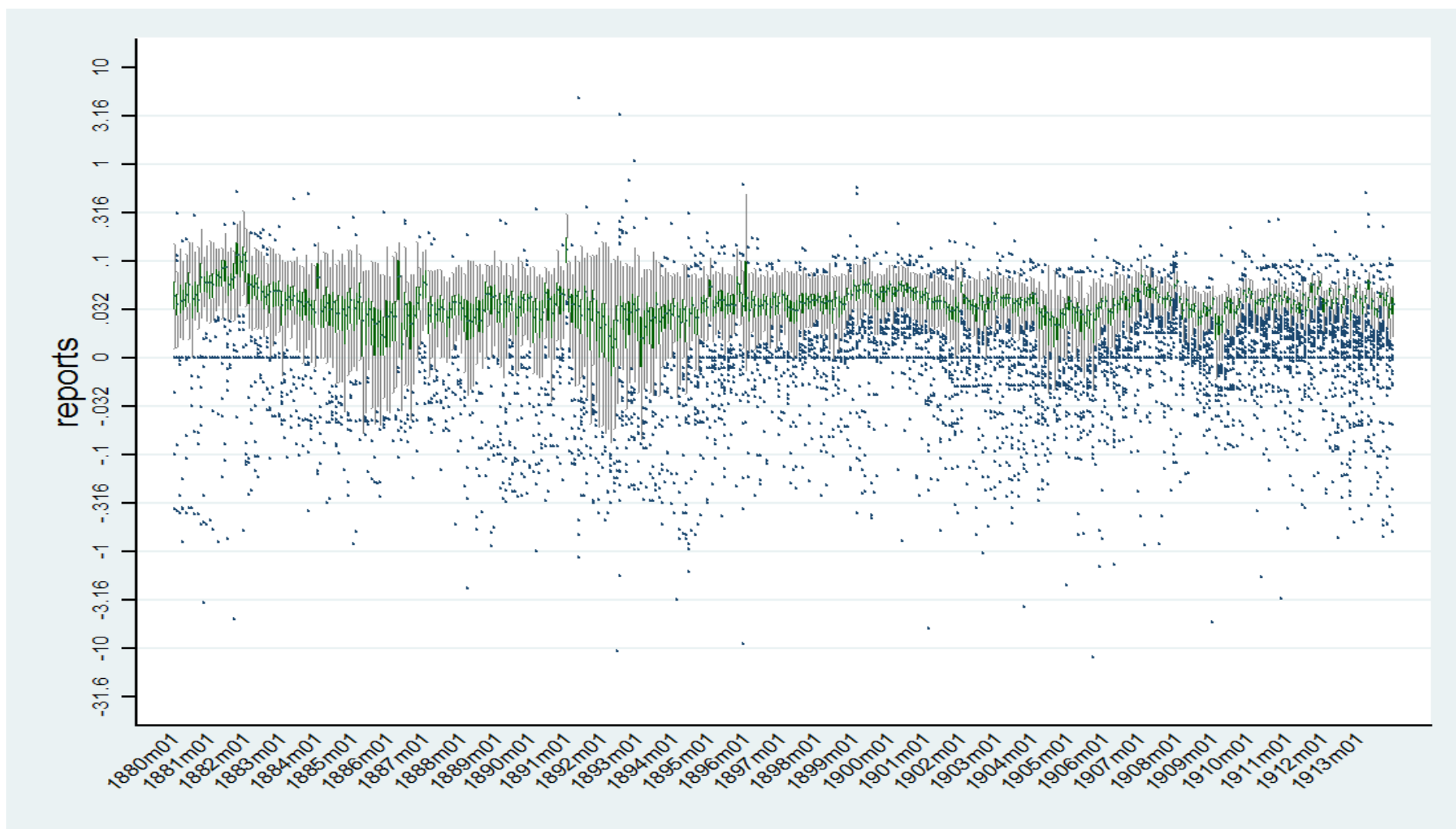
Figure 11 - Tukey box plot. In green, for each end-of-the-month settlement, the range including the reports rates between the first and third quartile (the 50 % central rates). In grey, the two ranges obtained starting from the two quartiles and then adding ±1,5 IQR. In blue, outliers. On the ordinate axis, logarithmic scale. Legend of Y axis shows actual interest rates (.032 = 3.2%; .316=31.6%). Source : my elaboration from data published on Paris Stock Exchange Official Lists, 1880-1913, and collected partly by me and partly in the context of Equipex DFIH. DFIH database (Paris School of Economics), version May 2017. (Hautcoeur and Riva, The Data for Financial History).
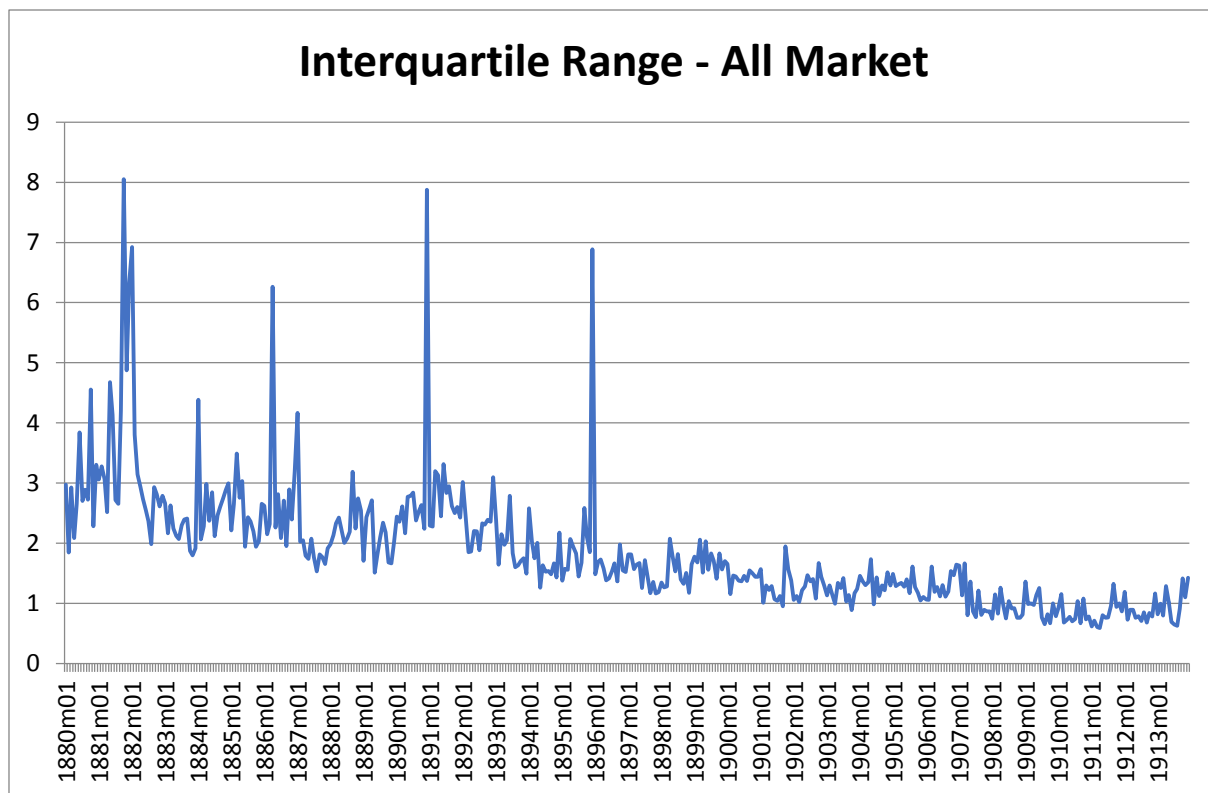
*Figure 12 - Dispersion of repo rates measured by the Interquartile Range (IQR). The IQR or H-spread is equal to the difference of 75th and 25th percentiles. All repo rates done at each end-of-month settlement from January 1880 to 1913 are included in the calculations. Source: my calculations from data published on the Paris Stock Exchange Official Lists.*



*Figure 5 - Risky and safe rates done on the repo market, 1896-1904. Source: my elaboration from data published on Paris Stock Exchange Official Lists.*
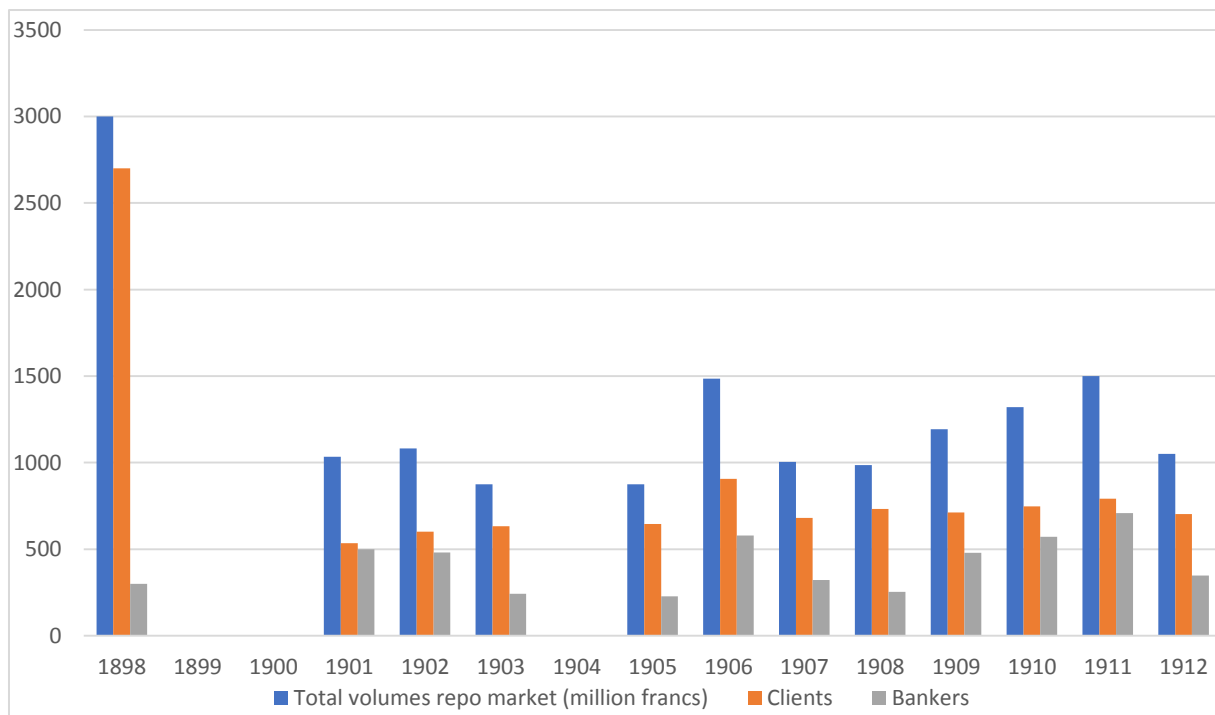
*Figure 6 - Funds invested on official repo market, 1898-1912. Sources: Charousset (1899) for 1898. Accounting verifications (CAC archives) for 1901-1912 (excluding 1906). Internal study by CAC for 1906.*
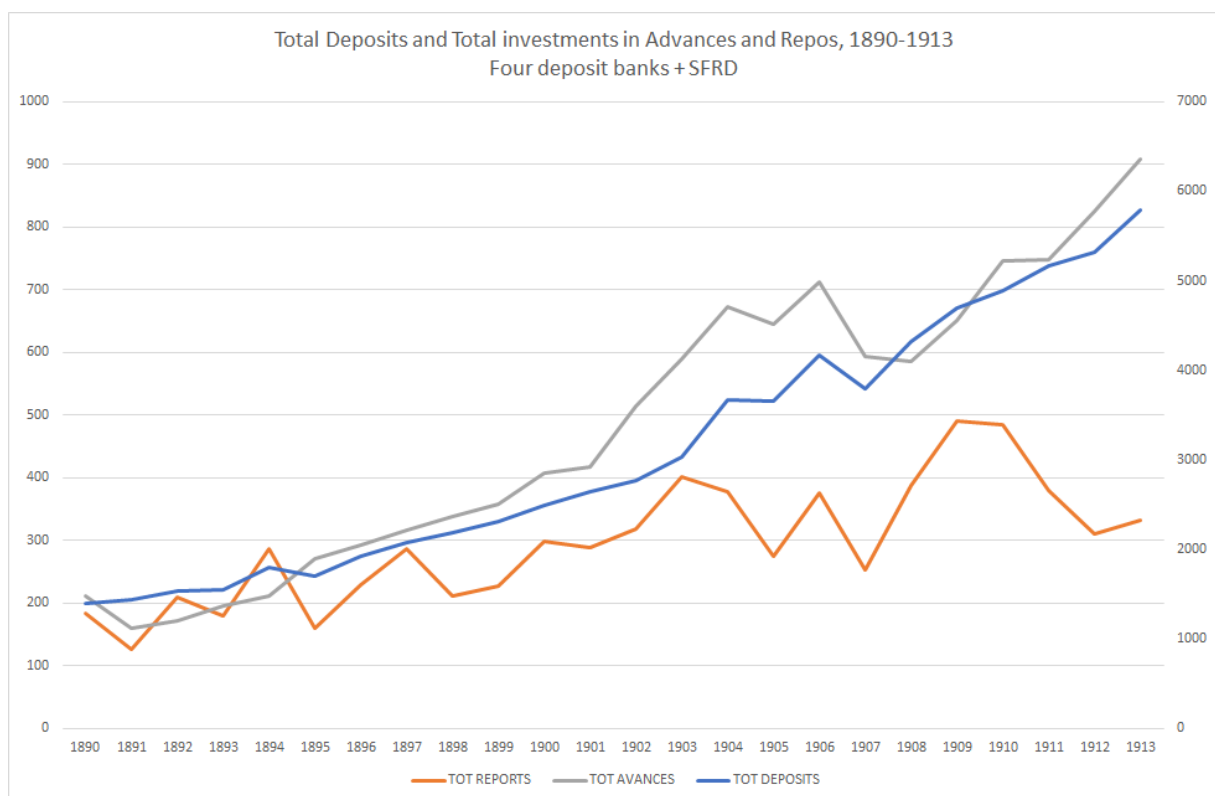


*Figure 7 - Total amount of funds invested in repos and advances, and total amount of deposits (scale on the right), by the four main investment banks and a firm specialized in short-term investment. Balance sheets data from December 31<sup>st</sup> of each year from 1890 to 1913. Source: author's DB.*

| Type of security/issuer | 1880 | 1885 | 1890 | 1895 | 1900 | 1905 | 1910 |
|---|---|---|---|---|---|---|---|
| French private stocks | 40 | 40 | 50 | 44 | 58 | 65 | 75 |
| | 57,97% | 53,33% | 51,55% | 31,21% | 31,52% | 32,83% | 28,09% |
| French public bonds | 3 | 4 | 3 | 6 | 8 | 8 | 7 |
| | 4,35% | 5,33% | 3,09% | 4,26% | 4,35% | 4,04% | 2,62% |
| French private bonds | 4 | 3 | 2 | 8 | 13 | 11 | 17 |
| | 5,80% | 4,00% | 2,06% | 5,67% | 7,07% | 5,56% | 6,37% |
| Foreign private stocks | 12 | 18 | 17 | 20 | 33 | 43 | 58 |
| | 17,39% | 24,00% | 17,53% | 14,18% | 17,93% | 21,72% | 21,72% |
| Foreign public bonds | 10 | 10 | 25 | 41 | 50 | 54 | 79 |
| | 14,49% | 13,33% | 25,77% | 29,08% | 27,17% | 27,27% | 29,59% |
| Foreign private bonds | 0 | 0 | 0 | 22 | 22 | 17 | 31 |
| | 0,00% | 0,00% | 0,00% | 15,60% | 11,96% | 8,59% | 11,61% |
| TOTAL | 69 | 75 | 97 | 141 | 184 | 198 | 267 |

*Table 1 – Number of securities used in at least one repo transaction done on the Parquet on the 31/12 settlement, by type of collateral. Source: Data collected by the author on Paris stock exchange official lists, and integrated with information coming from DFIH database, version May 2017 (Hautcoeur and Riva, The Data for Financial History).*

| Type of security | 1906 | 1914 |
|---|---|---|
| French perpetual bonds | 5.39% | 9.41% |
| French shares and bonds | 27.45% | - |
| Foreign public bonds | 31.08% | - |
| Foreign shares and bonds | 36.08% | - |
| French bonds, very good quality | - | 1.35% |
| French shares, very good quality | - | 5.41% |
| Public and private foreign bonds, good quality | - | 18.89% |
| Industrial shares, good quality | - | 27.71% |
| Overpriced industrial shares | - | 34.16% |
| Bad or very bad industrial shares | - | 3.06% |
| Total | 100% | 100% |

*Table 2 – Shares of volumes invested in the Paris repo market, by type of collateral asset. Sources: Figures for 1906 come from A-CAC, B-0064877/1,'L'Impôt sur les operations de bourse'. Figures for 1914 come from A-BDF, 1069200401/147, 'Note de la CAC concernant la liquidation de Juillet 1914, July 7, 1914'.*

| | | | | | | |
|---|---|---|---|---|---|---|
| French government bonds | 3 | 1 089 | 2.29 | 1.56 | -5.22 | 9.92 |
| French banks, stocks | 7 | 2 493 | 3.48 | 2.93 | -72.33 | 27.54 |
| French banks, bonds | 2 | 147 | 4.02 | 1.22 | 0.03 | 8.86 |
| French railways, stocks | 6 | 2 280 | 3.37 | 1.83 | -8.79 | 12.47 |
| French railways, bonds | 4 | 635 | 3.91 | 1.05 | 0 | 7.23 |
| Other French securities | 6 | 1 925 | 3.91 | 2.02 | -225 | 30.76 |
| Foreign government bonds | 8 | 2 560 | 3.13 | 1.91 | -11.34 | 61.78 |
| Foreign banks, stocks | 4 | 1 406 | 2.65 | 1.61 | -61.54 | 15.61 |
| Foreign railways, stocks | 5 | 1 718 | 4.27 | 2.29 | -20 | 27.43 |
| Foreign railways, bonds | 4 | 933 | 4.01 | 1.53 | -11.11 | 7.69 |
| Total French | 28 | 8 569 | 3.42 | 2.19 | -225 | 30.77 |
| Total Foreign | 21 | 6 617 | 3.42 | 2.12 | -61.53 | 61.78 |
| TOT | 49 | 15 186 | 3.42 | 2.16 | -225 | 61.78 |

*Table 3 -Descriptive statistics – Collateral assets composing the portfolio. Source: my DB.*

| Multiple breakpoint tests |
|---|
| Bai-Perron tests of L+1 vs. L sequentially determined breaks |
| Sample: 1880M01 1913M12 |
| Included observations: 408 |
| Breaking variables: C |
| Break test options: Trimming 0.05, Max. breaks 5, Sig. level 0.05 |
| Allow heterogeneous error distributions across breaks |

| Sequential F-statistic determined breaks: | | | 4 |
|---|---|---|---|
| Break Test | F-statistic | Scaled F-statistic | Critical Value** |
| | | | |
| 0 vs. 1 * | 291.3758 | 291.3758 | 9.63 |
| 1 vs. 2 * | 254.2529 | 254.2529 | 11.14 |
| 2 vs. 3 * | 48.68823 | 48.68823 | 12.16 |
| 3 vs. 4 * | 19.25702 | 19.25702 | 12.83 |
| 4 vs. 5 | 9.397443 | 9.397443 | 13.45 |

* Significant at the 0.05 level.
** Bai-Perron (Econometric Journal, 2003) critical values.

Break dates:

| | Sequential | Repartition |
|---|---|---|
| 1 | 1896M01 | 1882M04 |
| 2 | 1907M04 | 1896M01 |
| 3 | 1901M02 | 1901M02 |
| 4 | 1882M04 | 1907M04 |

*Table 4 – Multiple breakpoint test. Bai-Perron tests of L+1 vs. L sequentially determined breaks. Indicated date is the first settlement of new regime.*

|  | 1880-1900 | 1901-1913 | 1880-1913 | diff-in-diff |
|---|---|---|---|---|
|  | b/se | b/se | b/se | b/se |
| liquidity | -0.166*** | -0.209 | -0.107* | -0.069* |
|  | (0.04) | (0.22) | (0.05) | (0.03) |
| volatility | 13.387*** | -1.286 | 11.741*** | 13.193*** |
|  | (3.62) | (1.82) | (2.90) | (3.07) |
| general assembly | -0.500 | -0.369** | -0.435* | -0.445* |
|  | (0.30) | (0.13) | (0.20) | (0.20) |
| issue | -6.054* | -21.943* | -11.382* | -11.460* |
|  | (2.62) | (10.61) | (4.30) | (4.32) |
| risky group |  |  |  | 0.480* |
|  |  |  |  | (0.24) |
| post reform |  |  |  | 0.670* |
|  |  |  |  | (0.28) |
| interaction term |  |  |  | -1.084*** |
|  |  |  |  | (0.19) |
| Cross-section fixed-effects | YES | YES | YES | NO |
| Cluster fixed-effects | NO | NO | NO | YES |
| Time fixed-effects | YES | YES | YES | NO |
| Months dummies | NO | NO | NO | YES |
| Years dummies | NO | NO | NO | YES |
| constant | 0.094 | 0.574 | 0.061 | -0.563 |
|  | (0.31) | (0.53) | (0.23) | (0.33) |
| Within R2 | 0.168 | 0.169 | 0.120 |  |
| R2 |  |  |  | 0.142 |
| Obs | 5647 | 2817 | 8464 | 8464 |

*Table4 – Panel regressions results. Standard errors in parentheses. Standard errors calculated according to Driscoll and Kraay's (1998) methodology.*

Appendix

Data description – Macroeconomic variables

Number and level of spot prices for collateral assets come from the DFIH Database. The Data for Financial History DB is a long-run stock exchange database containing comprehensive quantitative and qualitative information on Parisian stock markets from 1795 to 1951. (Ducros et al., 2017a ; Ducros et al., 2017b).

The discount interest rate of BoF is to be found in the NBER Macrohistory DB, series m13014. The central bank's advances rate was usually kept above the discount rate by one half or one percentage point. As a consequence, it is not useful to add it as a variable, as the discount rate itself is enough.

The Paris open market rate was published by *The Economist* in London. It was the lower bound of French interest rates, since only the main Parisian banks could trade on this market certain kinds of the best paper (White, 1978). As such, this rate was structurally lower than the discount rate of the *Banque de France*, except for times of crisis. It is commonly used in the literature as representative of the Paris money market[67]. This rate is to be found in the NBER Macrohistory DB, series m13017.

I use the series of imports as a proxy for aggregate demand following Bordo and MacDonald (2005). Imports were published by the *Bulletin de Statistique et Legislation Comparée* and are available on NBER Macrohistory DB, series m07027. Nonetheless, the imports series incorporate a foreign supply dimension. Therefore, I use a quarterly series of railways revenues in order to check for robustness. The railways series has been constructed by Bazot, Bordo, and Monnet (2016) and is available as a supplementary material to their article. There is a vast literature using railways revenues as an indicator of economic activity during the Gold Standard, in both UK and Germany[68]. Moreover, Bazot, Bordo, and Monnet (2016) show that their series has a strong correlation with annual series of French activity.

Finally, I use monthly data on the BdF's bills portfolio and advances on securities as indicators of the monetary policy. Weekly data on the balance sheet of the BdF from 1898 onwards were collected by Patrice Baubeau and are available online on the BdF's website. Monthly data for 1890-1897 come from Bazot, Bordo, and Monnet's (2016) database.

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[67] For instance, by Flandreau and Sicsic (2003), Riva and White (2011), Bazot, Bordo, and Monnet (2016).
[68] See for instance Goodhart (1972), Jeanne (1995), Bordo and McDonald (2005).

## Settlement Prices (*Cours de compensation*)

Settlement prices were used to clear all forward contracts, not only repo transactions. They were created to balance out different forward orders placed at different prices for the same security. In the time span between a settlement and the following, that usually lasted 15 days, *agents de change* collected sale and purchase orders by their clients. Forward prices changed day by day. Let us remember that all orders were centralized by the *agents*. Therefore, brokers found themselves with opposite orders placed at different prices, among their own customers and among customers of their colleagues.

On the settlement day, brokers had to clear the market for each asset. The only way to do so in an orderly fashion was to fix one price for each security and use it as the reference price. The price was decided by the *Chambre Syndicale* (the governing body of the CAC) on the basis of the last actual transactions undertaken on that asset. It could be the average price calculated over the settlement day, or the first price done. This price was used to compensate orders among brokers. On the other hand, it was not applied to clients. Their transactions with brokers were settled at the order price.

In the repo market, settlement prices were used to fix the market value of each security. In case of repo chains, when a forward position was rolled over from a settlement to the following, the settlement price of the collateral asset worked as the reference price over which the interest rate was calculated. In case of a new repurchase agreement, coupling a sale on the spot market with a repurchase on the forward market, settlement prices were the spot market prices used as a reference for repo spot sales.

Estimation of volumes on the repo market

Data on volumes come from the accounts entries verifications of Parisian brokers. Starting from the January, 1901, the syndic (the head of the CAC) asked each agent de change to provide to his deputies precise information on the total amount of the funds invested in *reports* by their offices. This piece of information had to be supplied once or twice a year, depending on the occurrence of special events. The syndic, Maurice de Verneuil, had put in place this practice as a mean to control his fellows and reduce moral hazard. Brokers had to indicate whether funds invested on the repo market came from banks (*banquiers*) or other clients (*clients*).

Unfortunately, archives are incomplete, and this piece of information is not always available for each agent's file and for each date. For some cases, information on the total amounts is there but without any date. Nonetheless, for 10 dates I have information on 70% or more of the Parisian brokers. I discarded all dates for which I have information on less than 70% of the agents de change.

Using these data, I compute estimates of the total funds invested on reports market on the Parquet for each of the 15 dates. The idea at the basis of the procedure is that of respecting as much as possible the distribution of the volumes across agents de change. At the end of the procedure, I have 70 observations for each date, composed by the original sample and by randomly selected observations to fill the missing data.

The method I use is the following. First, I plot the distribution of the volumes by broker, for each of the 10 retained dates. Figure 9 is an example of such a plot, based on data for end of December, 1907. Funds employed by each agent's office were far to be normally distributed. Therefore, it makes no sense to multiply the sample mean on each date by 70 (the total number of brokers) in order to obtain the total amount invested in the market.

Second, using the Epanechnikov (1969) method, I determine the smoothing bandwidth of the kernel-density (Parzen-Rosenblatt) distribution for each date. Third, for each date I split the original sample into groups according to the bandwidth. Fourth, I let a statistical software randomly select n observations from the sample, respecting the relative weight of each group, where n = 70 − (dimension of the original sample).

Using these data, I can calculate the proportion between funds invested by banks and other clients on the Parquet. As an instance, clients invested for 460 million francs on the Parquet on the end of June settlement of 1911. The total amount invested by banks was of 412 million francs. The proportion is therefore 53:47. The sum of the two amounts gives a total of 872 million francs. This figure is a strong reduction with respect to Charousset's (1898) estimates on 1898 (3 billion francs).

Appendix Figures and Tables

| Variable | Driscoll-Kraay's Standard Errors | | | | Robust Standard Errors | | | | Bootstrap Standard Errors | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1880-1900 | 1901-1913 | 1880-1913 | diff-in-diff | 1880-1900 | 1901-1913 | 1880-1913 | diff-in-diff | 1880-1900 | 1901-1913 | 1880-1913 | diff-in-diff |
| interbank rate | 2.531*** | 0.856*** | 1.478*** | 1.477*** | 2.531*** | 0.856*** | 1.478*** | 1.477*** | 2.531*** | 0.856*** | 1.478*** | 1.477*** |
| | (0.44) | (0.19) | (0.31) | (0.30) | (0.20) | (0.18) | (0.13) | (0.15) | (0.23) | (0.14) | (0.12) | (0.11) |
| bdf rate | -1.378*** | -1.109* | -0.608 | -0.577 | -1.378*** | -1.109*** | -0.608** | -0.577** | -1.378*** | -1.109*** | -0.608*** | -0.577** |
| | (0.37) | (0.46) | (0.35) | (0.39) | (0.22) | (0.27) | (0.17) | (0.21) | (0.21) | (0.27) | (0.17) | (0.22) |
| cac 40 | 0.100 | 0.043 | 0.110 | 0.107 | 0.100* | 0.043 | 0.110** | 0.107** | 0.100** | 0.043 | 0.110*** | 0.107** |
| | (0.08) | (0.08) | (0.08) | (0.08) | (0.04) | (0.06) | (0.04) | (0.04) | (0.04) | (0.06) | (0.03) | (0.04) |
| corporate bonds | -0.260 | -0.092 | -0.333* | -0.345* | -0.260** | -0.092 | -0.333*** | -0.345*** | -0.260*** | -0.092 | -0.333*** | -0.345*** |
| | (0.19) | (0.14) | (0.15) | (0.16) | (0.08) | (0.17) | (0.06) | (0.06) | (0.07) | (0.16) | (0.05) | (0.06) |
| imports | -0.011 | -0.027 | -0.014 | -0.015 | -0.011*** | -0.027 | -0.014*** | -0.015*** | -0.011*** | -0.027 | -0.014*** | -0.015*** |
| | (0.01) | (0.02) | (0.01) | (0.01) | (0.00) | (0.02) | (0.00) | (0.00) | (0.00) | (0.02) | (0.00) | (0.00) |
| bdf credit | -0.050 | 2.833 | 1.582 | 1.625 | -0.050 | 2.833 | 1.582* | 1.625* | -0.050 | 2.833 | 1.582* | 1.625* |
| | (1.76) | (2.27) | (1.53) | (1.53) | (0.67) | (1.88) | (0.75) | (0.77) | (0.60) | (1.61) | (0.74) | (0.71) |
| asset returns | 0.022 | 0.627 | 0.120 | 0.119 | 0.022 | 0.627 | 0.120 | 0.119 | 0.022 | 0.627 | 0.120 | 0.119 |
| | (0.03) | (0.55) | (0.10) | (0.10) | (0.05) | (0.58) | (0.10) | (0.11) | (0.04) | (0.65) | (0.10) | (0.12) |
| forward | 0.007 | -0.563 | -0.086 | -0.084 | 0.007 | -0.563 | -0.086 | -0.084 | 0.007 | -0.563 | -0.086 | -0.084 |
| | (0.03) | (0.50) | (0.08) | (0.09) | (0.05) | (0.53) | (0.08) | (0.09) | (0.05) | (0.60) | (0.08) | (0.10) |
| liquidity | -0.166*** | -0.209 | -0.107* | -0.069* | -0.166*** | -0.209 | -0.107 | -0.069 | -0.166** | -0.209 | -0.107 | -0.069 |
| | (0.04) | (0.22) | (0.05) | (0.03) | (0.04) | (0.23) | (0.06) | (0.06) | (0.05) | (0.23) | (0.06) | (0.07) |
| volatility | 13.387*** | -1.286 | 11.741*** | 13.193*** | 13.387*** | -1.286 | 11.741** | 13.193*** | 13.387*** | -1.286 | 11.741** | 13.193** |
| | (3.62) | (1.82) | (2.90) | (3.07) | (3.35) | (1.19) | (3.50) | (3.90) | (3.59) | (4.24) | (3.88) | (4.30) |
| intdiv | -0.099 | -0.098 | -0.095 | -0.092 | -0.099 | -0.098 | -0.095 | -0.092 | -0.099 | -0.098 | -0.095 | -0.092 |
| | (0.11) | (0.16) | (0.08) | (0.08) | (0.13) | (0.15) | (0.11) | (0.11) | (0.15) | (0.18) | (0.09) | (0.12) |
| general assembly | -0.500 | -0.369** | -0.435* | -0.445* | -0.500 | -0.369* | -0.435 | -0.445* | -0.500 | -0.369 | -0.435* | -0.445 |
| | (0.30) | (0.13) | (0.20) | (0.20) | (0.31) | (0.18) | (0.23) | (0.22) | (0.35) | (0.20) | (0.22) | (0.23) |
| issue | -6.054* | -21.943* | -11.382* | -11.460* | -6.054 | -21.943* | -11.382* | -11.460* | -6.054 | -21.943* | -11.382** | -11.460 |
| | (2.62) | (10.61) | (4.30) | (4.32) | (3.22) | (10.07) | (5.13) | (5.13) | (3.66) | (10.77) | (4.27) | (6.48) |
| variable | | | | -0.352 | | | | -0.352 | | | | -0.352 |
| | | | | (0.22) | | | | (0.28) | | | | (0.33) |
| Private | | | | 0.189 | | | | 0.189 | | | | 0.189 |
| | | | | (0.33) | | | | (0.78) | | | | (0.87) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| semipublic | | | | 0.213 | | | | 0.213 | | | | 0.213 |
| | | | | (0.27) | | | | (0.51) | | | | (0.75) |
| Bank | | | | 0.155 | | | | 0.155 | | | | 0.155 |
| | | | | (0.21) | | | | (0.42) | | | | (0.67) |
| Railway | | | | 0.673*** | | | | 0.673 | | | | 0.673 |
| | | | | (0.17) | | | | (0.46) | | | | (0.70) |
| Foreign | | | | 0.207 | | | | 0.207 | | | | 0.207 |
| | | | | (0.19) | | | | (0.52) | | | | (0.57) |
| risky group | | | | 0.480* | | | | 0.480 | | | | 0.480 |
| | | | | (0.24) | | | | (0.59) | | | | (0.62) |
| post reform | | | | 0.670* | | | | 0.670** | | | | 0.670* |
| | | | | (0.28) | | | | (0.21) | | | | (0.27) |
| interaction term | | | | -1.084*** | | | | -1.084*** | | | | -1.084*** |
| | | | | (0.19) | | | | (0.28) | | | | (0.29) |
| Cross-section fixed-effects | YES | YES | YES | NO | YES | YES | YES | NO | YES | YES | YES | NO |
| Cluster fixed-effects | NO | NO | NO | YES | NO | NO | NO | YES | NO | NO | NO | YES |
| Time fixed-effects | YES | YES | YES | NO | YES | YES | YES | NO | YES | YES | YES | NO |
| Months dummies | NO | NO | NO | YES | NO | NO | NO | YES | NO | NO | NO | YES |
| Years dummies | NO | NO | NO | YES | NO | NO | NO | YES | NO | NO | NO | YES |
| constant | 0.094 | 0.574 | 0.061 | -0.563 | 0.094 | 0.574 | 0.061 | -0.563 | 0.094 | 0.574 | 0.061 | -0.563 |
| | (0.31) | (0.53) | (0.23) | (0.33) | (0.18) | (0.58) | (0.21) | (0.38) | (0.17) | (0.51) | (0.22) | (0.42) |
| Within R2 | 0.168 | 0.169 | 0.120 | | 0.168 | 0.169 | 0.120 | | 0.168 | 0.169 | 0.120 | |
| R2 | | | | 0.142 | | | | 0.123 | | | | 0.123 |
| Obs | 5647 | 2817 | 8464 | 8464 | 5647 | 2817 | 8464 | 8464 | 5647 | 2817 | 8464 | 8464 |

*Table 4 - Panel regressions results. Standard errors in parentheses. Standard errors calculated using 1) Driscoll and Kraay's (1998) methodology; 2) Robust estimate of variance (Huber 1967, White 1980 and 1982; 3) Bootstrap methodology.*

| Variable | 12 months | | | | 6 months | | | | 18 months | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | b/se | b/se | b/se | b/se | b/se | b/se | b/se | b/se | b/se | b/se | b/se | b/se |
| interbank rate | 2.531*** | 0.856*** | 1.478*** | 1.477*** | 2.578*** | 0.869*** | 1.488*** | 1.478*** | 2.505*** | 0.850*** | 1.474*** | 1.474*** |
| | (0.44) | (0.19) | (0.31) | (0.30) | (0.43) | (0.19) | (0.31) | (0.30) | (0.45) | (0.18) | (0.32) | (0.30) |
| bdf rate | -1.378*** | -1.109* | -0.608 | -0.577 | -1.449*** | -1.118* | -0.627 | -0.588 | -1.338*** | -1.044* | -0.599 | -0.566 |
| | (0.37) | (0.46) | (0.35) | (0.39) | (0.37) | (0.46) | (0.36) | (0.39) | (0.38) | (0.46) | (0.36) | (0.40) |
| cac 40 | 0.100 | 0.043 | 0.110 | 0.107 | 0.099 | 0.039 | 0.111 | 0.107 | 0.096 | 0.038 | 0.108 | 0.104 |
| | (0.08) | (0.08) | (0.08) | (0.08) | (0.08) | (0.08) | (0.08) | (0.08) | (0.08) | (0.08) | (0.08) | (0.08) |
| corporate bonds | -0.260 | -0.092 | -0.333* | -0.345* | -0.260 | -0.093 | -0.343* | -0.355* | -0.255 | -0.084 | -0.336* | -0.350* |
| | (0.19) | (0.14) | (0.15) | (0.16) | (0.19) | (0.14) | (0.15) | (0.16) | (0.19) | (0.15) | (0.15) | (0.16) |
| imports | -0.011 | -0.027 | -0.014 | -0.015 | -0.011 | -0.028 | -0.014 | -0.015 | -0.011 | -0.027 | -0.014 | -0.015 |
| | (0.01) | (0.02) | (0.01) | (0.01) | (0.01) | (0.02) | (0.01) | (0.01) | (0.01) | (0.02) | (0.01) | (0.01) |
| bdf credit | -0.050 | 2.833 | 1.582 | 1.625 | -0.130 | 2.775 | 1.535 | 1.586 | -0.046 | 2.848 | 1.563 | 1.611 |
| | (1.76) | (2.27) | (1.53) | (1.53) | (1.75) | (2.24) | (1.53) | (1.54) | (1.75) | (2.23) | (1.52) | (1.53) |
| asset returns | 0.022 | 0.627 | 0.120 | 0.119 | 0.025 | 0.631 | 0.124 | 0.122 | 0.023 | 0.630 | 0.122 | 0.120 |
| | (0.03) | (0.55) | (0.10) | (0.10) | (0.03) | (0.55) | (0.10) | (0.10) | (0.03) | (0.55) | (0.10) | (0.10) |
| forward | 0.007 | -0.563 | -0.086 | -0.084 | 0.006 | -0.561 | -0.087 | -0.086 | 0.007 | -0.565 | -0.085 | -0.083 |
| | (0.03) | (0.50) | (0.08) | (0.09) | (0.03) | (0.50) | (0.08) | (0.08) | (0.03) | (0.50) | (0.08) | (0.09) |
| liquidity | -0.166*** | -0.209 | -0.107* | -0.069* | | | | | | | | |
| | (0.04) | (0.22) | (0.05) | (0.03) | | | | | | | | |
| volatility | 13.387*** | -1.286 | 11.741*** | 13.193*** | | | | | | | | |
| | (3.62) | (1.82) | (2.90) | (3.07) | | | | | | | | |
| intdiv | -0.099 | -0.098 | -0.095 | -0.092 | -0.109 | -0.101 | -0.100 | -0.096 | -0.101 | -0.098 | -0.098 | -0.094 |
| | (0.11) | (0.16) | (0.08) | (0.08) | (0.10) | (0.16) | (0.08) | (0.08) | (0.11) | (0.16) | (0.08) | (0.08) |
| general assembly | -0.500 | -0.369** | -0.435* | -0.445* | -0.510 | -0.378** | -0.430* | -0.441* | -0.509 | -0.381** | -0.435* | -0.445* |
| | (0.30) | (0.13) | (0.20) | (0.20) | (0.30) | (0.13) | (0.20) | (0.20) | (0.30) | (0.13) | (0.20) | (0.20) |
| issue | -6.054* | -21.943* | -11.382* | -11.460* | -6.095* | -21.862* | -11.405* | -11.488* | -6.031* | -21.941* | -11.373* | -11.451* |
| | (2.62) | (10.61) | (4.30) | (4.32) | (2.61) | (10.54) | (4.30) | (4.32) | (2.62) | (10.63) | (4.31) | (4.32) |
| variable | | | | -0.352 | | | | -0.312 | | | | -0.330 |
| | | | | (0.22) | | | | (0.23) | | | | (0.22) |
| priv | | | | 0.189 | | | | 0.193 | | | | 0.183 |
| | | | | (0.33) | | | | (0.33) | | | | (0.32) |
| semipublic | | | | 0.213 | | | | 0.188 | | | | 0.202 |
| | | | | (0.27) | | | | (0.28) | | | | (0.27) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| bank | | | | 0.155 | | | | 0.142 | | | | 0.159 |
| | | | | (0.21) | | | | (0.20) | | | | (0.21) |
| railway | | | | 0.673*** | | | | 0.691*** | | | | 0.681*** |
| | | | | (0.17) | | | | (0.17) | | | | (0.18) |
| foreign | | | | 0.207 | | | | 0.230 | | | | 0.218 |
| | | | | (0.19) | | | | (0.19) | | | | (0.20) |
| risky group | | | | 0.480* | | | | 0.499* | | | | 0.484* |
| | | | | (0.24) | | | | (0.24) | | | | (0.23) |
| post reform | | | | 0.670* | | | | 0.656* | | | | 0.675* |
| | | | | (0.28) | | | | (0.28) | | | | (0.28) |
| interaction term | | | | -1.084*** | | | | -1.084*** | | | | -1.097*** |
| | | | | (0.19) | | | | (0.19) | | | | (0.20) |
| liquidity_6 | | | | | -0.130** | -0.203 | -0.094* | -0.071* | | | | |
| | | | | | (0.04) | (0.19) | (0.04) | (0.03) | | | | |
| volatility_6 | | | | | 12.745*** | -5.209 | 9.643** | 11.374** | | | | |
| | | | | | (3.14) | (3.60) | (3.14) | (3.24) | | | | |
| liquidity_18 | | | | | | | | | -0.193*** | -0.018 | -0.105* | -0.060 |
| | | | | | | | | | (0.05) | (0.18) | (0.05) | (0.04) |
| volatility_18 | | | | | | | | | 13.245*** | -5.034 | 11.082*** | 12.563*** |
| | | | | | | | | | (3.32) | (2.94) | (3.03) | (3.28) |
| Cross-section fixed-effects | YES | YES | YES | NO | YES | YES | YES | NO | YES | YES | YES | NO |
| Cluster fixed-effects | NO | NO | NO | YES | NO | NO | NO | YES | NO | NO | NO | YES |
| Time fixed-effects | YES | YES | YES | NO | YES | YES | YES | NO | YES | YES | YES | NO |
| Months dummies | NO | NO | NO | YES | NO | NO | NO | YES | NO | NO | NO | YES |
| Years dummies | NO | NO | NO | YES | NO | NO | NO | YES | NO | NO | NO | YES |
| constant | 0.094 | 0.574 | 0.061 | -0.563 | -0.030 | 0.552 | 0.034 | -0.593 | 0.188 | 0.092 | 0.052 | -0.610 |
| | (0.31) | (0.53) | (0.23) | (0.33) | (0.31) | (0.45) | (0.25) | (0.35) | (0.32) | (0.44) | (0.24) | (0.33) |
| Within R2 | 0.168 | 0.169 | 0.120 | | 0.169 | 0.170 | 0.119 | | 0.167 | 0.168 | 0.119 | |
| R2 | | | | 0.142 | | | | 0.142 | | | | 0.141 |
| Obs | 5647 | 2817 | 8464 | 8464 | 5647 | 2817 | 8464 | 8464 | 5647 | 2817 | 8464 | 8464 |

*Table 5 – Panel regressions results. Driscoll-Kraay's standard errors. Different time spans in: calculation of change in imports, calculation of assets capital gain, calculation of the average number of spot prices (measure of collateral liquidity), calculation of historical volatility.*
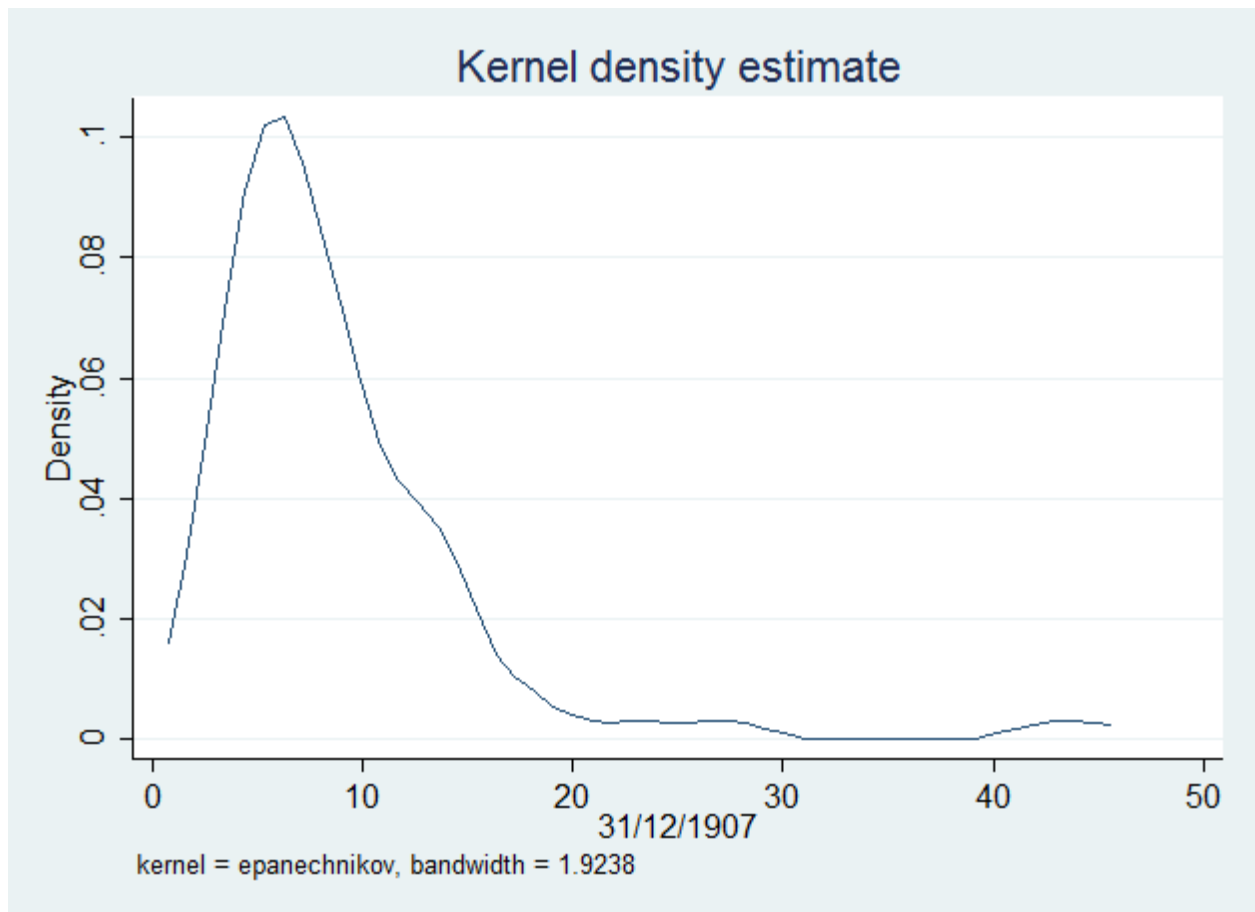
*Figure 9 - Kernel density (Parzen-Rosenblatt) distribution of repo volumes by broker, for 31/12/1907. On the horizontal axes, millions of francs. Source: author's DB. Kernel density estimates for the other 10 dates are available upon request.*

# Chapter 2. How does the bank lending channel work? Monetary policy transmission in France, 1890-1913.

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## Abstract

In this paper I study the instruments through which the Bank of France managed its monetary policy before WW1. I focus on the role of the banking sector. I build from archival sources the first dataset collecting balance sheets of French banks on a monthly basis over the period 1890-1913. I adopt a standard VAR methodology to account for the linkages between the banking sector and the real economy. I find that the Bank of France developed the practice of advancing against securities in order to build a direct channel to provide with credit the economy. This practice was later adopted by deposit banks too. When a shock hit the economy, individuals and firms borrowed against securities at the central bank and at the deposit banks branches. This resulted in a sterilization of shocks, which had no negative effect on aggregate demand.

## 1. Introduction

Since the 2007-2008 financial crisis, the role played by the banking sector in influencing the economy has become a main topic of interest for both policy makers and scholars. The crisis and its aftermaths have especially shown the critical importance of banks in supplying credit to the private sector. This essential feature of the financial market can be compromised in periods of distress. During the crisis, in the USA as well as in the Eurozone, the role played by central banks has been that of supporting aggregate demand and at the same time that of offsetting the contraction of credit granted by banks to the private sector.

Because of financial markets imperfections, highlighted by the crisis, and the very low level of interest rates, conventional monetary policy tools proved to be ineffective and sometimes not even applicable. Therefore, renewed interest was granted to the so-called "non-neoclassical" monetary transmission mechanisms. The latter are those arising because of financial markets imperfections, and do not pass through the main channel of increasing or lowering the interest rate.

In this paper, I study monetary policy transmission through the so-called "lending channel" of banks. The lending view posits that expansionary monetary policy affects aggregate demand through an increase in lending facilities of banks, especially commercial banks. To test this theory, I exploit a peculiar historical example: the Bank of France (BoF) during the *Belle Epoque*. The BoF implemented its monetary policy by adjusting its domestic asset portfolio, instead of changing its discount rate (Bazot *et al*. 2016). This approach resulted in a sterilization of international shocks and in a positive impact on French aggregate demand. The questions I raise in this paper deal with the mechanisms at work in this process. How did the BoF manage to transmit its monetary policy, if not touching at the short term interest rate? What was the role of the banking sector?

In order to answer to the question, I build a new original dataset of banks' balance sheets. It is the first database collecting balance sheets of French banks on a monthly basis. I focus in particular on short-term loans granted by commercial banks to the economy. Over the period 1890-1913, I collected more than 4,000 balance sheet items, in order to construct aggregate indices of the total amount of loans (mainly advances on securities, repos and commercial paper) granted each month by the four main deposit banks to their customers. These banks were *Crédit Lyonnais, Société Générale, Comptoir d'Escompte* and *Crédit*

*Industriel et Commercial*. Altogether, they were the main supplier of credit in pre-WW1 France[2].

Adrian and Shin (2009) note that market-based instruments such as repos and commercial paper are better indicators of credit conditions that influence the economy with respect to traditional monetary aggregates such as M2. This is true for today, but is applicable also to *Belle Epoque*'s France. Figure 1 shows the sum of balance sheet assets items representing short-term loans (commercial paper, advances on securities and historical repos[3]) as a fraction of total assets for the four main commercial banks of the period. During the period 1890-1913, they represent more than a half of deposit banks total assets. Archival evidence and contemporary studies confirm that investing in these short-term activities the short-term resources at their disposal was the main job of deposit banks of the time (Warburg 1910).

[Figure 1 here]

Bazot, Bordo, and Monnet (2016) show that, analogously, the main monetary policy tool used by the BoF consisted in the provision of lending against very good quality commercial bills and French securities. It is straightforward, therefore, to verify how those instruments played their crucial role in monetary policy transmission of pre-WW1 France. Did monetary policy transmission pass through the balance sheets of deposit banks? Is there evidence of a bank lending channel? Consistent with the short-term approach of this paper, which only focuses on shocks and not on long-term effects of monetary policy, I adopt a standard VAR methodology to account for the linkages between the banking sector and the real economy.

I find that monetary policy transmission followed different mechanisms according to the instrument at work. In particular, I find evidence of a bank lending channel which worked through advances on securities. On the other hand, I find no transmission of monetary policy shocks through the commercial portfolios of large deposit banks.

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[2] According to Plessis (2001), around 1910 the share of commercial paper in circulation held by the main deposit banks was around 37.5%, a figure comparable to that held by all local and regional banks altogether, and three times the share held by the Bank of France. Adding advances on securities and repos to commercial paper, the proportion of credit granted by these four deposit banks with respect to other all other stock-issuing banks is 65:35 (Lescure 2010).

[3] Flandreau and Sisic (2003), Ungaro (2018).

The BoF discount facilities were almost exclusively reserved to banks and bankers, as "direct" clients – such as retailers or industrial firms - represented only a very small fraction of the commercial portfolio held by the central bank. Therefore, given that there is evidence that an increase in the commercial portfolio of the *Banque* produced an impact on French aggregate demand, the latter was arguably mediated by small banks.

This conclusion is only suggested, as no monthly series of small banks balance sheets can be constructed based on available data. Nonetheless, the absence of transmission through the commercial portfolio of large deposit banks, as well as the small weight of direct clients in the commercial portfolio of the central bank, leave no other possible explanations.

The pre-WW1 banking sector in France was characterized by a strong competition between large deposit banks and the BoF (Baubeau 2016). This competitive dynamics brought to a strong evolution of the banking system in the period at study, with consequences on monetary policy. We can point out six consequential steps of this evolution.

First, starting from the 1880s, the Bank of France strongly developed its network of regional branches (Bazot 2014). Second, starting from the 1890s the large deposit banks decided to follow the Bank of France example and expand their networks. They did so by setting up new branches rather than acquiring small regional banks (Lescure 2010). Third, this strategy resulted in large deposit banks progressively absorbing the commercial paper previously on the balance sheets of small regional banks.

Fourth, the Bank of France, aiming at building a direct channel to finance the economy, developed its advances facilities. Fifth, large deposit banks, constrained by competitive pressure from the BoF, and pushed by a financial market rearrangement taking place in 1898, strongly increased their advances facilities at the expenses of loans granted to stock exchange intermediaries. Finally, this diversification strategy allowed deposit banks to grant more advances to individual customers when a shock hit the economy, partially compensating the liquidation of their positions on the stock exchange. The short-term effect was that of increasing aggregate demand.

The remainder of this paper is organized as follows. In the next section I present the literature related to this paper. In section 3, I introduce the main actors and instruments at

work in the money market of the time. In section 4 I present the data. Section 5 presents econometric analysis. Section 6 concludes.

## 2. Literature

The monetary transmission mechanism has been subject to a wide range of studies, because of its theoretical and practical importance. Nonetheless, the role played by the so-called "credit channel" in economic fluctuations and monetary policy remains, as of today, much less studied. The main issues in developing research on this subject deal with "difficulty in specifying the relevant mechanism and finding the supporting empirical evidence" (Boivin et al. 2010). Credit channels, or non-neoclassical transmission mechanisms, are those arising because of financial markets imperfections.

The standard textbook account distinguishes among three main non-neoclassical channels[4]: 1) government interventions in credit markets having effects on credit supply; (2) the so-called bank-based channels, acting through lending and bank capital; (3) the balance-sheet channel, working directly on firms and households. In this paper, I focus mainly on the bank lending channel. According to the lending view, banks are crucial actors of the financial sector, as they are well suited to solve asymmetric information problems in credit markets. More specifically, some types of borrowers do not have access to credit unless they borrow from banks.

The bank lending channel functions as follows. Expansionary monetary policy, through a rise in bank reserves and bank deposits, increases the quantity of bank loans. The increase has a positive effect on those borrowers depending on banks for their access to credit. In turn, this dynamics has a positive effect on aggregate demand[5].

Empirical literature in the last twenty years has tried to assess the importance of the bank lending channel, finding conflicting results. Gertler and Gilchrist (1993, 1994), as well as Peek and Rosengren (1995a and 1995b), and Kashyap and Stein (1995), find evidence in support of the lending view, while Romer and Romer (1989) and Ramey (1993) rule out the

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[4] Gertler and Kiyotaki (2010), Adrian and Shin (2010b), Boivin, Kiley and Mishkin (2010).
[5] Bernanke and Gertler (1985), Bernanke and Gertler (1995), Bernanke (2007), Gertler and Kiyotaki (2010), Diamond and Rajan (2006), Gertler and Karadi (2011), Adrian and Shin (2010b).

possibility of the effectiveness of this channel. More recent research tries to disentangle the different mechanism at work. Kashyap and Stein (2000) study the impact of monetary policy on lending behavior, finding that there are important cross-sectional differences among banks. In particular, impact of policy shocks is stronger for smaller banks and, among those, for banks with the least liquid balance sheets. The evidence I show in this paper is perfectly consistent with Kashyap and Stein's (2000) results.

Iacoviello and Minetti (2008) present evidence of bank lending channel in the housing market, arguing that the relevance of the credit channel depends on the efficiency and organization of the housing finance system. Gerali et al. (2010) find that the existence of a banking sector helps propagate supply shocks. Finally, Ciccarelli, Maddaloni, and Peydrò (2015) find that the credit channel amplifies the impact of a monetary policy shock on GDP. In their view, the bank lending channel is especially at work for business loans.

Another strand of literature this paper is linked to is the one about French monetary policy under the classical gold standard. This literature mainly focuses on the debate about the so-called "rules of the game"[6]. Central banks were supposed to increase their discount rates to facilitate a gold inflow, and to reduce the interest rates to ease a gold outflow, in case of balance-of-payment deficits. The aim was that of restoring the ratios of price levels among countries, to bring them back to the par exchange rate[7].

It is well known that the Bank of France repeatedly violated the rules of the game[8]. In particular, while the other two pillars of the Gold Standard, the Bank of England (BoE) and the Reichsbank, regularly intervened on their discount rates, the BoF did not change its rate as often[9]. Bazot, Bordo, and Monnet (2016) explain the stability of the French rate despite international constraints by looking at the BoF's domestic asset portfolio. They find that when an international shock arrived, the BoF did not react by touching its interest rate, but rather by adjusting its portfolio. Monetary policy was indeed effective, as gold outflows were offset by an increase in central bank liquidity, and most importantly international shocks did not have negative effects on French aggregate demand.

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[6] According to Eichengreen and Flandreau (1997), the first use of this expression has to be attributed to Keynes (1925).
[7] Officer (2007), Bordo and Schwartz (2009), Eichengreen and Flandreau (1997).
[8] Bloomfield (1959).
[9] Morys (2013).

Finally, a recent paper by Jobst and Ugolini (2014) addresses the long-term relationship between money markets and monetary policy. Basing their analysis on a dataset covering ten countries over two centuries, they find that changes in money market microstructures can impact on monetary policy tools and targets and vice versa. In this paper, I focus on the short-term aspects of this relationship. In particular, I study how money market structure and functioning participated to the transmission of BoF's monetary policy shocks to the economy.

## 3. The actors and instruments of the money market: 1890-1913

The main actors at stake in the money market of the time were the central bank, four large deposit banks representing the main liquidity supplier in the economy, local and regional banks, as well as brokers and dealers operating on the stock exchange.

### The Actors

At the center of the system was the Bank of France, a private institution, whose monopoly of notes issue was usually renewed by the Government in exchange for regular improvements. The traditional role of the central bank was that of supporting national trade and manufacturing through promoting an easy access to credit, low interest rates and integrated financial markets.

A second main player of the market was represented by four large deposit banks. They were characterized by national networks of branches, and specialized in short-term activities. These banks, namely *Crédit Lyonnais*, *Société Générale, Comptoir d'Escompte* and *Crédit Industriel et Commercial*, started to specialize their business after the banking crises of the 1880s, namely the *Union Générale* crash of 1882 and the *Comptoir d'Escompte* crack of 1889.

They progressively abandoned large investments in industrial projects, and focused on short-term investments. From 1890 in particular, following the evolutions at work in the BoF, they expanded their activity throughout all the country by opening new branches, attracting short-term deposits and supplying short-term credit. The leading bank in this respect was *Crédit Lyonnais*, followed shortly afterwards by *Société Générale* and *Comptoir d'Escompte* (Lescure 2003). *Crédit Industriel et Commercial* remained essentially a Paris-based bank.

[Figure 2 here]

Figure 2 shows the evolution of regional branches for the three main deposit banks and Bank of France, from 1901 to 1913. It represents the number of branches outside Paris and its region at the end of each year. The source is an internal document elaborated by the Department of Economic and Financial Studies of *Crédit Lyonnais*, called *The Album* (see Baubeau et al. 2018). No data are available before 1901. During the first 13 years of the 20th century, Bank of France regional branches were multiplied by 1.61 (from 351 to 568), following the evolution started in 1880, while regional branches of the three main deposit banks were multiplied by almost three (from 552 in 1901 to 1515 in 1913).

A third actor of the market can be found in local and regional banks. These banks held 70% of the discount market up to the end of the 19th century (Bouvier 1979). This figure decreased by a half in the first ten years of the twentieth century (Plessis 2001). This loss of market share was mainly due to the expansion of the regional activities of the main deposit banks shown in Figure 2. As a consequence, local and regional banks had to differentiate their business model. They reduced the quantity of commercial-paper-backed loans by increasing long-term loans to local business. This change in business increased their exposure to liquidity risk. They were therefore increasingly dependent on BoF's assistance to get access to short-term funding in case of need.

Figure 3 shows the weight of commercial portfolio in the balance sheets of regional banks and deposit banks. The source is once again the *Album* elaborated by the *Crédit Lyonnais*. No data are available before 1901. I define regional banks those banks having headquarters outside Paris and its region. I count 68 of them in the *Crédit Lyonnais Album*, which is a source highly representative of the banking system of the time (Baubeau et al. 2018). Figure 3 shows that deposit banks kept their commercial portfolio stable with respect to total assets from 1901 to 1913. On the other hand, the weight of commercial portfolio decreased in 13 years from 46% to 25% of total assets for regional banks. Regional banks were progressively threw out the commercial bills market, and became more illiquid.

[Figure 3 here]

Finally, an important segment of the money market took place inside the stock exchange. Commercial banks, as well as liquidity holders in trade and manufacturing, used to invest a part of their short-term assets on the stock exchange. A fourth category of actors at stake was therefore represented by stock market intermediaries. There were two types of them. The *agents de change* were the official brokers operating on the Paris Bourse. The *coulissiers* were the brokers-dealers that managed transactions on the Parisian OTC-like market, called the *Coulisse*. *Agents de change* and *coulissiers* borrowed every 15 or 30 days the capital necessary to perform the settlement of forward operations[10], providing securities as collateral.

**The Instruments**

Given this diversity in players, the French money market was characterized by an analogous plurality of instruments. Let us describe in detail three of them: commercial bills, advances on securities, and repurchase agreements.

The most important money market instrument was the commercial bill (Baubeau 2004). This was a written order binding one party (the drawer or *tireur*) to pay a fixed sum of money to another party (the drawee or *tiré*) at a predetermined future date, usually in 60 to 90 days. The original parties operated in trade and, to a minor extent, in manufacturing. Regional banks, commercial banks and private bankers invested in these instruments most of their deposits.

By adding theirs as a third signature, they could rediscount the bills at the BoF at need, and convert them instantly to cash. The commercial paper discount mechanism was the milestone of the French banking system, according to the most prominent bankers of the time[11]. The Bank of France, by statute, could not accept less than three signatures on the paper it discounted. As a consequence, its discount facilities were almost exclusively reserved to banks and bankers. The share of commercial bills coming by individual clients held in BoF's portfolio was around 5% in the 1880s and increased to no more than 13% in

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[10] The official market or *Parquet* organized two settlements per month, at the 15th and at the end of the month. The OTC market or *Coulisse* settled its forward operations only once a month.
[11] Banque de France Archives (BFA), 1069199406/1, Preparatory documents of the US Senate National Monetary Commission. See also National Monetary Commission, Document No. 405, Interviews with M. Ullmann, Director of the Comptoir d'Escompte, and with Baron Brincard, administrateur délégué and other officials of the Crédit Lyonnais.

1913 (Lescure 2003). Therefore, the so-called "*escompte direct*" (direct discount) represented only a small part of BoF's business.

Deposit banks, as well as the central bank, also granted advances against collateral. The BoF only accepted French assets of very good quality. The central bank's advances rate was usually kept above the discount rate by one half to one percentage point as a means to discourage "speculation" as opposed to "national trade"[12]. Commercial banks, on the other hand, advanced money against both French and foreign collateral. The rates they applied varied on the basis of both securities and borrowers' quality, but were decided according to the general conditions of the market. The main indicator used by banks as a reference for their loans was the repo rate, or *taux des reports*[13].

The latter was the rate at which banks and other short-term lenders lent money to stock market intermediaries through the *reports* market. The French historical repo market, or *marché des reports*, took place inside the Paris stock exchange. In this market, money lenders were mainly banks, manufacturing firms and retailers investing their liquid assets, as well as individual investors[14]. Money borrowers were bullish traders willing to roll over their open positions, who needed liquidity to do so.

Loans took the form of the sale of an asset coupled with the agreement to repurchase the same asset on the forward market on a specific future date. In practice, they were collateralized loans, during whose validity the lender enjoyed full ownership rights over the underlying security. Every transaction was mediated by an *agent de change*, a pure broker. Said differently, every loan was centralized.

From the point of view of a commercial bank, *reports* and advances were very similar. The time span was quite the same: one to three months for advances, two weeks or one month, often renewed, for repos. Collateral assets were the same. What changed were mainly the borrowers. Advances on securities were granted to people engaged in trade and

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[12] Banque de France Archives (BFA), 1397199403/178, "Du développement des avances sur titres à la Banque de France", 1913.
[13] Crédit Lyonnais Archives (CLA), Circulaires Direction Générale. 29 November 1902.
[14] French National Archives, Alexandre Ribot personal archives, Lettre de M. Ribot à M. Pallain, November 7, 1914, 563/AP/16. See also François Marsal, vol. V, pp. 200-201.

manufacturing[15]. Repos were loans to brokers, who used the money to perform the settlements of forward operations.

Accordingly, deposit banks applied different conditions to different types of borrowers. Following the BoF, commercial banks applied margins to their loans. They lent an amount of money lower than the market value of the collateral security. The margin amount varied through assets types, from 20% up to 40%, for the less sure collateral. No margins were applied in the repo market, where banks were protected by joint liability among brokers, at least from 1899 on (Ungaro 2018) .

[Figure 4 here]

Starting from the second half of the 1890s, deposit banks progressively developed their advances on securities at the expenses of *reports*. Figure 4 shows the total amount of advances granted against securities and the total amount of funds invested on the repo market at the 31/12 of each year from 1890 to 1913 in the balance sheets of the four main deposit banks. The graph allows to assess the relative development of repos and advances on securities. Repos were progressively outnumbered by advances. The proportion became of 1:3 at the end of the period.

This dynamics had two main reasons. The first has to be sought in the competitive framework of the banking sector. The second in a regulatory change. Let us consider the two elements separately. In 1898, the government passed a new set of regulations reorganizing the financial market[16]. One of the main points addressed directly the banking system. Banks had to pass through the intermediation of the *Parquet* for each transaction undertaken on securities listed on the official stock exchange.

This measure meant that banks had to pay a commission fee plus the financial transaction tax (FTT) for each repo transaction undertaken on a listed security. The same did not apply to advances, as they were not considered stock market operations. Therefore, advances were not subject to the FTT or to brokers' stamp duties (Allix 1901, p. 156). Commercial banks, starting from *Crédit Lyonnais*, the market leader, had therefore an incentive to

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[15] National Monetary Commission, Document No. 405, Interviews with M. Ullmann, Director of the Comptoir d'Escompte, and with Baron Brincard, administrateur délégué and other officials of the Crédit Lyonnais.

[16] For details, see Hautcoeur, Rezaee, and Riva (2010), Lagneau-Ymonet and Riva (2017), and Ungaro (2018).

diversify their short-term loans, fostering the development of advances on securities at the expenses of repos[17].

The second reason explaining the development of advances facilities by deposit banks is internal to the banking system. Competition among banks (including the Bank of France) reduced the quantity of commercial paper in circulation, inducing deposit banks to decrease their discount rates in order to attract clients[18]. As a consequence, commercial banks looked for other short-term investment possibilities.

Moreover, since the beginning of the 1890s, the Bank of France itself had increased the amount of its advances on securities[19]. Figure 5 shows the evolution of total assets, as well as advances and commercial paper portfolios of the Bank of France, from 1890 to 1913. Figures are relative to the end of each year, and 31/12/1890 is taken as a basis. During this period, the amount of commercial paper in the balance sheet of BoF was multiplied by two, exactly as the total assets did. On the other hand, the amount of advances against securities was multiplied by three.

[Figure 5]

The reasons of the BoF advances development were multiple[20]. Firstly, the 1870-1914 period, in particular after 1890, was marked by an important development of the stock market. The total market capitalization of the Paris stock exchange grew from 78 billion francs in 1880 to 141 billion francs in 1913 (Hautcoeur 1994). The figures represent around 3.5 times the French GDP, as estimated by Lévy-Leboyer and Bourguignon (2008). Second, and even more importantly, this wealth was extremely parceled out and for a large part in the hands of small savers[21].

As a consequence, the Bank of France had a double interest in developing its advances facilities. First, as a private entity, the intensification of its presence in the advances market

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[17] CLA, Circulaires Direction Générale. September 17th, 1901 ; June 3rd, 1902 ; November 29th, 1902.

[18] CLA, Circulaires Direction Générale. 17 September 1902. See also Bazot (2014).

[19] According to Lescure (2003), the ratio between the two portfolios – discount and advances – evolved from 16/84 in 1880 to 31/69 in 1913.

[20] BFA, 1397199403/178, *Note sur les Avances sur titres en 1870*, BoF's internal document, undated (likely around 1912).

[21] BFA, 1397199403/178, *Les Avances sur titres*, BoF's internal document, 30 June 1900, as well as *Note sur les Avances sur titres en 1870*, BoF's internal document, undated (likely around 1912).

was clearly a source of revenues to be exploited. Second, as a public actor, always seeking to confirm its monopoly of notes issue, the BoF could display the development of advances as a service to small savers. The latter was the main reason motivating the 1890 decision of lowering the minimum amount the BoF could advance against securities, from 500 to 250 francs[22].

Accordingly, the creation of advances current accounts (*comptes courants d'avances*) in 1880 was decided in order to provide a service to retailers and small borrowers[23]. This was true for Paris but also for the network of branches that was rapidly increasing all over France (Bazot 2014). According to an internal document of the BoF, the average amount lent through those current accounts was very low, and declining over the period 1902-1912 from 1100 to 960 francs per account[24]. This figure represents approximately the annual salary of a non-qualified laborer in 1912, in a context of very high salary inequality (Piketty 2006, chapter 3). In 1909, the number of securities depositors amounted to almost 100.000, "in vast majority private individuals"[25].

Advances current accounts allowed borrowers to open up a line of credit at the Bank of France by depositing their securities. The aim was that of granting access to liquidity as fast as possible in case of need. For "traditional" advances, the borrower needed to be physically present at the moment of the loan demand, and had to wait a few days to pass through all the necessary controls. By depositing securities in their account at the BoF, on the other hand, retailers and other kinds of small borrowers gained direct access to liquidity in moments of necessity.

It should be noted here that this possibility was highly useful not only to face idiosyncratic shocks, but also as a monetary policy tool in order to transmit expansionary shocks directly to the economy. In such a context, when deposit banks looked for a way to increase and diversify their short-term investments, the choice of developing their own advances facilities was the most natural way to follow.

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[22] BFA, Minutes of Conseil Général (CGM), board of directors, March 27th, 1890, and Minutes of Comité des Livres et Portefeuilles (CLPM), March 24th, 1890.

[23] BFA, 1397199403/178. J. Ganne de Beaucoudrey, *Du développement des avances sur titres à la Banque de France*, 1907.

[24] BFA, 1397199403/178 J. Ganne de Beaucoudrey, *Du développement des avances sur titres à la Banque de France*, 1907.

[25] BFA, G. Robineau's note, '*La banque de France et les sociétés de crédit*', 1909, cited in Lescure (2003).

## 4. Data

I hand collected balance sheet items regarding money market instruments of the four main deposit banks, from 1890 to 1913. Data frequency is monthly. After the 1882 *Union Générale* crisis, the main credit establishments started publishing their balance sheets with monthly frequency on the economic and financial press. There was no legal duty to do so: the law only required an annual statement at the end of the year. *Crédit Lyonnais* and her colleagues opted for this practice as a form of advertisement based on transparency, in order to attract deposits. Small banks did not do so. As a consequence, no monthly series can be constructed for these institutions.

The main sources I use are the *Cote de la Bourse et de la Banque* and the *Economiste Français*. The former was a prominent daily financial newspaper edited by Emmanuel Vidal, previously a dealer on the *Coulisse*. The latter was an important economic and financial magazine issued weekly and edited by Paul Leroy-Beaulieu, member of the *laissez-faire* minded *Société d'Economie Politique* and Political Economy professor at *Collège de France*. Before September 1890, it was impossible for me to build a complete series. In particular, *Crédit Lyonnais*' balance sheets are published without regularity and often with 2- or 3-months gaps, before this date. This limitation determines the start date of this paper.

The items I collected are the ones related to the main money market instruments. The main item is "*portefeuille commercial*", which evaluates for each bank the value of the bills of exchange held by the institution and ready to be discounted at the Bank of France at in case of need. The second item I collected is "*avances sur garanties*". This item contains the amount of advances granted by the bank, against any type of pledge. Securities were by far the most employed type of collateral[26]. Let us note that the amount does not correspond to the market value of the securities, as the banks applied a margin to each advance granted.

The third item for which I collected data is "*reports*". The figure corresponds to the total amount of cash invested in the market, that is to say lent to stock market intermediaries against collateral in account for the end-of-the-month settlement. Unfortunately, after July

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[26] A series conserved at *Crédit Lyonnais* Archives (31 AH 85 to 31 AH 310) contains precise information on the type of collateral accepted by this bank, which was by far the largest of the market. Moreover, during certain sub-periods of my study, *Crédit Industriel et Commercial* in its reports distinguishes between advances collateralized by securities and advances collateralized by other types of pledge. Securities were the main type of collateral for both the institutions.

1904 the *Crédit Lyonnais* stopped distinguishing in its statements between advances and *reports*, cumulating the two amounts in a unique balance sheet item. The same holds for *Comptoir d'Escompte* before October 1891. Therefore, separate series for the two items are only possible for the period October 1891 – July 1904.

[Figure 6 here]

Figure 6 shows the assets side of the *Crédit Lyonnais* balance sheet on December 31, 1907. The figure is taken from the US Senate National Monetary Commission Inquiry. This research was undertaken after the 1907 crisis to study other countries' monetary systems. Based on this figure, we can discuss the main balance sheet items. The *Portefeuille* (Bills discounted) is by far the largest item on the assets side, and represents seven times the cash on hand and in the banks.

Bills of exchange were immediately convertible in cash, therefore they represented the true reserves of the banks. *Avances sur garanties et reports* is translated by the National Monetary Commission as "Loans upon collateral". The sum of the two items "*Portefeuille*" and "*Avances et reports*" represent the total amount of short-term loans granted by the *Crédit Lyonnais*[27]. The other three banks, though using different terminology, present the same items in their balance sheets in similar proportions[28].

In order to analyze the effects of a monetary shock on the balance sheets of commercial banks, I construct four indicators: (1) the sum of the commercial portfolios of the four deposit banks, over the period 1890-1913; (2) the sum of all advances on securities granted by the four banks, for the period 1891-1904; (3) the sum of all repo lending granted by the four banks, for the period 1891-1904; (4) the sum of all the advances and repos balance sheets items of the four banks, covering the whole period 1890-1913.

The other data I use in my econometric analysis come from a variety of sources. For each month, I calculate a reference interest rate for the repo market, starting from a new, mostly

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[27] *Comptes courants* were overdrafts, "*crédits à découvert*", granted by the *Crédit Lyonnais* to its clients with no predetermined due date. Therefore, they cannot be considered as short-term loans.
[28] M. Lescure (2010), speaks about a "relative equalization" of different types of asset-side balance sheet items taking place in the 1880-1913 period.

hand-collected dataset[29]. The French historical repo market was characterized by a strong dispersion of rates among different collateral securities, especially before 1898 (Ungaro 2018). Nonetheless, even before this date it is possible to calculate a median interest rate. This was the one around which the bulk of repo loans was granted.

The advances interest rate of the BoF was hand collected by me starting from the Paris Stock Exchange official lists. The discount interest rate of BoF, as well as the French money market rate (the so-called "Paris open market") are to be found in the NBER Macrohistory DB[30]. The Paris open market rate was published by *The Economist* in London. It was the lower bound of French interest rates, since only the main Parisian banks could trade on this market certain kinds of the best paper (White 1978). As such, this rate was structurally lower than the discount rate of the BoF, except for times of crisis. It is commonly used in the literature as representative of the Paris money market[31]. Bazot, Bordo, and Monnet (2016) show that this rate was highly reactive to international shocks, and in particular to shocks in the Bank of England discount rate.

[Figure 7 here]

Figure 7 represents the four interest rates at stake during the period. The repo rate is the highest and the more volatile, as it represented the linkage between the money and financial markets. The money market rate is quite always the lowest. Advances and discounts rates of the BoF are stable and only move during very specific moments (as in 1907).

I then use the exchange rate between Paris and London in order to account for international pressures on the money market and to avoid a "foreign supply" effect on the series of imports, which I use as a proxy for aggregate demand following Bordo and MacDonald

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[29] I personally hand-collected most of them. I deeply thank the Equipex DFIH for providing me with the remaining data. All data are now in the DFIH Database. (Hautcoeur and Riva 2016).
[30] Discount rate is series m13014, while money market rate is series m13017.
[31] For instance, by Flandreau and Sicsic (2003), Riva and White (2011), Bazot, Bordo and Monnet (2016).

(2005) [32]. Finally, following Bazot, Bordo, and Monnet (2016) I use monthly data on the BoF's bills portfolio and advances on securities as indicators of the monetary policy[33].

## 5. Monetary policy transmission: econometric analysis

The questions I raise in this section are the following. How did the BoF manage to transmit its monetary policy, if not touching at the short-term interest rate? What was the role of the banking sector? In particular, did commercial banks increase their loans as a consequence to positive monetary policy shocks, as the lending view suggests?

To answer to these questions, I estimate a VAR and simulate the effect of a monetary shock, identified as a shock of the money market rate, on the balance sheets of the BoF and of the four largest deposit banks, and in turn on aggregate demand. I find evidence of a bank lending channel which worked through advances on securities. On the other hand, I find no transmission of monetary policy shocks through the commercial portfolios of large deposit banks.

A VAR system allows simultaneous relationships between different variables. In my system, interest rates depend on other economic variables that they influenced. In order to identify the effects of a monetary shock on the economy I apply a Cholesky decomposition to solve the VAR model. The Cholesky scheme is a common identification scheme in which the results depend on the particular ordering of the variables. Any variable has a contemporaneous effect on variables ordered afterwards, but there is a lag before they affect the first variable in turn. More formally, a shock happening in period t to the first variable is restricted to be orthogonal to the shocks on other variables in the same period t.

I simulate a one-standard-deviation shock in the residual of the money market rate equation. The shock is defined to be orthonormal to the current value of all other variables in the model. This means that I rule out the possibility that a shock in the policy variables of the Bank of France has an immediate effect on the money market rate.

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[32] Imports were published by the Bulletin de Statistique et Legislation Comparée and are available on NBER Macrohistory DB, series m07027. The series on exchange rate between Paris and London is on NBER Macrohistory DB, series m14107.

[33] Weekly data on the balance sheet of the BoF from 1898 onwards were collected by Patrice Baubeau and are available online on the BoF's website (Baubeau 2006). Monthly data for 1890-1897 come from Bazot, Bordo, and Monnet's (2016) database.

This identification assumption is based on two elements. First, the money market rate was directly influenced by the international monetary situation and, in particular in the context of the classical Gold Standard, by the Bank of England rate. Bazot, Bordo, and Monnet (2016) based on quantitative and qualitative evidence, show that the Bank of France followed the Bank of England's policy decisions. As a consequence, international shocks hitting the money market rate determined a response of the Bank of France, while the contrary did not happen. Second, prices move faster than quantities, and BoF monetary policy was based on its portfolio rather than on its interest rate. Therefore, a shock in the BoE rate had an immediate effect on the money market rate, through international arbitrage, but a retarded effect on the policy instruments of the BoF, namely its commercial paper and advances portfolios.

Moreover, the money market rate influenced the repo rate (Ungaro 2018). In turn, the advances rates of commercial banks were set on the basis of the repo rate itself. Said differently, the short-term collateralized lending strategies of commercial banks depended not only on the monetary policy of the Bank of France, but also on the general conditions of the money market, synthetized by the money market rate.

I define the money market shock $\epsilon_t$ such that the money market rate $r$ at time t is represented by the following function:

$$r_t = f(Y_{t-n}) + \epsilon_t$$

Where Y is a vector containing all variables in the VAR:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_n Y_{t-n} + C\eta_t$$

C is the contemporaneous impact matrix of the $\eta_t$ mutually uncorrelated disturbances. The money market shock $\epsilon_t$ is defined to be the first element of $\eta_t$. Therefore, it is interpreted as a short-term money market shock, exogenous and not explained by past BoF's policy variables. This is my identification assumption.

The VAR requires stationary data to be estimated. Therefore, all series with a unit root are in first-differences while stationary series are in levels[34]. Frequency is monthly. The first VAR I estimate includes the following set of variables: the money market rate, the first-difference of the BoF discount rate, the exchange rate with London, the repo rate, the difference of the logarithm of total loans granted by the Bank of France, the total sum of advances and commercial paper portfolios of the commercial banks, and difference of the logarithm of imports. Given that the VAR includes two lags of each variable, it is estimated over the period 1890m12-1913m12. The lag length was chosen using the Hannah-Quinn information criterion[35].

Figure 8 and 9 present respectively the responses and the accumulated responses of the variables to a one-standard-deviation shock to the money market rate. The shock increases the total loans granted by the Bank of France by 4%. This increase has an immediate competitive negative effect on loans granted by commercial banks, but this is very small (-0.013%). The increase in BoF's portfolio has a positive impact on French aggregate demand, proxied by French imports. The increase is around 3% and it is stable. The accumulated response after 6 months is positive, statistically significant and around 4%.

[Figures 8 and 9 approximately here].

At a first look, therefore, the monetary policy of Bank of France does not seem to be transmitted through the balance sheets of large commercial banks. This result is in line with the literature understating the importance of large and liquid commercial banks in the bank lending channel[36]. Nevertheless, it is worth analyzing separately the commercial portfolio and the advances portfolio in order to find out potential differences between the two channels.

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[34] I conducted the Augmented Dickey-Fuller unit root test on the variables. The null hypothesis of the test is that the variable has a unit root. The P-values are the following. Money market rate 0.00, BoF discount rate 0.23 in levels and 0.00 in first difference, BoF advances rate 0.51 in levels and 0.00 in first difference, repo rate 0.00, exchange rate 0.00, logarithm of total loans granted by the Bank of France 0.00, logarithm of total loans granted by commercial banks 0.00, logarithm of French imports 0.14 in levels and 0.00 in first differences, logarithm of advances granted by commercial banks 0.02 and 0.00 in first differences, logarithm of advances and repos granted by commercial banks 0.00, logarithms of repos granted by commercial banks 0.00, logarithm of advances granted by BoF 0.02 and 0.00 in first differences, logarithm of commercial paper portfolio of BoF 0.00, logarithm of commercial paper portfolio of commercial banks 0.01.

[35] For robustness, I estimated the VAR using more or less lags and the main results do not change.

[36] Kashyap and Stein (2000), Ciccarelli, Maddaloni, and Peydrò (2015).

To discriminate between the two channels, I first run a VAR based on the commercial portfolios of BoF and commercial banks, then a set of VARs where the variables at stake deal with the advances portfolios. The first one includes the following set of variables: the money market rate, the discount rate of the BoF, the exchange rate, the difference of the logarithm of commercial paper portfolio of BoF, the difference of logarithm of commercial paper portfolio of the four large commercial banks, and the difference of the logarithm of French imports.

[Figure 10 here]

Figure 10 shows the response to a one-standard-deviation shock to the money market rate. The discount portfolio of the Bank of France increases by 6%. The immediate response of the discount portfolios of commercial banks is negative, and even if after one month there is a bouncing (positive) effect, this is very small and barely significant. This analysis clearly shows that the monetary policy transmission did not pass through discount facilities to the large deposit banks. This result, anyway, does not rule out the role of the lending channel. Rather, it is consistent with both the recent literature on non-neoclassical monetary transmission channels and the literature on French monetary transmission under the gold standard.

Kashyap and Stein (2000) show that a policy shock has stronger effects on smaller banks, and in particular on those with least liquid balance sheets. Nishimura (1995) and Bazot (2014) claim that local and regional banks undertook longer-term investments with respect to the four large Parisian commercial banks. As a balance, the BoF branches encouraged local and regional bank lending operations and by this way increased local firms' access to credit.

In the light of this literature, we can presume that the lending channel operated through the commercial paper discounted by small (Parisian and regional) banks. The latter were more dependent on the Bank's assistance to get access to short-term funding in case of need, with respect to large deposit banks. This result remains hypothetic. As a matter of fact, there is no way in BoF's balance sheet data series to distinguish the part of paper discounted by large banks with respect of small banks.

At a central level, the BoF only distinguished between Paris and branches. Paris portfolio data are informative on both the headquarters of large deposit banks, and a high number of

small banks operating in the Paris region. Nishimura (1995) provides estimates of the total number of banks in France in 1906, counting 3,162 of them in the whole country and 744 in Paris only (23.5% of the total). Therefore, paper discounted at BoF in Paris came from both kinds of actors.

Nonetheless Lescure (2003), using data coming from eight large BoF's branches[37], claims that in 1913 83.2% of their rediscount portfolio came from local and regional banks. Only 12.6% of the paper was presented by the four large commercial banks[38]. The proportion is quite similar for 1880 (83% vs. 15.8%). These figures allow us to think that, given the effectiveness of BoF's balance sheet policy in absorbing shocks, the lending channel was indeed there, and worked through commercial paper discounted by small banks.

This interpretation is confirmed by the findings of Nishimura (1995), according to whom "provincial banks assisted local industrial enterprises by discounting their accommodation bills. In turn, the Banque's branches re-discounted these bills for provincial banks". Finally, the so-called "*escompte direct*" (direct discount) represented only a small part of BoF's business. Commercial paper discount was almost exclusively reserved to banks. The absence of a channel passing through the commercial portfolio of large deposit banks leaves only small local banks as potential suspects.

### Discount vs. Advances

Did the advances channel behave in the same way? In order to investigate this possibility, I run four separate VARs. The first one studies the impact of an increase in the advances portfolio of the central bank on the total amount of advances and repos lent by commercial banks. Afterwards I study separately the two instruments, in order to rule out possible differences between advances and repos. I then focus on the post-1898 period, the one during which advances outnumbered repos in the commercial banks' balance sheets.

[Figure 11 here]

The first VAR includes the following set of variables: the money market rate, the advances rate of the BoF, the exchange rate, the difference of the logarithm of advances portfolio of BoF, the difference of logarithm of advances and repos portfolio of the four large

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[37] Bordeaux, Grenoble, Lille, Lyon, Marseille, Nancy, Rouen, Toulouse.
[38] The rest, 4.1%, was represented by mutualist banks.

commercial banks, and the difference of the logarithm of French imports. Figure 11 shows that a shock in the money market rate and the following increase in the advances portfolio has no effect on the total amount of advances and repos granted by commercial banks.

At a first glance, therefore, monetary transmission through the advances and repos items seems to work as through commercial paper portfolio. To study distinctly the two instruments, advances and repos, I run a VAR in which the difference of logarithm of repos and the difference of logarithm of advances are separate. Because of data availability, the VAR has been run over the period October 1891 – July 1904.

I ordered first repos, and afterwards advances, because repo settlements took place every two weeks, and the banks could decide not to continue their investment on the stock exchange and withdraw their money, or a part of it. On the other hand, advances were granted for two or even three months to individual borrowers: the banks could not require their money back before the end of the loan. Therefore, even if in normal times the two instruments had similar time spans, in case of crisis an investment on the repo market was easier to abandon for the banks.

 [Figure 12 here]

Figure 12 shows the responses to a one-standard-deviation shock to the money market rate. The Paris open market rate increases by 2.5 percentage points. Such an increase has an immediate effect on the monetary policy of the BoF, which increases its advances portfolio by 2%. The reaction of the advances rate is by far less intense (around 0.25 percentage points). The reason is that the main monetary policy tool of the BoF consisted in increasing its domestic portfolio, and not its interest rates. The amount of repo lending by commercial banks is immediately reduced. This is straightforward, at the light of the interest rates' increase.

On the other hand, the amount of advances granted by commercial banks increases. The increase is low in magnitude (around 0.35%) and barely significant. Nonetheless, it is worth studying this response in detail, as its behavior is counterintuitive. An increase in prices (interest rates) should bring to a decrease in demand of loans. Therefore the amount of advances should decrease together with a money market rate increase. This is not the case.

Moreover, if I limit the VAR to the post-1898-reform period, the increase in the advances amount even doubles its magnitude and becomes statistically significant. Figure 13 presents the responses to a one-standard-deviation shock to the money market rate in the period 1899-1904.

[Figure 13 here]

I interpret this result as a consequence of commercial banks' investment diversification. When an international or national monetary shock hit the economy, commercial banks withdrew a part of their money from the repo market. At the same time, they partially compensated the liquidation of their positions on the stock exchange by increasing their loans in the advances market. This diversification strategy was clearly more effective in the period after the 1898 rearrangement. The reason is twofold. On one hand, the market for advances itself had grown. On the other hand, the market share covered by the four commercial banks had increased, allowing them to be more flexible in shaping their investment decisions.

The advances channel did not work solely through this diversification effect. The central bank's lending channel was indeed at work. Figure 14 shows the response to a one-standard-deviation shock to the advances portfolio of the Bank of France after 1898. Even if the magnitude of the increase in the advances' amount is small, it is statistically significant. When a shock arrived, commercial banks borrowed at the BoF and increased their lending against securities.

[Figure 14 here]

To sum up, we can say that the Bank of France's strategy of development of advances on securities reached both a long-term and a short-term effect. On one side, by leading the process of development of this market, especially in its regional branches, the BoF put a competitive pressure on commercial banks and became the example to follow. When commercial banks had sufficiently developed their advances facilities, they participated to sterilization of money market shocks by increasing their advances loans. The short-term effect is represented in Figure 14: through its competitive pressure, the BoF managed to build up a bank lending channel through advances lending.

When a shock hit the economy, individuals and firms borrowed against securities at the central bank and at the deposit banks branches. This resulted in a sterilization of negative shocks, which had no effect on aggregate demand.

## 6. Conclusions

In this paper, I study how monetary policy is transmitted when the interest rate is not the main tool used by the central bank. I focus on the case of Bank of France during the *Belle Epoque*, from 1890 to 1913. During this period, the French central bank only changed its interest rate thirteen times. Its monetary policy, working through its domestic asset portfolio, was effective.

Using a new original database and a standard VAR approach, I find that the Bank of France adapted its monetary policy according to the instruments it employed. By statute, it could not rediscount commercial bills having less than three signatures. As a consequence, its discount facilities were mostly dedicated to banks and bankers, and used only for a small part by trade and manufacturing firms.

The evidence presented in this paper excludes that large and liquid deposit banks played a role in the transmission of monetary policy through rediscounting facilities. These banks did not increase their commercial-paper-based lending after an expansionary monetary shock provoked by the Bank of France as a way to sterilize gold outflows. The role of linkage was arguably represented by small local and regional banks.

In order to build a direct channel with small borrowers and bypass the three-signature restriction, the Bank of France developed its advances on securities facilities starting from the early 1890s. Through regular improvements, this instrument became an important monetary policy tool used to transmit expansionary shocks directly to the economy. The growth of this facility put competitive pressure on large commercial banks, which at the end of the 19th century started using advances on securities as a way to diversify their short-term collateralized investments.

As a consequence, when a shock hit the economy, the private sector had easy access to liquidity by borrowing against securities. This mechanism took place both at the Bank of France and at the branches of large commercial banks, which competed on this market. Finally, this paper presents evidence of a bank lending channel taking place in the first years of the 20th century through advances. Deposit banks themselves had direct access to the BoF advances facilities in times of trouble, and in turn transmitted liquidity to the private sector. The magnitude of this effect was small, but its existence is certified by statistical evidence.

## Archives

**Banque de France Archives (BFA)**
Minutes of Conseil Général (CGM)

Minutes of Comité des Livres et Portefeuilles (CLPM)

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**Crédit Lyonnais Archives (CLA)**
7AH2, Circulaires Direction Générale.

**French National Archives**
563/AP/16, Alexandre Ribot personal archives

**Archives de la Compagnie des Agents de change près de la Bourse de Paris (CAC), at the Centre des Archives Economiques et Financières**
Procès-verbaux de la Chambre Syndicale (A-CAC, MCS), procès-verbaux des assemblées générales (A-CAC, MGA) de la Compagnie des Agents de Change

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## Figures
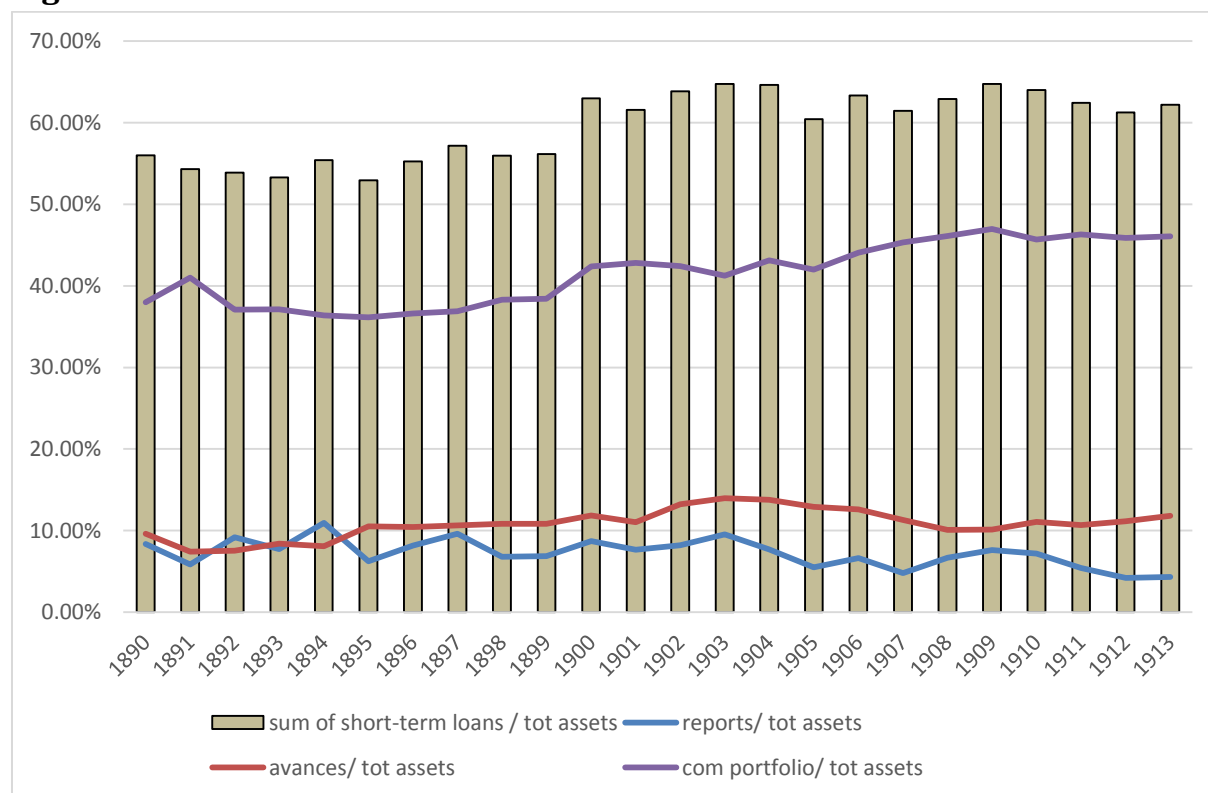


*Figure 13 – Evolution of the three items related to short-term loans published in the balance sheets of the four main commercial banks, as a fraction of total assets, and their sum. Data are based on yearly balance sheets published on December 31 of each year of the 1890-1914 period. Source: author's DB*
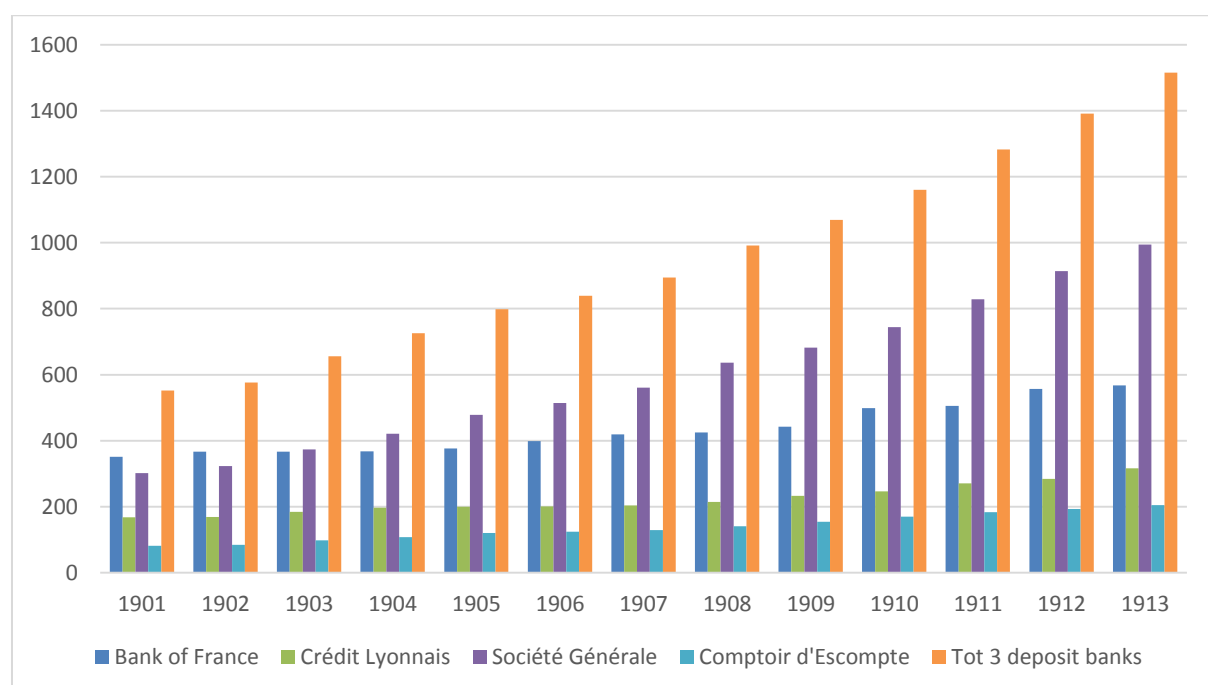


*Figure 14 – Number of regional branches (outside Paris and its region). Bank of France and three main deposit banks, 1901-1913. Source: Author's elaboration from Crédit Lyonnais archives.*
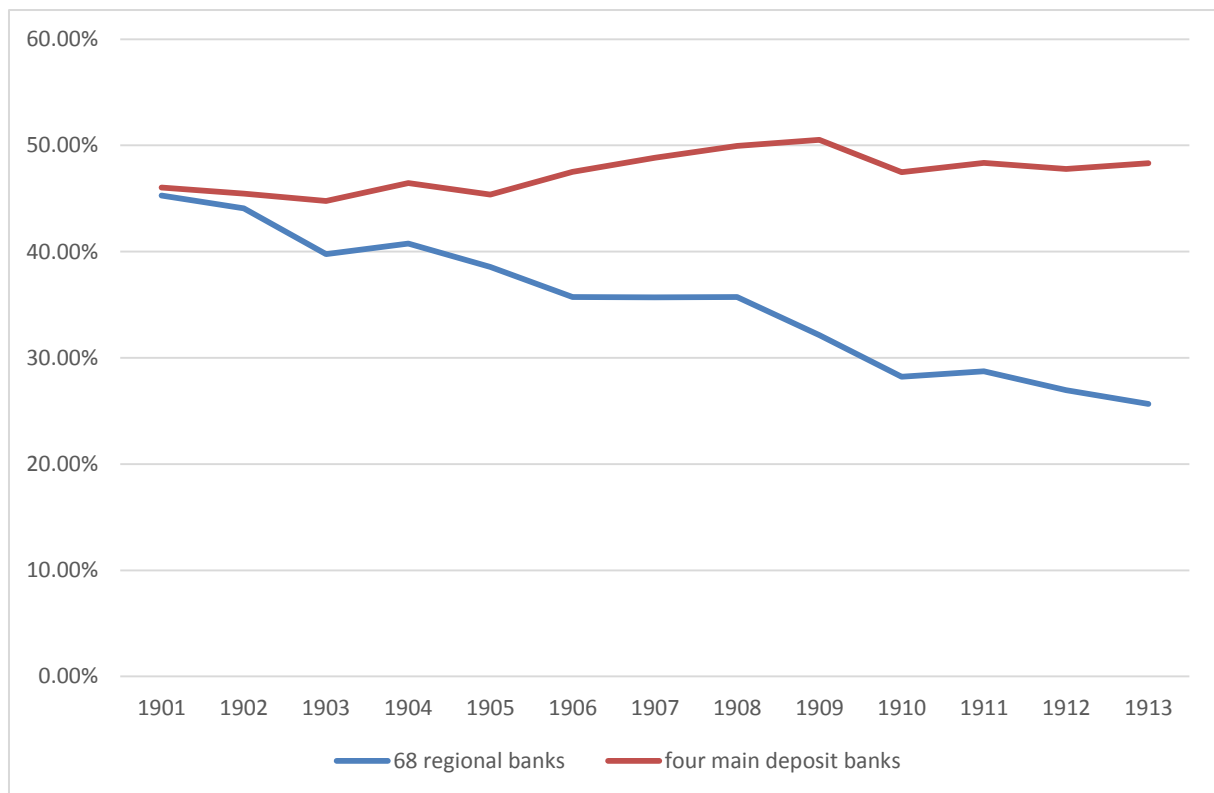
*Figure 15 – Weight of commercial portfolio in the balance sheet of 68 regional banks vs four main deposit banks. For both types of banks, share of commercial portfolio in percentage of total assets. Source: Author's elaboration from Crédit Lyonnais archives.*
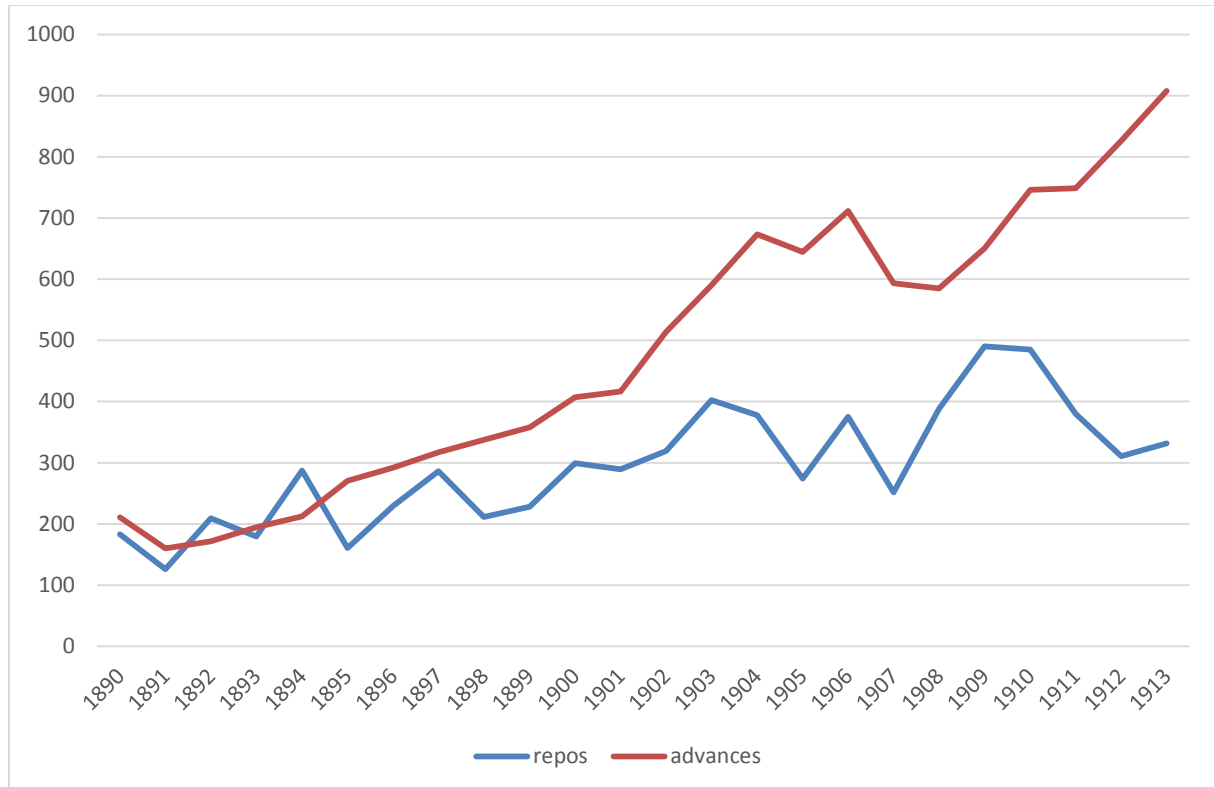


*Figure 16 - Total amount of advances granted against securities and the total amount of funds invested on the repo market at the 31/12 of each year from 1890 to 1913 in the balance sheets of the four main deposit banks. Source: my DB.*
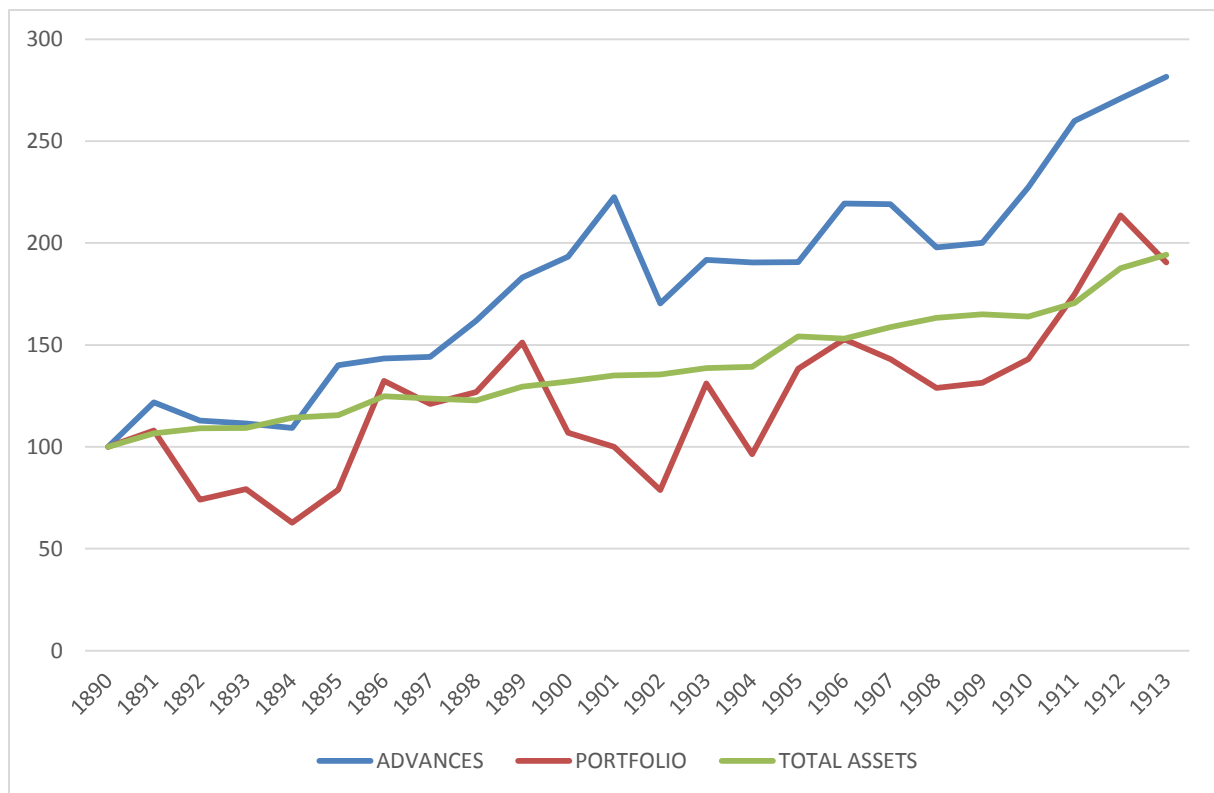
*Figure 17 - Evolution of total assets, advances and commercial paper portfolios of the Bank of France from 1890 to 1913. 1890=100. Source: Annhis, Banque de France (Baubeau 2006)..*

## ACTIF.

| | |
|---|---|
| Espèces en caisse et dans les banques | Fr.150,060,798.98 |
| Portefeuille | 1,094,966,467.70 |
| Avances sur garanties et reports | 297,155,630.58 |
| Comptes courants | 568,448,897.90 |
| Portefeuille titres (actions, bons, obligations et rente) | 8,280,206.97 |
| Comptes d'ordre et divers | 1,342,578.84 |
| Immeubles | 35,000,000.00 |
| Total | 2,155,254,580.97 |

## ASSETS.

| | |
|---|---|
| Cash on hand and in the banks | $28,961,734 |
| Bills discounted | 211,328,528 |
| Loans upon collateral | 57,351,037 |
| Current accounts | 109,710,637 |
| Stocks, bonds, certificates, etc | 1,598,080 |
| Sundry accounts | 259,118 |
| Real estate | 6,755,000 |
| Total | 415,964,134 |

*Figure 18 - Assets side of the Crédit Lyonnais Balance sheet. December 31, 1907. Source: US Senate National Monetary Commission. Document no. 410.*

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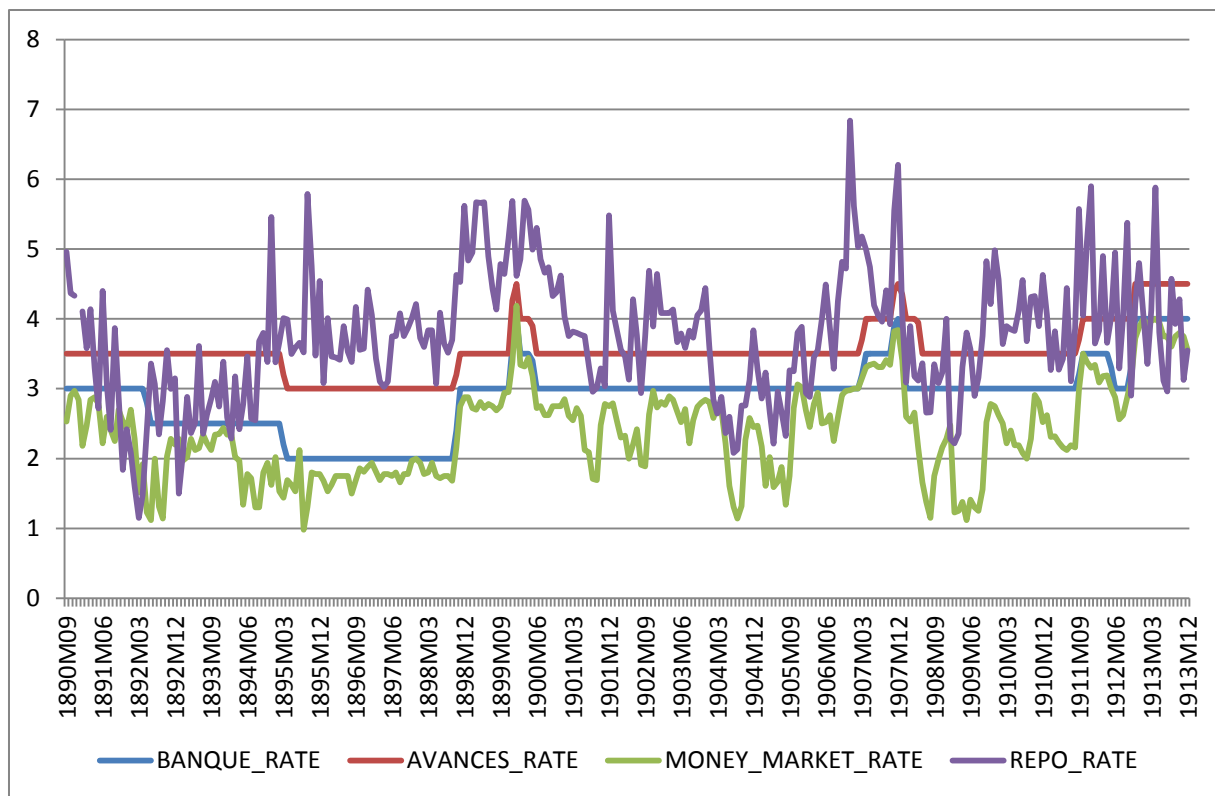
*Figure 19 – Interest rates in France, 1890-1913. Sources: Banque Rate and Money Market rate, NBER MacroHistory DB. Historical repo rate: Author's DB (see Ungaro 2017 for details). Advances rate: Paris Stock Exchange official list.*
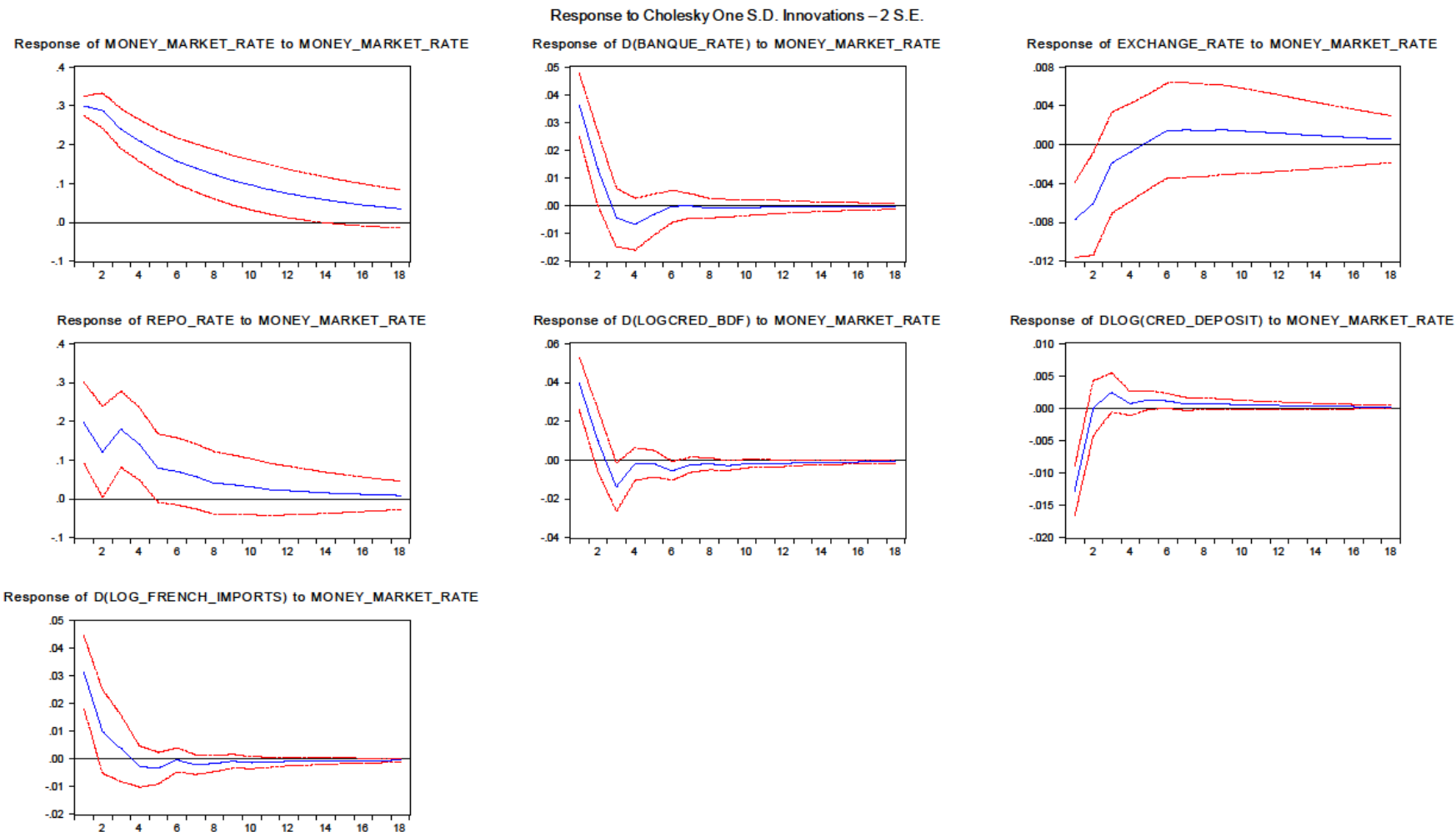
*Figure 20 – Responses to a shock in the domestic asset portfolio (discount and advances – monthly data). The impulse-response functions are based on OLS-VAR results where variables are in the following order: 1) Money market rate 2) First difference of the BoF's discount rate 3) Exchange rate with London 4) Repo rate 2) First difference of the logarithm of BoF's domestic portfolio 5) First difference of the logarithm of the sum of commercial banks' total loans 7) First difference in logarithm of imports.*
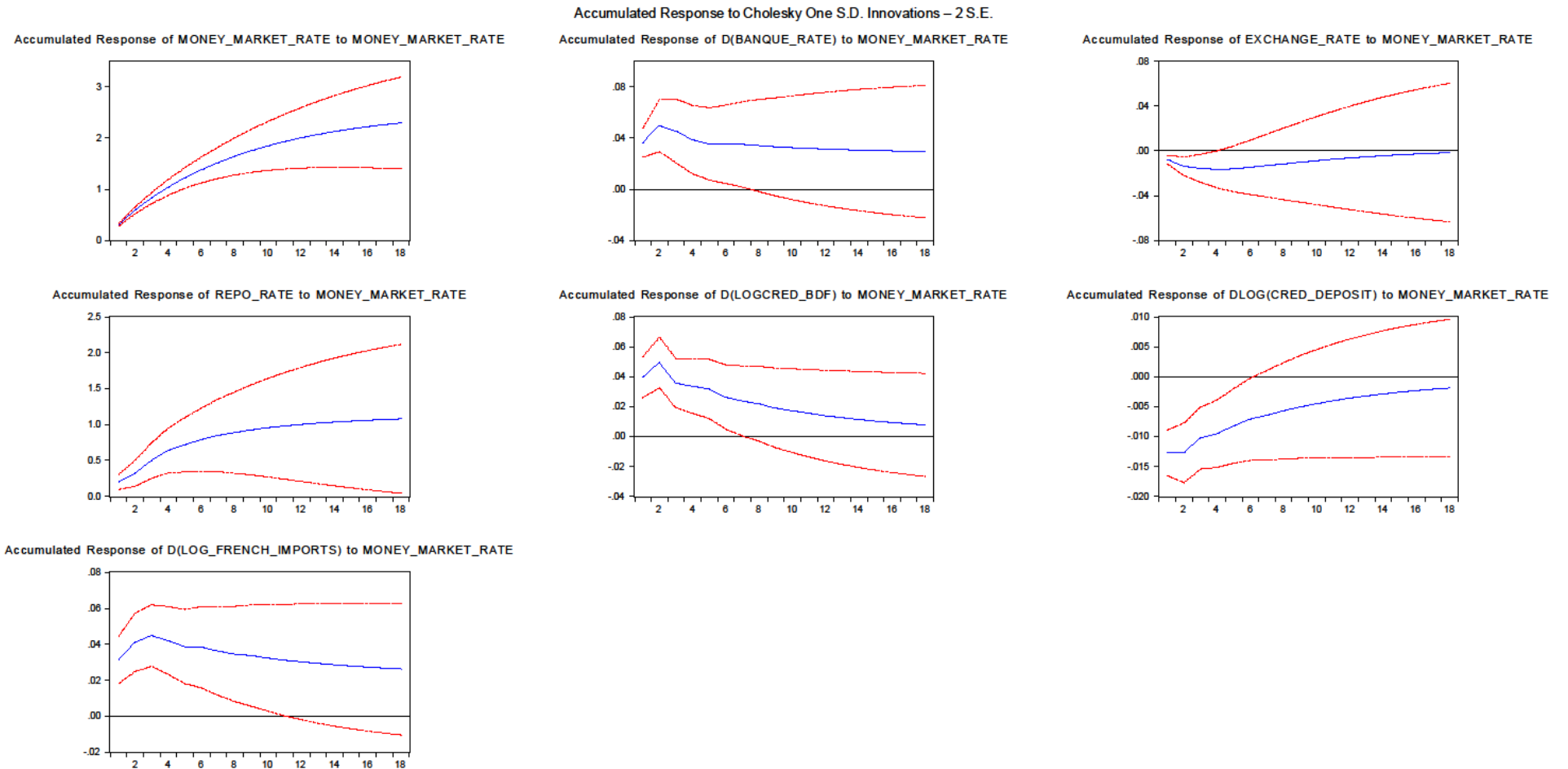
*Figure 21 – Accumulated responses to a shock in the domestic asset portfolio (discount and advances – monthly data). The impulse-response functions are based on OLS-VAR results where variables are in the following order: 1) Money market rate 2) First difference of the BoF's discount rate 3) Exchange rate with London 4) Repo rate 2) First difference of the logarithm of BoF's domestic portfolio 5) First difference of the logarithm of the sum of commercial banks' total loans 7) First difference in logarithm of imports.*

**Response to Cholesky One S.D. Innovations – 2 S.E.**
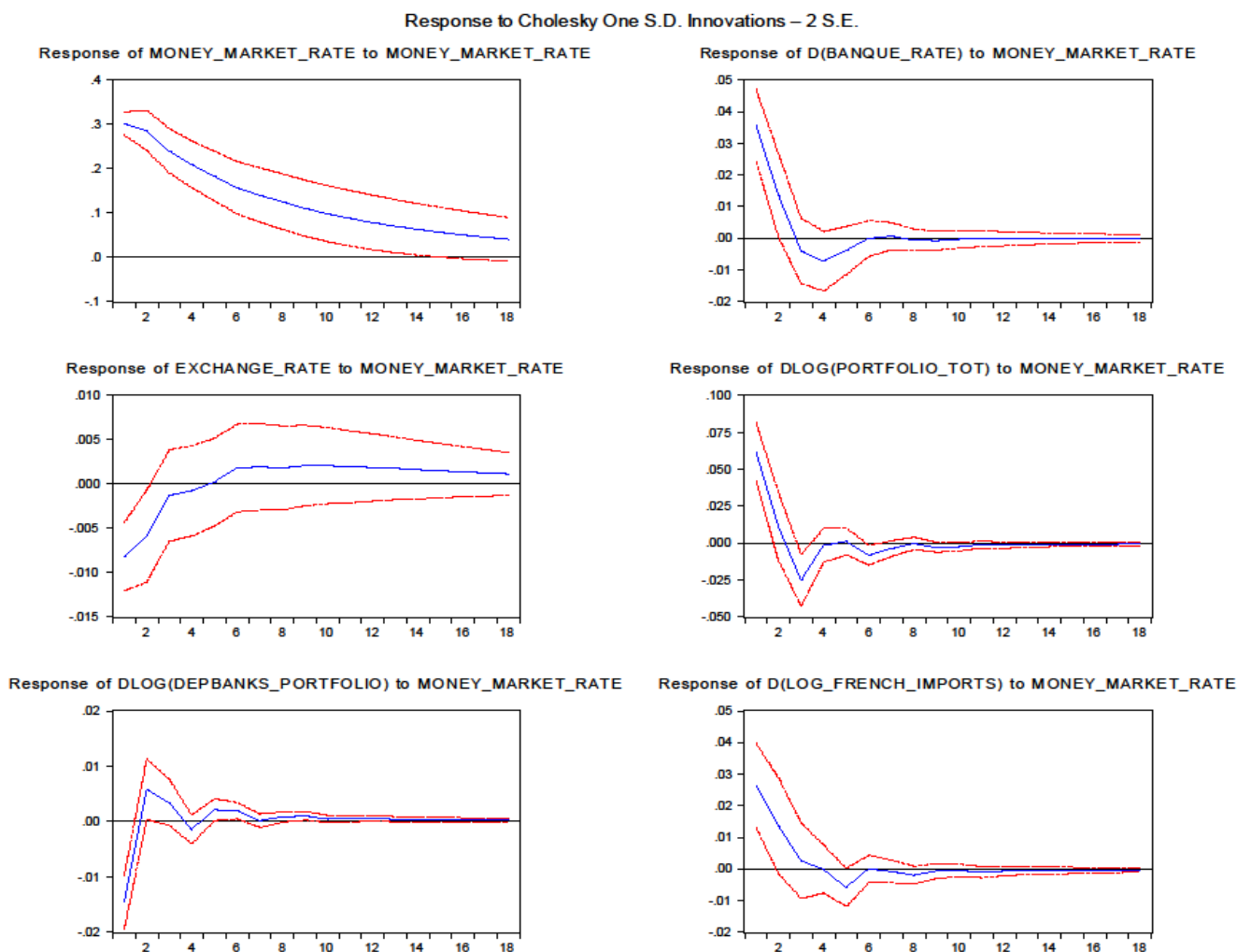
*Figure 22 - Response to a shock in the commercial paper portfolio of the BoF (monthly data). The impulse-response functions are based on OLS-VAR results where variables are in the following order: 1) Money market rate 2) First difference of the BoF's discount rate 3) Exchange rate with London 4) Repo rate 5) First difference of the logarithm of BoF's commercial paper portfolio 6) First difference of the logarithm of the sum of commercial banks' commercial paper portfolios 7) First difference in logarithm of imports.*
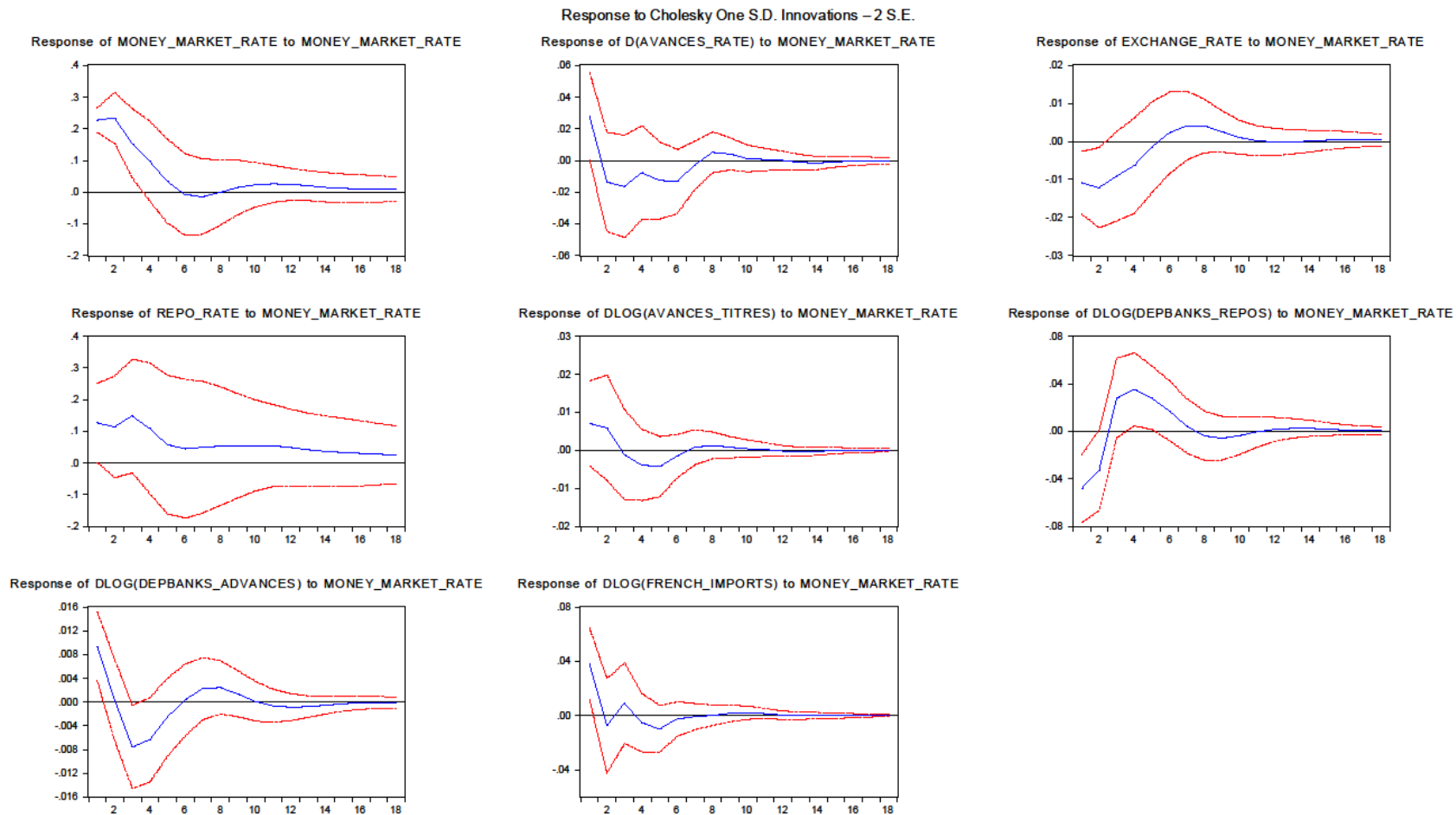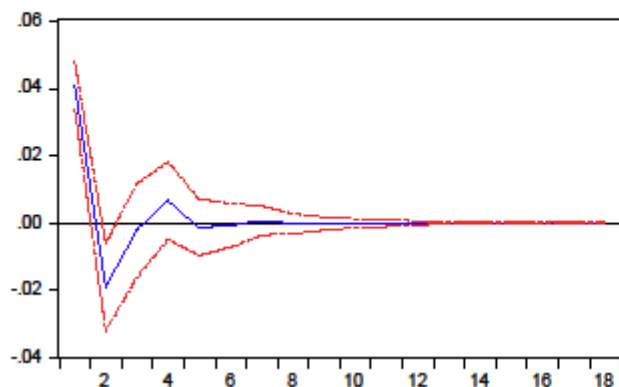
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Response to Cholesky One S.D. Innovations – 2 S.E.
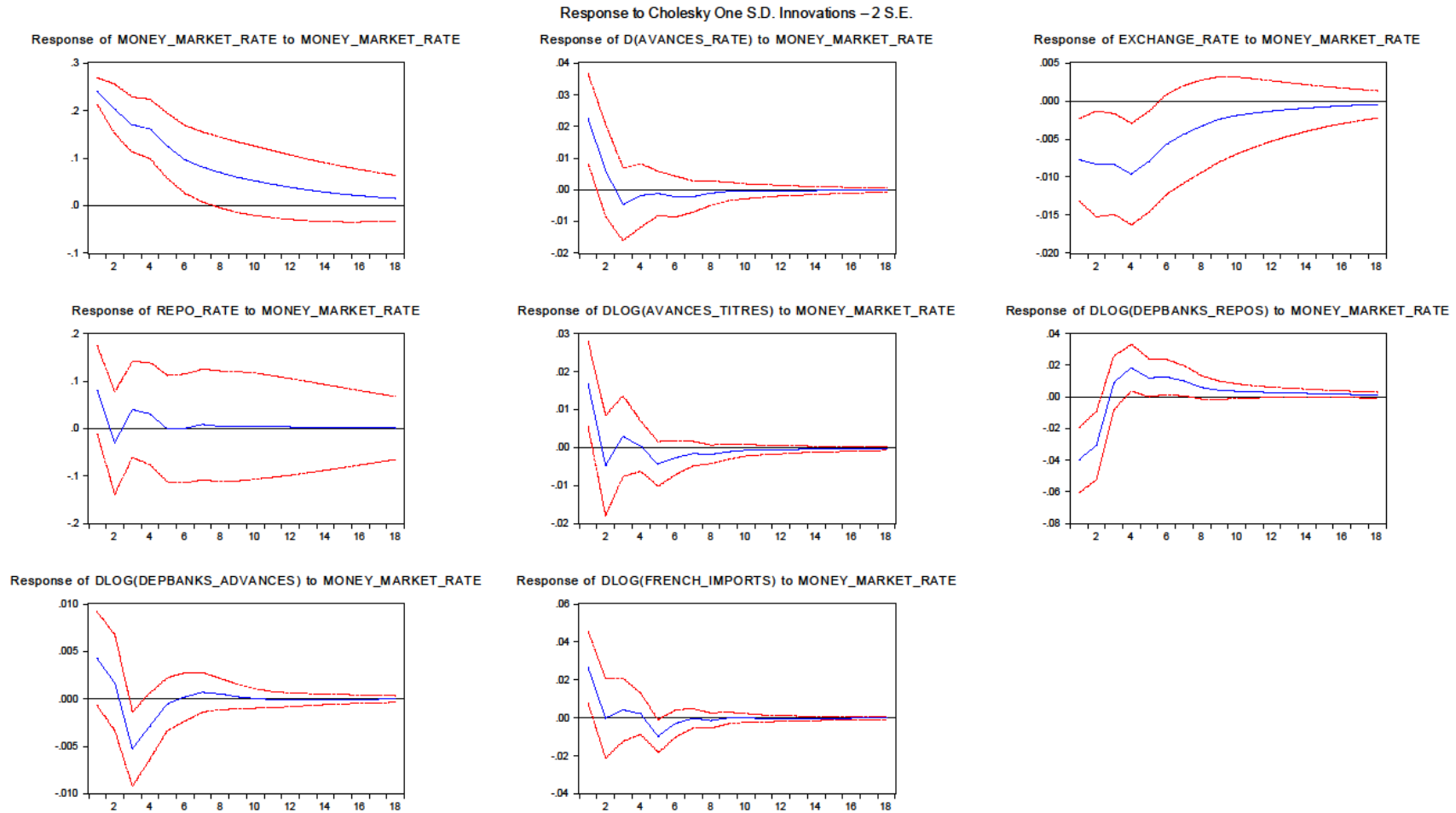
*Figure 23 - Responses to a shock in the advances portfolio of the BoF (monthly data). The impulse-response functions are based on OLS-VAR results where variables are in the following order: 1) Money market rate 2) First difference of the BoF's advances rate 3) Exchange rate with London 4) Repo rate 2) First difference of the logarithm of BoF's advances portfolio 5) First difference of the logarithm of the sum of commercial banks' advances and repos portfolios 7) First difference in logarithm of imports.*
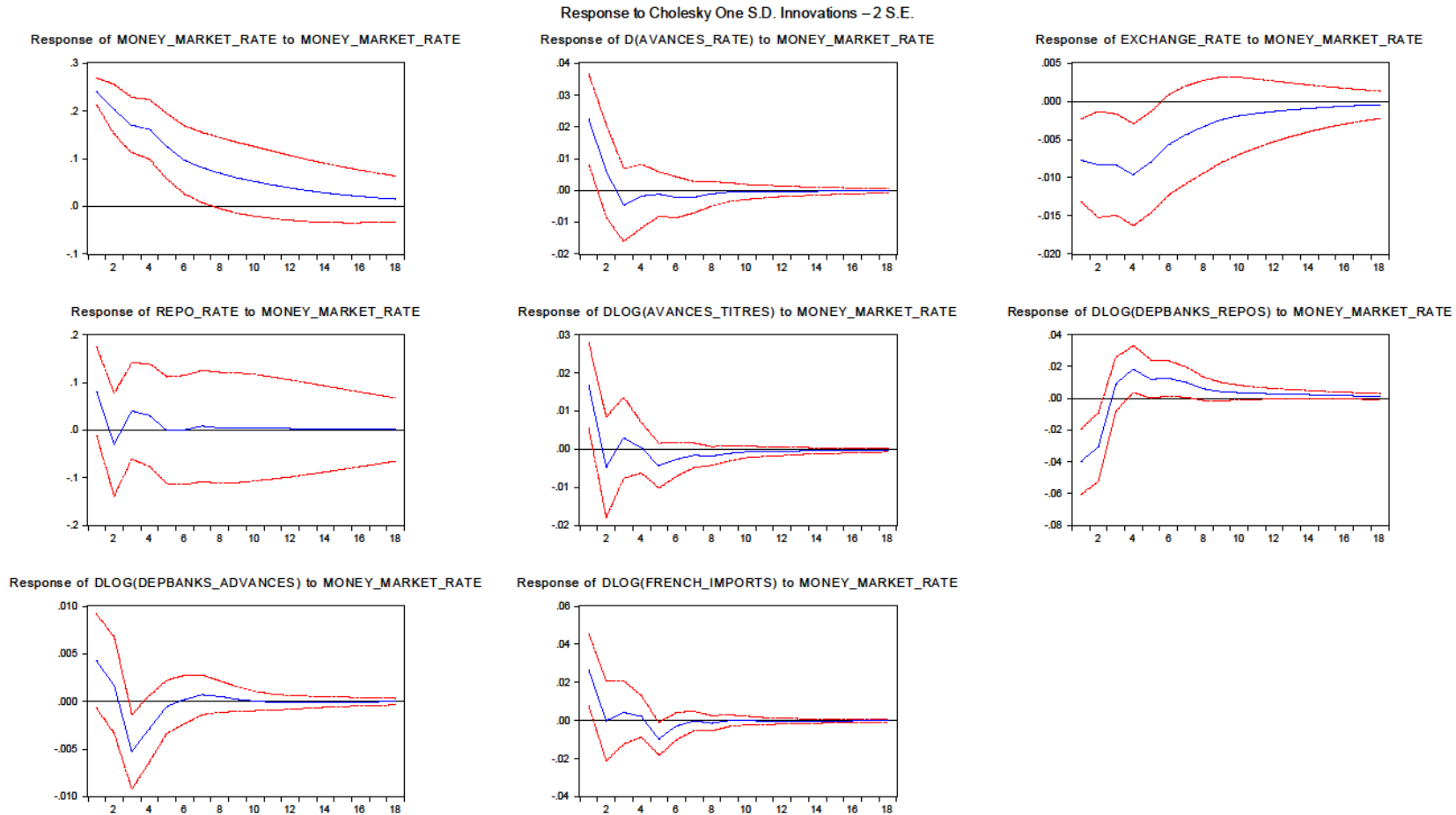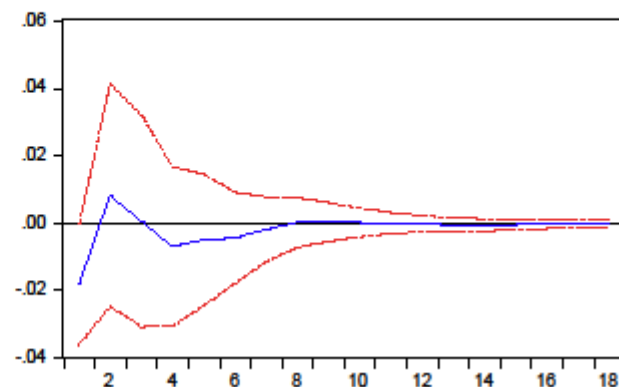
*Figure 24 - Responses to a shock in the money market rate (monthly data, period October 1891 – July 1904). The impulse-response functions are based on OLS-VAR results where variables are in the following order: 1) Money market rate 2) First difference of the BoF's advances rate 3) Exchange rate with London 4) Repo rate 5) First difference of the logarithm of BoF's advances portfolio 6) First difference of the logarithm of the sum of commercial banks' repos portfolios 7) First difference of the logarithm of the sum of commercial banks' advances portfolios 8) First difference in logarithm of imports.*
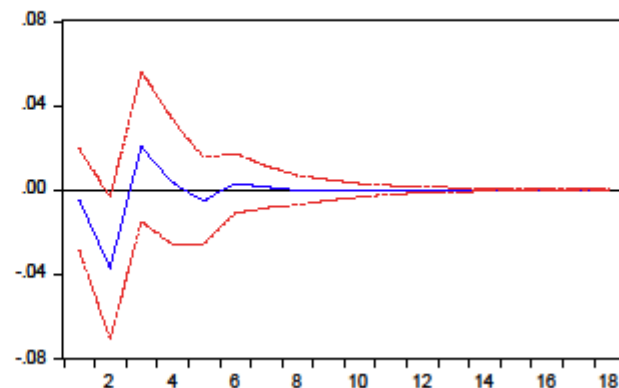
*Figure 25 - Responses to a shock in the money market rate (monthly data, period January 1899 – July 1904). The impulse-response functions are based on OLS-VAR results where variables are in the following order: 1) Money market rate 2) First difference of the BoF's advances rate 3) Exchange rate with London 4) Repo rate 5) First difference of the logarithm of BoF's advances portfolio 6) First difference of the logarithm of the sum of commercial banks' repos portfolios 7) First difference of the logarithm of the sum of commercial banks' advances portfolios 8) First difference in logarithm of imports.*

Response to Cholesky One S.D. Innovations – 2 S.E.

*Figure 26- Responses to a shock in the money market rate (monthly data, period January 1899 – July 1904). The impulse-response functions are based on OLS-VAR results where variables are in the following order: 1) Money market rate 2) First difference of the BoF's advances rate 3) Exchange rate with London 4) Repo rate 5) First difference of the logarithm of BoF's advances portfolio 6) First difference of the logarithm of the sum of commercial banks' repos portfolios 7) First difference of the logarithm of the sum of commercial banks' advances portfolios 8) First difference in logarithm of imports. In this graph, impulse is a shock in the BoF's advances portfolio.*

# Chapter 3. Rationing Credit during a War

The Political Economy of a Missed LOLR Intervention

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Abstract

Major aggregate shocks, like a world war, are typical cases in which the intervention of a monetary authority such as the central bank is essential in providing with liquidity the economy and in stemming financial panics that potentially arise. In this paper I show both qualitatively and quantitatively that during WW1 the Bank of France did not perform its natural Lender of Last Resort (LOLR) role, and applied credit rationing especially towards the stock exchange. The reasons of this behavior must be sought in concerns about the renewal of the monopoly of notes issue and about the possible devaluation of the French Franc. The choice of not acting as a LOLR contributed to the rise of a panic that had international repercussions and was only stopped by a series of moratoria on outstanding debts imposed by the government.

1. Introduction

Recent literature, motivated by the 2007-2009 crisis and by the centenary of World War 1, has revisited the history of the largely unknown "Great Financial Crisis of 1914" (Silber, 2007; Roberts, 2014). According to Richard Roberts, this crisis culminated in London with the closure for the first time ever of the Stock Exchange, on Friday 31 July. The Exchange was to be reopened only five months later, at the beginning of January 1915.

The choice of closing down the Exchange had been triggered by a decision taken in Paris two days earlier, on Wednesday 29 July (Keynes, 1914). At the Bourse, the date of the settlement of forward operations was approaching. In order to perform the settlement, the Parisian brokers needed cash. The context was that of a generalized liquidity crisis, spreading rumors of war, and mini bank runs taking place in Paris and at the border with Germany.

In order to raise the money needed, the brokers' guild, which managed the Bourse, asked for the help of the Bank of France. The sum was relatively little and the guild enjoyed both a very good reputation and excellent relationships within the Ministry of Finance. Moreover, the central bank had a history of direct and indirect participations to Lending of Last Resort (LOLR) or bailout operations during the previous century (White, 2007; Bignon, Flandreau and Ugolini 2012; Hautcoeur, Riva, and White, 2014). In spite of all this, the Bank of France denied its help to the stock exchange. Therefore, the guild had no choice but to postpone the settlement by one month. All payments were deferred to the end of August. Because of cross-country exposures, the French decision had heavy international repercussions.

In this article, I study the determinants of this decision. I document the struggles internal to the General Council (*Conseil Général*) of the Bank of France, and among the different stakeholders: the Ministry of Finance, then guided by the ephemeral minister Joseph Noulens, the brokers' guild, and the representatives of the major French banks including the central bank itself. I find that the Bank's choice of not providing funds to the stock market has to be evaluated in the context of the overall policy decisions taken by the powerful central bank governor Georges Pallain. Since the first rumors of war, the choice was to finance war and the Treasury, and to ration credit to the economy.

Pallain's policy can be explained by two main reasons. First of all, the French anticipated a short conflict, at the image of what had happened during the 1870 Franco-German war. The

governor did not want to devaluate the franc, and wanted to keep it anchored to gold. Pallain had dedicated his whole mandate, started at the end of the 19<sup>th</sup> century, to the building of immense gold reserves. The aim was that of being prepared to a war against Germany, without jeopardizing the franc convertibility. Therefore, the governor was contrary to provide liquidity to the economy, for fear of devaluating the currency. The only actor that was granted almost unlimited access to the Banque's facilities was the Treasury.

The stock exchange was not the only to pay the consequences of this policy. The banking system was affected as well. One of the main Parisian banks, the Société Générale, that experienced liquidity issues, was twice refused an advance during the first months of the war. On a broader scale, the central bank did not follow the Bagehot principle of free lending, preferring to apply credit rationing (Blancheton 2014). As a consequence, banks could not discount their bills without limit at the Bank. This policy aggravated the liquidity crisis already in place.

The second reason why the Bank of France preferred providing with liquidity the Treasury at the expense of the financial sector and the rest of the economy has to be found in the monopoly of issuing notes. The Bank of France enjoyed a monopoly (or "privilege", as it was called), that was subject to renewal every 23 years. Renewal negotiations had been harsh in the past, with the central bank always looking for arguments in order to convince the political power of being indispensable.

In the 1890s, for instance, the Banque had developed a network of branches with the aim of providing credit access to the whole country. This policy had been well looked upon by the government. The privilege, granted the last time in 1897, arrived to an end in 1920. Negotiations, therefore, had to take place during the war. Being the main financial supporter of the conflict put the Bank of France in a strong bargaining position. When the conflict showed to be a long one, Pallain had to choose again between extending the Banque's credit to the economy and reserving it to the Treasury. Once again he chose the first option, willing to use the Banque's support to the government as leverage to obtain the renewal of the privilege.

The credit rationing policy, as a consequence, lasted during the whole period of the war. This happened despite an important change in the government had happened. A new, more

experienced and powerful minister of Finance was named in August 1914, and remained in charge up to 1917: Alexandre Ribot. Ribot managed to impose to the Banque to collaborate to unblock the capitals that had remained stuck in the stock exchange, and to reopen the forward market. Nonetheless, the participation of the Bank of France to this scheme was more ideal than material.

The central bank intervention consisted in a 250 million francs loan granted by the Banque to the brokers' guild. The guild was in turn in charge of providing with cash those investors who had their capital blocked but could not resell the securities they had been given as collateral, because no market was there. The Banque classified securities in four classes, "first class", "good", "average", and "bad". Margins applied by the central bank in lending against these assets changed according to the class. Contemporary literature and press praises the Bank's intervention as indispensable for the reopening of the stock exchange. Anyway, the loan was left almost untouched, as only 16 out of the 250 million francs had effectively been used.

In this paper I use previously unexploited archival sources to understand whether the Banque intervention was useful or not. In particular, I perform a simple test to assess quantitatively whether in the second phase of the war, when the stock exchange reopened, the Banque persisted in rationing its credit. In order to do so, I calculate the market interest rates for a basket of collateral assets accepted or not by the Banque to provide its loan. I then calculate the interest rates applied by the bank to the same collateral assets, taking into account not only the nominal rate but also the haircut applied according to the class of assets. I then compare the two interest rates.

I find that the Banque systematically applied lower interest rates with respect to the newly reopened stock market on the same collateral assets. This is an evidence of credit rationing. If lenders could find higher interest rates on the market, they had no interest in accessing to the central bank facilities. Moreover, I find that with respect to earlier negotiations, the central bank decided to exclude from the list of accepted collateral a high number of assets, accepting only the better ones.

As an additional test, I perform an ordered logit regression on the same basket of securities. Ordered logit models are regression models used when dependent variables are ordinal. I

follow the Banque's classification of securities in "first class" (A), "good" (B), "average quality" (C), and "bad quality" (D). Then I test whether the behavior of collateral assets before the war, such as their liquidity, volatility, or returns, allow to explain the choice of the bank in classifying them. As expected, I find that no market variable has an explanatory power. The only statistically significant variable associated to finding a security in a higher class is, meaningfully, the fact of being issued by a French institution.

The rest of this paper is organized as follows. Section 2 presents the related literature. Section 3 deals with the historical setting. Section 4 presents the empirical tests. Section 5 concludes.

## 2. Literature

Following the 2007-2009 financial crisis, theoretical and empirical literature has taken in novel consideration the Lending of Last Resort function of central banks. This rich research field stems from the seminal works by Thornton (1802) and Bagehot (1873). The classical approach justifies the existence of Lenders of Last Resort as necessary to support the whole financial system and to provide stable money growth. Nonetheless, in order to implement market discipline and to avoid moral hazard, Bagehot and subsequent commentators emphasized some "rules" to be adopted during a LOLR operation. The central bank had to lend freely, on good collateral only, and at high rates.

Recent research has questioned both the effective necessity of the existence of a Lender of Last Resort, and the three Bagehot rules. Moreover, it has extended the role of the LOLR, considering it to cover also non-banking institutions (Freixas and Parigi 2014). This is crucial in periods of financial innovation, such as the pre-2007 period, or when a substantial part of the money market takes place outside the banking system, as it was the case in pre-WW1 France (Ungaro 2018).

Even if the actual LOLR interventions are often sharply criticized (see for instance Meltzer 2009 and Taylor 2009), there is consensus among central bankers and academics that a LOLR mechanism is necessary to allow solvent institutions to obtain liquidity if the money market fails to operate correctly. A clear example of such a situation is the presence of a major aggregate shock like a world war, during which a LOLR mechanism is essential in providing

with liquidity the economy and in stemming financial panics that potentially arise (Bordo 1990).

In these contexts, markets become thin as in the Akerlof lemon problem and financial intermediaries become reluctant to lend to each other for maturities other than very short (Freixas and Jorge, 2008). The intervention of a monetary authority is therefore necessary either as a liquidity provider (Allen and Gale 2000), or as a crisis manager (Freixas, Parigi, and Rochet 2000). In Allen and Gale (2000), the crisis is originated in an unpredicted liquidity shortage; therefore, any liquidity injection allows solving the crisis no matter where the liquidity is injected. Liquidity long institutions will profitably lend to liquidity short institutions.

In Freixas, Parigi, and Rochet (2000) the crisis takes origin in a rational alternative equilibrium strategy for depositors and investors. Therefore, injecting additional liquidity does not solve the crisis. For instance, during the panic of 2008, banks feared that the money markets might not work well and might fail to recycle the liquidity injected by the central bank. As a consequence, they hoarded liquidity and made the interbank market incur in a liquidity trap. The role of the central bank here is that of guaranteeing that all claims on banks will be fulfilled, through an efficient ex-ante regulatory framework.

In this article, I present a situation in which the Ministry of Finance and the Bank of France tried to play the role of crisis managers more than that of liquidity providers. Facing the freeze of the repo market, instead of providing liquidity to investors the public powers decided to progressively unblock the market itself instead of injecting liquidity. The measure, nonetheless, had no sizeable effect on the market, which had experienced a substantial contraction with respect to the pre-war period and would never return to the previous situation, even when peace returned.

This paper studies a missed LOLR intervention in the context of the classical gold standard. A number of recent papers have reconsidered the roles played by the Bank of France and the Bank of England during banking and financial crises happening in this period. Bignon, Flandreau, and Ugolini (2012) provide evidence that the two central banks followed Bagehot's prescription of lending freely at high rates and against good collateral. Nonetheless, these procedures were not always applied.

White (2007) and Hautcoeur, Riva, and White (2013), for instance, study two major French crises of the 1880s: the 1882 Union Générale crash, and the 1889 Comptoir d'Escompte failure. In both cases, the Bank of France preferred to manage the crisis not through direct intervention but by organizing guarantee syndicates of banks in order to absorb potentially large losses. The same kind of operation was implemented by the Bank of England in 1890 during the Baring crisis (White 2018). In 1914, the Bank of France tried to solve the liquidity crisis that was hitting the financial market by organizing a same type of syndicate. This time, in face of war, the main Parisian and French banks refused to help.

3. The Great Financial Crisis of 1914

The Great Financial Crisis of 1914 hit a complex and vast market, in which the banking sector and the stock exchange were strictly connected through a financial instrument called report. In July 1914, the market experienced a true panic. The Bank of France and the Ministry of Finance reacted by imposing a series of moratoria and by closing down the stock exchange. In 1915, the repo and forward markets of the Paris stock exchange were reopened in order to perform settlement operations, under pressure of the Ministry of Finance and with the participation of the central bank.

In 1914, the Paris financial market was organized as a duopoly. The official stock exchange, the *Parquet*, made up the transparent and secure segment of the Bourse, while the *Coulisse*, an OTC-like market, provided opacity, immediacy and liquidity mainly to professional investors (Hautcoeur and Riva 2012). The *Parquet* operations were managed by a guild called *Compagnie des Agents de Change* (CAC), whose governing body, the *Chambre Syndicale* (CS), was headed by a syndic. The Bourse as a whole was primarily a forward market (Lagneau-Ymonet and Riva 2017).

The *Parquet* organized two settlements of forward contracts per month, at the 15th and on the last day of each month. In order to perform these settlement operations, a huge amount of liquidity was required by the market every two weeks. This amount could reach and sometimes exceed 1.5 billion francs per settlement, a figure representing some one fourth of the total assets of *Bank of France*, or two thirds of the total assets of the main commercial bank of the time, the *Crédit Lyonnais* (Ungaro 2018).

The banking sector played a crucial role in supplying liquidity to the financial market. The instruments through which banks and other money suppliers provided with liquidity the market were called *reports* (Flandreau and Sicsic 2003, Ungaro 2018). A *report* was a sale of a security coupled with an agreement to repurchase the same security at a specified price at the following settlement. As such, it can be considered the historical equivalent of the current instrument called repurchase agreement, or repo[1].

From a practical point of view, *reports* were loans against securities. Remuneration of lenders was provided by an interest rate, depending on the general conditions of the money market and on collateral-specific factors (Ungaro 2018). The role played by the French historical repo market as chain of transmission of liquidity from the money market to the stock exchange made it a potential source of risk, ready to explode in times of high leverage (White 2007).

The repo market worked as follows. At each settlement date, forward contracts negotiated on the exchange expired. Bullish traders, borrowers on the repo market, transmitted their orders to their *agents de change* or *coulissiers*. They could either fulfill their purchase obligation and put an end to the transaction, or roll over their position to the following settlement. In both cases, the broker had to find a counterparty for his client among his or other brokers' customers. Typically, forward purchases outnumbered forward sales, leaving a need for cash. In order to raise this money and clear the market, brokers called in investors in possession of liquidity, who acted as repo lenders for the time of a settlement or more.

In 1914, depositors in the repo market were by a half industrial firms and merchants investing their treasury, and by the other half deposit banks[2]. The banking sector was dominated by four main institutions, *Crédit Lyonnais*, *Société Générale*, *Crédit Industriel et Commercial*, and *Comptoir National d'Escompte* (Baubeau 2016). In the two months preceding the Great Financial Crisis, the banking sector went through two moments of potential distress. At the beginning of June 1914, a distrust crisis hit the *Société Générale*, the second bank of the country. At the origins of the crisis were some rumors, advanced by a

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[1] About contemporary repo markets and their role during the last financial crisis see, among numerous others, Gorton and Metrick (2012).

[2] Archives nationales, Alexandre Ribot personal archives, Lettre de M. Ribot à M. Pallain, November 7, 1914, 563/AP/16. See also Ungaro 2018.

part of the Parisian and provincial press, about the solidity of the *Générale* in particular with respect to their German and Austro-Hungarian partnerships (Bonin 2016).

The crisis was faced by the bank on two fronts. On one side, the *Générale* organized a scheme involving "friendly" industrialists and bankers to perform high volumes of purchases of its shares on the stock exchange. This was done in order to increase the price of the bank's stock. On the other hand, the *Générale* asked the *Bank of France* to perform a control on its balance sheet, in order to obtain a loan from the central bank. It eventually obtained it on June 6th, 1914, for an amount of 200 million francs, brought to 300 million francs the day after, and to 800 million francs at the end of the month[3]. Total deposits in *Société Générale* were some 900 million francs at the end of May 1914.

The second event that imposed a burden on the Paris money market at the beginning of the summer of 1914 was the issue of a new government loan, the 3 ½ % *amortissable*, launched on July 7th, 1914, for a nominal capital of 805 million francs. Government bonds at the time were issued through the direct involvement of banks, which immediately bought the most part of securities to resell them at a higher price in the following months (Strauss 1982, Vaslin 1999). Before the issue, banks had to provide the Treasury with all the funds they could, covering the total amount of the loan even 20 or 30 times. At the moment of the issue, bonds were distributed to subscribers in proportion to their relative participation to the initial call, and banks were reimbursed of the additional funds they had deposited.

Given this mechanism, the only way for banks to participate as much as possible to government bonds issues was to have back in their cashes all their short-term funding. Table 1 shows that more than a half of the 1914 loan was bought by three banks, the *Société Générale*, the *Crédit Lyonnais*, and the *Comptoir National d'Escompte de Paris*, together with the Stock Exchange brokers' syndicate, the CAC. These four institutions together held 500 million out of the 884 million francs the loan was worth at the moment of its issue. At the moment of the crisis, twenty days later, less than a half of bonds had actually been subscribed by final investors (Jèze 1915). The rest of them remained in banks' cashes.

[Table 1 here]

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[3] Minutes of the Bank of France's Conseil Général, September 29th, 1914.

## 3.1 The Panic

The news of the Austro-Hungarian ultimatum to Servia came as a thunderbolt in the evening of Thursday, July 23rd. During the weekend, panic spread. Common savers, struck by rumors of a possible upcoming war, began withdrawing their bank deposits (Tennenbaum 1919). Commercial banks discounted their commercial portfolios at the Bank of France in order to get liquidity to pay off depositors (Hayem 1917). From July 27th to August 1st the BoF portfolio doubled, passing in six days from 1583 to 3041 million francs (Martin 1925).

The BoF's rediscount operations allowed commercial banks repaying deposits for more than a billion francs in six days, from July 25th to July 30th (Tennenbaum 1919). One of the banks more concerned by the massive withdrawals was the *Crédit Industriel et Commercial* (CIC). From Monday 27 July to Saturday 1 August the CIC faced a run by its depositors, who withdrew 150 million francs in just one week (Stoskopf 2016). As a benchmark, the total amount of deposits and current accounts held at the CIC on December 31st, 1913 was 184 million francs.

Even the very small savers felt the panic. At the time, the surest way to deposit little sums enjoying an interest was to open a savings account in one of the *Caisses d'épargne* (savings banks). Depositors were mainly from the middle class, as 35% of the French owned such an account in 1914. Starting from July 24th, depositors began to queue outside the *Caisses d'épargne* at 5 am each morning[4]. This phenomenon increased during the week of July 27th. Only in Paris, 1.5 million francs were withdrawn in three days, from Tuesday 28 to Thursday 30 July, by 2,500 depositors (Tournié 2011). 2,500 people was indeed the limit that the counters of the *Caisse* could afford in a working day (Tournié 2016).

One of the first measures taken by the government in order to stop the liquidity crisis was about the *Caisse d'Epargne*. A safeguard clause was decreed on July 30th, fixing a withdraw limit to 50 francs per depositor and per fortnight. The reason of this measure has to be looked for in the balance sheet of the *Caisse de Dépôts et Consignations* (CDC), that managed the placements of the hundreds of different *Caisses d'Epargne* since 1837 (Gallais-

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[4] Le Petit Journal, August 1st, 1914

Hamonno and Hautcoeur 2007). On June 30th, 1914, the 74% of CDC liabilities was made of securities held in account for the *Caisses*[5].

This figure represented a total amount of capital of more than 4 billion francs, mainly invested in French *Rente* and Treasury bonds. Table 2 shows the composition of the special portfolio held by CDC in account for the *Caisses d'Epargne* at the end of 1912. The French Rente represents by itself the 90% of the *Caisses*' portfolio. In case of an important run at the *Caisses*, the CDC would have needed to massively sell the securities held in its portfolio. These sales would have had a disrupting effect on the Stock Exchange and on the money market, already experiencing very difficult times.

[Table 2 here]

After the first days of panic, during which the BoF discount portfolio doubled, the Banque decided to stop advancing against securities to its manufacturing and industrial clients, and to significantly reduce its discounting facilities[6]. Only operations "directly linked with the war" could now be financed[7]. Facing a violent liquidity crisis, the central bank decided not to provide with liquidity the economy.

Instead of playing its role of LOLR, by keeping its discount window open and lending freely at high rates, the BoF preferred to save its money for the needs of the war. According to a contemporary practitioner, a 500 million sum given to the main Parisian banks would have allowed to avoid the moratorium on deposits[8]. Instead, in order to cut off the banking panic and contain the liquidity crisis, the government issued a decree on August 2nd, partially freezing deposits and current accounts. The decree saved the Société Générale, which in the previous week had twice asked an advance to the Bank of France without being satisfied.

The Bank of France decision can be explained by two main reasons. First, governor Pallain feared a currency devaluation. Second, the Banque entered in a period of negotiations with the government to obtain the renewal of the monopoly of notes issue, and by only lending to the state it increased its bargaining power.

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[5] Journal des Caisses d'Epargne, 1914
[6] Minutes of the Conséil Général of the Bank of France (A-BDF, MCG), 28 July 1914.
[7] A-BDF, MCG, 29 July 1914.
[8] Germain Martin of Société Générale, cited in Vignat (2001).

France anticipated a short conflict, at the image of what had happened during the 1870 Franco-German war. The governor wanted to keep it anchored to gold. Pallain had dedicated his whole mandate, started at the end of 1897, to the building of immense gold reserves. The aim, since then, was that of avoiding the risk of devaluating the currency in case of a war against Germany. When WW1 became a reality, the governor was contrary to provide liquidity to the economy in order to maintain the franc convertibility. The only actor that was granted almost unlimited access to the Banque's facilities was the Treasury.

The reason why the Bank of France preferred providing with liquidity the Treasury at the expense of the financial sector and the rest of the economy has to be sought in the status of the Bank of France, which was at the time a private institution having the monopoly of issuing notes. The Banque enjoyed a monopoly (or "privilege", as it was called), that was subject to renewal every 23 years. Renewal negotiations had been harsh in the past, with the central bank always looking for arguments in order to convince the political power of being indispensable.

In the 1890s, for instance, the Banque had developed a network of branches with the aim of providing credit access to the whole country. This policy had been well looked upon by the government. The privilege, granted the last time in 1897, arrived to an end in 1920. Negotiations, therefore, had to take place during the war. Being the main financial supporter of the conflict put the Bank of France in a strong bargaining position. When the conflict showed to be a long one, Pallain had to choose again between extending the Banque's credit to the economy and reserving it to the Treasury. Once again he chose the first option, willing to use the Banque's support to the government as leverage to obtain the renewal of the privilege.

## 3.2 The Stock Exchange

Let us now consider the situation on the stock exchange. In figures 1 and 2, showing stock-exchange prices and indices variations during 1914, some key dates can be easily singled out. July 23rd is the day of the ultimatum; this was delivered at 5 pm, therefore after the closing of the Paris Stock Exchange (open between midday and 2 pm). On Friday 24, both the official market and the *Coulisse* reacted badly to the news. The mostly hit securities were the French and Balkan government bonds, and the banking sector shares.

[Figure 1 here]

On Saturday 25th, the Bourse, and in particular the *Coulisse*, lived a "true panic session", as witnessed by the financial press and by the main newspapers of the time[9]. The *Coulisse* decided to stop negotiating the French government bonds, or *Rente*, for excessive drop in offer prices. On Monday 27, the Coulisse tried to open up its forward market, but was forced to suspend it immediately. In the minutes that followed this decision, a group of young employees of the exchange began attacking Oscar Rosenberg, a Hungarian banker, who was said having speculated on the fall of the French *Rente* prices[10]. This episode demanded the intervention of the police. The Coulisse suspended its forward operations. They were not to be resumed until the end of the war.

[Figure 2 here]

Depositors were withdrawing their money from banks. The forward market in Coulisse was closed. As a consequence, non-financial investors in the *reports* market on the *Parquet* asked their brokers to be reimbursed in order to leave the market on the approaching settlement[11]. From July 27th to July 29th, more and more investors asked their money back to their brokers. The settlement of forward operations, and in particular the rollover of repo contracts, was seriously jeopardized.

On Wednesday 29, the Minister of Finance summoned the representatives of the main banks to ask their help to perform the settlement of forward operations on the stock exchange. In order to repay common investors, the brokers needed to find fresh money. The bankers opposed an abrupt refusal[12]. In normal times, the banking sector would have helped. As an instance, during the 1911 Agadir crisis, banks had supplied the market with the liquidity necessary to perform the settlement. In this particular moment, nonetheless, banks had to face runs, so that their liquidity was drying out[13].

Not willing to confess their situation to competitors and to the Minister of Finance, bankers representatives motivated their refusal by reminding to the Minister the help provided with

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[9] 'La Cote de la bourse et de la banque', 'Le temps', 'Le Petit Journal', July 25th, 1914 .

[10] Le Petit Journal, July 28th, 1914.

[11] *Bank of France* Archives: 1069200401/147, Letter from M. Deseilligny to M. Ribot, July 7th, 1915.

[12] *Archives nationales*, Alexandre Ribot personal archives, *Lettre de J. Noulens à A. Rochet*, July 29th, 1914, 563/AP/16.

[13] *Bank of France* Archives : 1069200401/147, Letter from M. Deseilligny (head of the CAC) to M. Ribot, (Minister of Finance), July 7th, 1915. "The Bank of France intended to reserve its resources to the State, and commercial banks had to face enormous withdrawals, so that [the Agents de Change] did not receive any effective support"

the issue of the 3 ½ % *Rente*. Less than a half of the total amount of the loan had actually been bought by final purchasers by July 27th (Jèze 1915). A large chunk of the government bonds was in the hands of credit institutions, who had bought the bonds not to keep them, but to resell them on a market that, however, was now blocked. The later Minister of Finance Ribot estimated "250 to 300 million francs (…) that could not be subscripted because war had arrived too early"[14]. Of these, around 100 million francs' bonds were blocked at the *Parquet* (Vidal 1920). The remainder was in the banks cashes.

[Figure 3 here]

In the meanwhile, the price of the 3 ½ % perpetual bond was falling. Figure 3 shows the evolution of the prices of the *Rente* 3 ½ % on both the official and the OTC markets. In the first days of the panic, the price of the bond had fallen to 85 francs per security, well below the rate of issue fixed at 91 francs. 250 to 300 million francs were yet to be sold to final investors and were floating on the forward market. The performance of a settlement at the end of the month would have meant huge losses for the owners of the debt certificates, in particular for those having taken a position at the *Coulisse*.

With the government bond issue in such a situation, and faced to the impossibility to found on the money market the liquidity necessary to perform settlement operations, Minister of Finance Noulens decided to postpone the settlement to August 31st. This decision, officially taken by the Minister on July 29th, was not communicated until the evening of July 30[th15].

The decision of the Minister to freeze the forward and repo contracts by a month was opposed by Alfred Rochet, the head of the CAC. He blamed the Coulisse for the market's bad situation. He displayed certainty that the Parquet was sound and safe, and able to perform the settlement. The postponement of the end of contracts, according to Rochet, would have put the official market in danger[16]. Nonetheless, the measure was officially taken by the Minister of Finance on July 29th, blocking at the Parquet an amount of money of some 600 millon francs, plus other 150 million francs at the Coulisse (Giraud 1918).

This amount is much lower than the volumes that had been negotiated on the Paris Bourse up to the Agadir crisis of 1911 – a sign that the *reports* market had slowed down in more

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[14] *Journal Officiel, Chambre des Députés, Documents, 18 mars 1915*.
[15] Le Petit Journal, July 31st, 1914.
[16] Minutes of the Chambre Syndicale of the Compagnie des Agents de Change (A-CAC, MCS), July 29th, 1914.

recent years[17]. This, as pointed out by the later Minister of Finance Ribot, was lucky: for otherwise the situation might have been much worse.

The news of the postponement of the Bourse's settlement arrived in London on July 30th, in a moment in which the situation on the Stock Exchange seemed to get better with respect to previous days (Roberts 2013). The French decision implied that London financial firms that had sold securities in Paris would have to wait until 31 August for payment. At the same time, "danger arose [also] out of the purchases made by foreigners [French] earlier in the account or carried over from previous accounts" (Keynes 1914). In the absence of liquidity coming from the continent, the London market was in serious distress, and would have faced panic selling in case of opening. The Stock Exchange Committee decided therefore to close down the exchange (Michie 1999).

On August 17th the CS decided to defer the settlement originally fixed at the end of the month to the end of October, mainly because of the multiple moratoria that allowed banks and other creditors to avoid honoring their debts for the time being. Capital investors, who had been deprived of the possibility of withdrawing their capitals since July, were thus forced to wait at least two additional months before getting their money back.

Moreover, at the end of August no remuneration was given on those capitals. That is why on August 25th the Minister of Finance summoned the syndic Rochet and presented him with the project of giving an interest to the reporteurs who had their funds blocked. Asked advice on what such interest should amount to, Rochet suggested 5%. On September 2nd, with the securities physically relocated to Bordeaux and the German army close to Paris, the Stock Exchange closed its doors.

### 3.3 The first loan: unblocking capitals

On August 27th, 1914, a new Government called Union Sacrée ("Sacred Union") replaced the previous, left-wing one. The Government and the Stock Exchange moved to Bordeaux and Alexandre Ribot, who had already served as Prime Minister, Minister of Finance, Minister of the Interior and Minister of Foreign Affairs during the 1890s was again appointed Minister of Finance. While preparing to make French finances ready for wartime, he first dealt with some urgent issues.

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[17]Intervention of Mr. Ribot at the *Assemblée Nationale*, in response to the interrogation of Mr. Monzie, on September 23rd, 1915.

One of the first measures he took, mainly due to the pressure  investors were putting on him, was that of issuing, on September 27th,  a decree (so-called Décret Ribot) by which a moratorium was finally granted on stock exchange operations, that had been excluded from the measures taken on July. The terms of the decree were the following:

-        Every demand for payment and every judicial action relative to forward operations undertaken before August 4th were suspended to a later date (*sine die*).

-        A moratorium interest of 5%, to be paid by buyers to sellers under the guarantee of the intermediaries, had to be applied on outstanding debts. This measure was specifically taken in order to help those lenders whose money was employed in reports and that had been blocked since the end of July.

Once he had issued the moratorium, Ribot started to work to unblock at least part of the capitals on the *reports* market.  How much money are we talking about? Contemporary estimations differed, because it was the settlement itself that determined the sum; the total amount, however, can be   put at 600 million francs.  As the Minister himself recognized in a speech at the *Assemblée Nationale* in September 1915, this was much less than the amounts that had been negotiated on the Paris Bourse up to the Agadir crisis of 1911 – a sign that the reports market had slowed down in more recent years.  This, as Ribot also pointed out, was lucky: for otherwise the situation might have been much worse.

Following a suggestion of the syndic's, the Minister requested that the Banque de France intervene to unblock the capitals. The intervention was justified by the fact that, since more than a half of the blocked funds belonged to industrialists, merchants and bankers, it was in the interest of the whole Parisian financial market that some course of action be taken.

The plan Ribot submitted to Georges Pallain, the governor of BdF, was based on that which had underpinned the unblocking of the London Stock Exchange. The main difference was that the French government was unable and unwilling to provide the Banque de France with the same guarantee that the English government had given the Bank of England.  At worst, however, the Banque could use the reserve fund made available by an agreement between the Government and the BdF signed on September 21st.

The proposed scheme consisted in a 200 million francs loan from the BdF to the CAC, an amount that was around a third of the total needed to perform the whole settlement. It was

supposed not to integrally reimburse capital investors, but only to provide them with some liquidity. Lenders  simply had to ask their brokers for an advance not exceeding 40% of the market value of securities that had remained blocked because of the sine die adjournment of the July 1914 settlement.  Once they had deposited the stocks and bonds into the Banque de France, the brokers received the sum from BdF at an interest rate equal to the official discount rate of the Banque of 5%, and in turn gave it to their clients. So the scheme did not allow the reporteurs to have their money entirely back, as the securities remained their property and not saleable. Nonetheless, it allowed money investors to receive liquidity in a moment of extreme difficulty.

The project was initially criticized by Edouard de Rothschild, regent of the Banque de France, who feared that the scheme might take the form of a loan against low quality securities. The problem was that the BdF, by charter, could not provide loans against any kind of security. Securities admitted to advance at the Bank were strictly regulated and needed to be very sure – while reports were done on every security admitted to the forward market of the Paris Bourse.

The method finally adopted to perform the loan was the following. As primary collateral to the 200 million francs loan, the brokers provided debt acknowledgment certificates. On every certificate were appended three signatures, two belonging to the two brokers responsible for the operation, and one belonging to the Syndic or his representative and committing the whole CAC.

In support to each certificate, the brokers delivered to the Banque, as secondary collateral, the securities on which reports had been negotiated and that were property of their customers. The total amount of the loan could not exceed 40% of the total amount of this secondary collateral. Therefore the latter did not represent the direct collateral for the loan, but only an additional guarantee for the Banque. This solution was thus accepted by all the regents. The convention was signed on November 10th, 1914. On December 7th, 1914 the stock market re-opened, though only for spot operations.

Once he had dealt with the most urgent matters, Ribot started to plan his action as a finance minister in time of war. Between financing the conflict through taxes or public loans, he soon took up the latter option, freezing the income tax (which had been voted in July 1914, right

before the war, by the left-wing majority), and started to think of issuing a new series of loans.

Ribot soon understood that, in order to issue public bonds, he had to unblock the capitals market, and in particular to free investors from the burden of their engagements on the 3 ½% amortissable loan. This loan had been issued on July 7th, 1914, for a capital of 805 million francs. At the outbreak of the War, less than a half of bonds had actually been subscribed by final investors. A large chunk of them was in the hands of credit institutions, which had bought the bonds not to keep them, but to resell them on a market that, however, was now blocked. It was therefore necessary "to clear the market from securities" in direct conflict with the emission of new loans.

This is why on September 11th 1914 Ribot signed a decree allowing the bearers of 3 ½% loan certificates to dilute the repayment of their debt over four terms (from September to December 1914), and, even more importantly, to exchange those certificates at the favorable price of 91 francs against the commitment to buying upcoming bonds.

At the beginning of December, Ribot asked the Banque de France to help free up the 3 ½ % bonds. At the moment of the emission, the funds amounted to 270/300 million francs in capital. 90/100 million had already been deposited in the Treasury. An additional 180/200 million francs was needed; Ribot turned to Pallain, and asked him to lend it not directly to the Treasury, but to the bearers of 3 ½ % certificates.

That helped to clear the market and was at the same time profitable for the Banque. Under the conventions, the BdF applied a rate of interest of only 1% to the State while perceiving an interest of 6% by the final investors. The Banque was moreover guaranteed by the fact that the bearers of 3 ½ % certificates could in the future exchange them at a rate of 90 francs for the payment of future loans' subscriptions.

As Ribot himself recognized, from a strictly financial point of view the operation represented a loss for the State. The Treasury, however, was interested in treating investors "with benevolence" in order to get their help to finance war. The scheme was a success and by the end of July 1915 the loan was almost entirely freed up: only 15 million francs in capital remained floating. The market was almost ready to support the issuing of new loans: it only remained to perform the settlement that was postponed sine die since the end of July 1914.

Capital investors had been helped, and the most part of the 3 ½ % amortissable loan had been moved out of the market. In order to issue new loans and finance war, it was now necessary to fully reactivate the financial market (the official stock exchange, the Coulisse, and the regional exchanges). In order to do so, the next move was to perform the settlement of forward operations suspended since July 1914. Several institutions cooperated to achieve such an end: the Ministry of Treasury, the *Banque de France*, the *Caisse des Dépôts et Consignations*, and of course the *Compagnie des Agents de Change*.

Ribot decided to separate the settlement of the Rente 3% and the remaining stock of 3 ½ % amortissable loan from the settlement of other securities. The measure was meant not to "expose the national funds to price fluctuations that could provoke the liquidation of important volumes", and was initially opposed both by the agents de change (who feared problems might arise for Rente purchasers who were also sellers of other securities) and by the *Banque* (which wanted to keep the bonds as sure collateral for the loan they were going to make to brokers).

In order to perform the settlement of the Rente 3% it was necessary to employ 35 million francs, of which six million in Coulisse. At first Ribot asked the CAC to advance the amount to the unofficial stock exchange. The syndic, however, refused, for two reasons. First, the amount of the debts outstanding in Coulisse was high. Second, to satisfy Ribot would have meant to "officially recognize" the fact that the unofficial market could negotiate the French perpetual bonds, that were legally subject to the monopoly of the CAC.

The solution found was to make the *Caisse de dépôts et Consignations*, a public institution, to purchase the floating Rente 3% (a capital of 35 million francs), and to delegate banks and financial institutions to offer the 15 million of 3 ½ % amortissable directly to their customers. Every *report* made on Rente was finally reimbursed by the end of August 1915.

The settlement of all other securities, which eventually took place at the end of September 1915, was jointly organized by the CAC and the Banque of France. The agreement concluded in November 1914 between the Compagnie and the Banque had not been particularly useful in reimbursing lenders, as it applied to them penalizing conditions. Of the 200 million francs loan, only 16 million had effectively been used by September 1915. This first agreement was

terminated and its place taken by a new one, which brought the maximum amount to 250 million francs.

Originally, the Banque did not want to cooperate in the operation. Only the direct intervention of the Minister of Finance Ribot finally convinced Pallain, motivating the unblocking of the capitals stuck in the stock exchange as related to National Defense. It was only in this perspective that BdF accepted to extend and increase its loan by 50 million francs.

In exchange for its unwilling involvement, the Banque required some additional guarantee. First of all, because of their surety the *Rente* bonds were repeatedly asked for as collateral. As we have seen, for reasons of national security Ribot had decided not to include the *Rente* in the standard settlement operation.  In their stead, he lent to the Compagnie 30 million francs in the form of National Defense bonds without interests to be paid, renewable every three months during two years. Those bonds had to be given as secondary collateral to the Banque de France, and could be withdrawn only after all the other securities given in pledge, so that they remained in possession of the BdF until the total reimbursement of the loan.

As a second increment of the guarantee, the Banque required the debt certificates, which were accepted as primary collateral for the loan, be signed not by three brokers anymore, but by all seventy of them, making  each responsible for one seventieth of the total amount of discounted certificates. This was meant to extend the personal guarantee of each broker, and was needed because the signature of the syndic only committed the common fund, not the personal funds of the Agents. It was also taken as a counter-measure in case the brokers' customers should ask to be reimbursed before the Banque. Without this clause, the BdF would have been a simple creditor, not a priority one.

A third condition imposed by the Banque was to include as secondary collateral only a selected sample of securities, and not every stock or bond blocked because of the postponement of the settlement. Moreover, securities were accepted with a margin: their evaluation was reduced with respect to their nominal value. The original proposal by the CAC distinguished among six categories of securities:

1.      First order bonds, such as the best French fixed income securities, bonds of the French railways company, and some foreign bonds considered as particularly sure (English consols, Swedish, etc.). Those securities were to be evaluated at a 90% rate;

2.      First class stocks, such as the Suez and the French railways companies. Given the price fluctuation typical of variable income securities, their evaluation was to be set at a 80% rate;

3.      State funds, foreign cities and foreign industrial bonds of good and medium quality. Rate of evaluation: 75%;

4.      Industrial stocks of good quality: 75%;

5.      Industrial stocks overpriced or of uncertain quality, with a capitalization rate considered too high. The value of the pledge was to be kept at 65%;

6.      Dubious, mediocre and bad securities, such as loans of State with a weakened credit. Rate of 50%.

Nonetheless, the Banque did not accept this proposal, and in particular did not want to accept as collateral the assets of categories 5 and 6, considered of being of too bad quality. Moreover, the BoF required higher haircuts for assets in categories 3 and 4. The final classification applied by the Banque distinguished among "first order" bonds (class A), only issued by French institutions; good securities (class B), including the first class stocks originally in category 2, as well as foreign bonds originally in category 1; and "average" securities (class C), including assets previously in categories 3 and 4.

For securities of "first order" (A), the haircut applied was of 5%. For "good" securities (rate B), the Banque applied a haircut of 20%. For "average" securities (class C), the haircut was fixed at 30%. Following this classification, the total amount of the offered guarantee reached the level of some 220 million francs, which together with the 30 million francs in Bons de la Défense Nationale managed to satisfy the BdF's requests.

On its side, the Compagnie issued 75 million francs of 6% bonds. These bonds, with a nominal value of 1000 francs, were issued at a rate of 980. They were redeemable starting in 1920 and with a maximum delay of twenty years. They were easily placed – a sign that the CAC still enjoyed a good reputation. These funds were specifically destined not to the reimbursement of capitals, but to the payment of the differences between prices in July

1914 and in September 1915 on the one hand, and of the moratorium interest of 5% on the capitals of the repo lenders on the other.

In order to make sure the settlement would be a success, it was necessary to perform it on the Parquet, at the Coulisse and in the regional exchanges at the same time. Ribot delegated the CAC to provide loans to those exchanges.  In support, the Ministry lent 85 million francs in Bons du Trésor to the Compagnie, with zero interest and without any pledge. These Bons were to be discounted at a 4.5% rate at the Crédit Lyonnais in case of massive need of money.

Thus backed by the Government, the CAC advanced 36 million 400 thousand francs to the Coulisse to perform its settlement of forward operations. The interest to be paid on this loan was 6.75%. The Coulisse was not in a position to immediately reimburse the capitalists who had invested in reports – nor did it intend to. It just wanted to pay the differences accumulated during the year of war, and 36 million francs were enough for that.

When the CAC asked the unofficial exchange for a guarantee, Gaston Dreyfus, the president of the Coulisse des valeurs à terme, proposed to create a dedicated fund. This was meant stand in for a collective responsibility that was impossible to establish for the Coulisse. In order to constitute the fund, called Caisse des réglements, the 11 million francs available in the common fund of the Coulisse were deployed, as well as a deposit of 10 thousand francs for each Maison (seat) and a fee on commissions.

Additional loans to the regional exchanges were granted by Desilligny (who had been the new syndic since July 1915) following a direct request from Ribot. The reason for these interventions was that provincial brokers had commitments on Paris Bourse, so that in order to perform the settlement in Paris it was necessary to unblock these capitals too. The only three Parquets concerned were those of Lyon, Marseille and Bordeaux.

In Lyon, the volume of outstanding debts was estimated at some 8 million francs by the syndic of the local CAC, Dumenge.  About half of them were commitments with the Parisian financial place, equally shared between the Parquet and the Coulisse. After some opposition, Lyon accepted to provide a mutual solidarity on the 8 million francs loan made available by the Parisian CAC. In exchange for the loan, the Lyon brokers engaged to give to Paris debt certificates, half at 6% interest and half without interest, guaranteed by a joint liability of all

the agents de change. A similar measure was taken in Bordeaux, in exchange for a 100.000 francs loan given in order to face the engagements contracted with the Parisian Parquet. In Marseille only one broker was in a bad situation, and was eventually helped by the members of his own Compagnie.

The settlement in Paris took place on September 30th, 1915.  Following the example of London, the Compagnie adopted the following rules: any forward operation not aiming at reducing the existent positions was forbidden; only one price per day was done for each security, in order to assure equality of treatment for all interested parts; no order execution was assured;  minimum prices were established, as in London, in order to avoid heavy falls in prices.

The deployment of the settlement was smooth. The capitals employed in reports remained almost integrally at disposal of the Parquet, and only a few lenders required an advance of the *Banque*. Why was it the case? In period of war, there was a shortage of liquidity. We would therefore expect that lenders massively withdrew their funds. One possible explanation to this behavior is that tha BoF rationed credit, by applying lower interest rates with respect to those practiced on the market. I test this possibility in the next section.

4. Empirical tests

In order to quantitatively assess whether the Bank of France rationed credit to the stock exchange at the moment of the reopening of the repo market in September 1915, I perform two tests. The first consists in comparing interest rates done on the repo market with those applied by the *Banque* on its loans on the same collateral assets. Lower market rates are to be interpreted as a sign of credit rationing. The second step consists in an ordered logit model through which I test whether market characteristics of collateral assets can explain how the Banque decided to rate securities.

The Banque applied haircuts on its loans, according to the class of assets. A haircut is the difference between the market value of an asset and the amount of the loan. In other words, the BoF did not provide to the borrower the whole value of the collateral asset in cash, but it reduced the amount of the loan by a haircut depending on the class of the securities.

For securities of "first class" (A), the haircut applied was of 5%. For "good" securities (rate B), the Banque applied a haircut of 20%. For "average" securities (class C), the haircut was fixed at 30%. If I adjust the interest rate of 5%, which was fixed by the *Banque* for those loans, with the haircuts applied to each class of assets, I can compute the actual interest rates paid by borrowers to the central bank. I apply a simple formula:

$$r_c = \frac{r_b}{1 - h_c} \qquad (1)$$

Where $r_c$ is the actual interest rate applied by the Banque of France for lending against a collateral asset belonging to class c, $r_b$ is the interest rate of 5% fixed by the Banque, $h_c$ is the haircut applied to the class of assets c, and $1 - h_c$ is the so-called loan to value ratio, the actual amount of cash lent, expressed in percentage of its market value. This calculation brings to an actual interest rate of 5.23% for assets of class A, 6.25% for assets of class B, and 7.14% for assets of class C. These were the interest rates at which investors could borrow money from the Banque by providing as collateral those stocks and bonds that had remained in their hands because of the adjournment of July 1914 settlement.

These loans could be done starting from September 30, 1915, the date of the reopening of the repo market. In order to test whether the Bank of France rationed credit to these types of investors, I compute the interest rates practiced on the repo market for the same collateral assets. I then compare the interest rates applied by the Banque to those available on the market. If lenders could find higher interest rates on the market, they had no interest in accessing to the central bank facilities.

That would be evidence of credit rationing, because fixing higher interest rates for the same asset would mean pushing rational investors towards the market. Formally, I test whether I can accept the null hypothesis that the Banque did not ration credit: if the interest rate fixed by the Banque is below the repo market rate for the same security, I reject the null that the Banque acted a lender of last resort, and accept the alternative hypothesis that it rationed credit[18].

I conducted the test over a basket of 36 securities. I selected the securities in the basket on the basis of their liquidity. I therefore chose the ones that had at least a spot price published

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[18] Bignon, Flandreau and Ugolini (2012) use a similar test to study the LOLR practices of the Bank of England during the 19th century.

on the official list in at least 10 of the 12 monthly settlements preceding the war (that is, from July 1913 to June 1914 included). The aim is that of computing for them measures of historical volatility and liquidity, and only continuous time series allow me to do. In the basket, I have five securities of class A, 15 securities of class B, nine securities of class C, and seven of class D, that is not admitted as collateral by the Banque of France.

[Table 3]

Table 3 presents some descriptive statistics of these assets. I have 22 securities issued by French institutions, and 14 issued by foreign states or companies. 27 assets were issued by private companies, while 9 of them were public bonds. The four remaining bonds were issued by private companies, bringing the total number of bonds to 13, and the total number of stocks to 23.

In order to perform my test, I have to compute the market interest rates for the same securities on the date of the reopening of the repo market. In order to compute the annualized repo rate I apply the formula used by contemporaries, that is the following (Haupt, 1894):

$$rate = \frac{repo\ price\ X\ number\ of\ yearly\ settlements\ (12\ or\ 24)}{settlement\ price}$$

Where the settlement price is the market price of the security as it is published on the official list, the repo price is the additional amount of cash paid by the borrower at the end of the transaction, as it is published on the official list, and the number of settlements changes between 12 and 24 according to the type of security. In order to compute an annualized rate, if the loan was undertaken for only two weeks I multiply the rate by 24, while if the loan was undertaken for one month I multiply the rate by 12.

Table 4 presents the results of the empirical test. It shows the rating decided by the Bank of France (A, B, C or D), the resulting interest rate computed by applying (1) to each security of my basket, and the interest rate paid on the same securities on the repo market on the reopening day, September 30 1915. I find that the Banque systematically applied lower interest rates with respect to the newly reopened stock market on the same collateral assets. Only for a few of them (outlined by darkest lines) the rate to be found at the Banque was higher than on the market. This is an evidence of credit rationing. If lenders could find

higher interest rates on the market, they had no interest in accessing to the central bank facilities.

As an additional test, I perform an ordered logit regression on the same basket of securities. I follow the Banque's classification of securities in "first class" (A), "good" (B), "average quality" (C), and "bad quality" (D). Then I test whether the behavior of collateral assets before the war, such as their liquidity, volatility, or returns, allow to explain the choice of the bank in classifying them.

Ordered logit models are regression models for an ordinal response variable. The model is based on the cumulative probabilities of the response variable. My ordered logit model for an ordinal response $Y_i$ with four categories C for the i-th subject, is defined by a set of C-1 equations where the cumulative probabilities $g_{ci} = \Pr(Y_i < y_c | x_i)$ , c = 1, …, 4, are related to a linear predictor $\boldsymbol{\beta}' = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \cdots$ through the logit function:

$$logit\ (g_{ci}) = \log(\frac{g_{ci}}{1 - g_{ci}}) = \alpha_c - \boldsymbol{\beta}' x_i, \quad c = 1, 2, C - 1.$$

Where $x_i$ is the vector of covariates and the parameters $\alpha_c$ are called thresholds or cutpoints. It is not possible to estimate simultaneously the overall intercept $\beta_0$ and all the thresholds. I solve this identification problem by omitting the overall constant from the overall predictor.

The variables I consider in the regression are the following: liquidity is a proxy for asset liquidity. The Paris stock exchange official list published the price of every transaction done on the spot market for any security, if different from the immediately previous price done on the same day. I can therefore use the number of prices published in the settlement day as a proxy for liquidity, as it represented the minimum number of transaction done on the spot market for that security. This variable in my database can vary between zero and ten. I then average these "daily" liquidity measures over twelve months in order to obtain a historical liquidity proxy. Number of prices come from the DFIH database[19].

The variable volatility is the historical volatility of asset prices over 12 months. For each asset, I calculate asset returns each month with respect to the previous one, and I then compute the standard deviation of the returns over 12 months. Variable return represents

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[19] DFIH database, version May 2017 (Hautcoeur and Riva, 2016).

for each security the asset returns calculated over a year, July 1913 to June 1914. French and private are dummy variables for the type of issuer. Stock is a dummy variable representing the type of security.

Table 5 presents the results of the ordered logit estimation, run with robust standard errors (Huber/White/sandwich estimator). I also run an ordered probit model and an OLS with the same variables, for robustness. As expected, I find that no market variable has an explanatory power. The only statistically significant variable associated to finding a security in a higher class is, meaningfully, the fact of being issued by a French institution. Being a "French" security increases the odds of being in a higher class versus being in a lower one by 14.995. The probit and OLS models both confirm this result.

This additional test allows to understand that the choice by the Banque of attributing a security to a class or another had little to do with a market evaluation of these assets, and more to do with political reasons. This represents additional evidence on the BoF policy of credit rationing.

## 5. Conclusion

In this paper, I study the impact of World War One on the Paris financial market. Facing a liquidity crisis, the Bank of France had to choose between acting as a lender of last resort and provide with liquidity the banking and financial systems, or rationing credit. It opted for the second choice, in order to reserve its resources to the government and the financing of war.

This decision was taken as soon as rumors of war began to spread and provoked mini-runs and liquidity shortages throughout different types of financial institutions. The choice of not acting as a LOLR contributed to the rise of a panic that had international repercussions and was only stopped by a series of moratoria on outstanding debts imposed by the government.

The approach was maintained during the whole war, and credit rationing was still implemented when the stock exchange reopened its repo market in order to settle pre-existing debts. By using two different quantitative tests, I show that the Bank, though nominally available to help the brokers reopening the market, rationed credit and drastically reduced the scope of its intervention, which resulted being more ideal than material.

I find that the Banque systematically applied lower interest rates with respect to the newly reopened stock market on the same collateral assets. This is an evidence of credit rationing. If lenders could find higher interest rates on the market, they had no interest in accessing to the central bank facilities. Moreover, I find that with respect to earlier negotiations, the central bank decided to exclude from the list of accepted collateral a high number of assets, accepting only the better ones.

The choice of not acting as a LOLR had long-standing consequences on the overall financial market. The repo market experienced a substantial contraction with respect to the pre-war period, and never returned to the previous situation. On the contrary, the decision to massively finance the State brought to the development of a large market for short-term Treasury bills, which ended up partially substituting the repo market after the end of the War. A new segment of the money market had been created, providing new investment opportunities for short-term investors.

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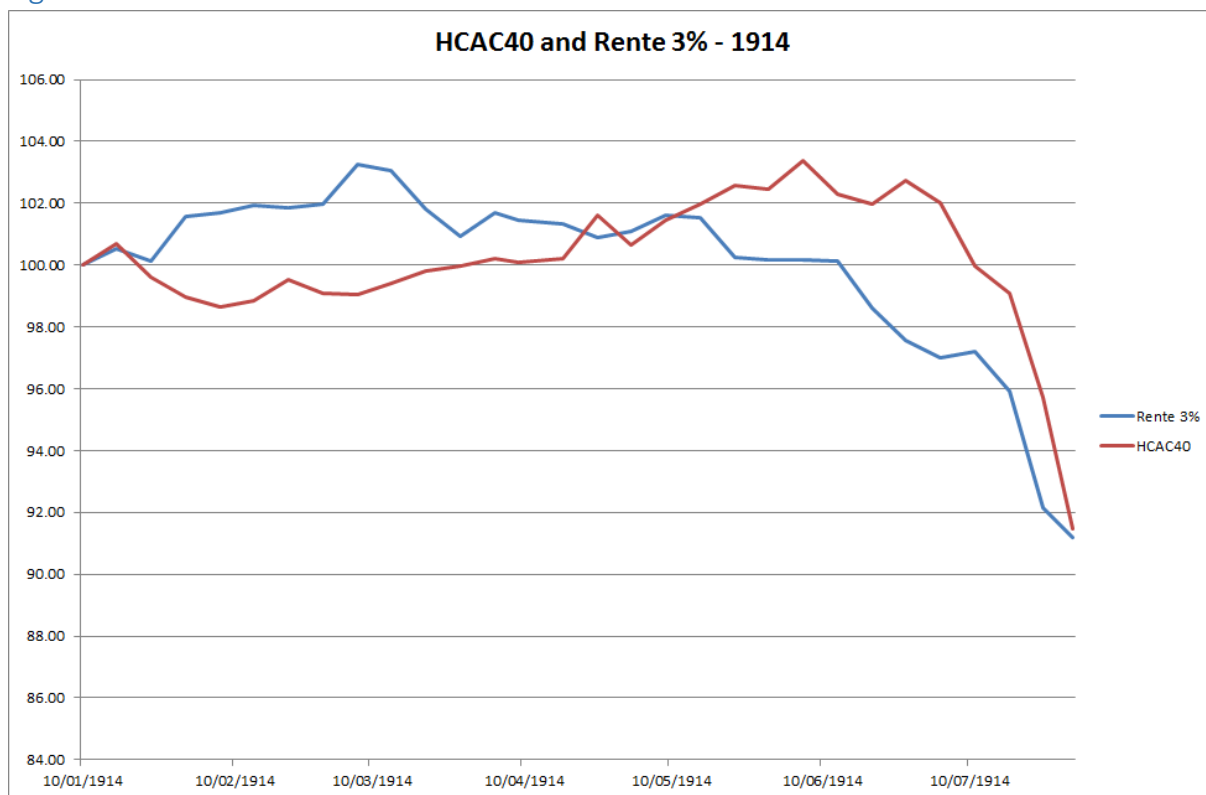
**Figure 27 - Evolution of Historical CAC40 index and Rente 3% during year 1914. 10/01/1914 = 100. Sources: Paris Stock Exchange Official List; Le Bris 2011, for the composition of HCAC40 in 1914.**
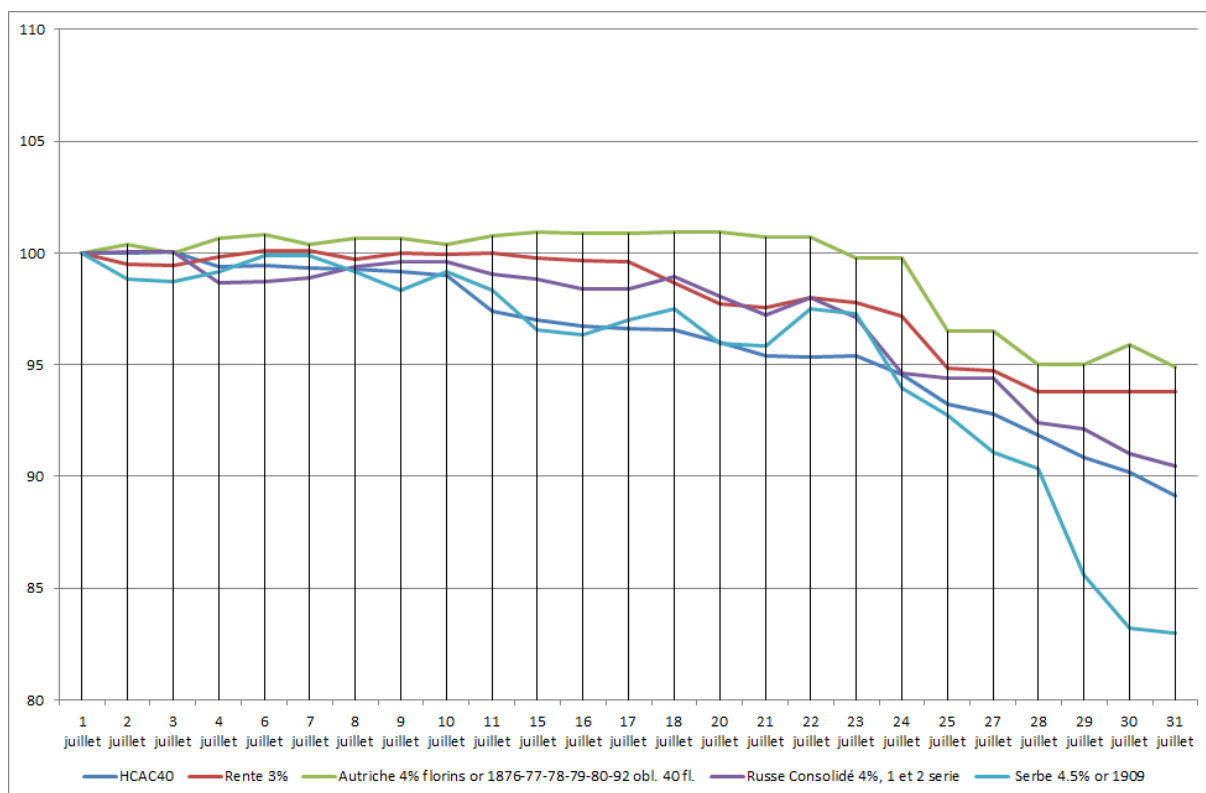


**Figure 28 - Evolution of stock prices and indices during July 1914. 01/07/1914 = 100. Sources: Paris Stock Exchange Official List; Le Bris 2011 for the composition of HCAC40 in 1914.**
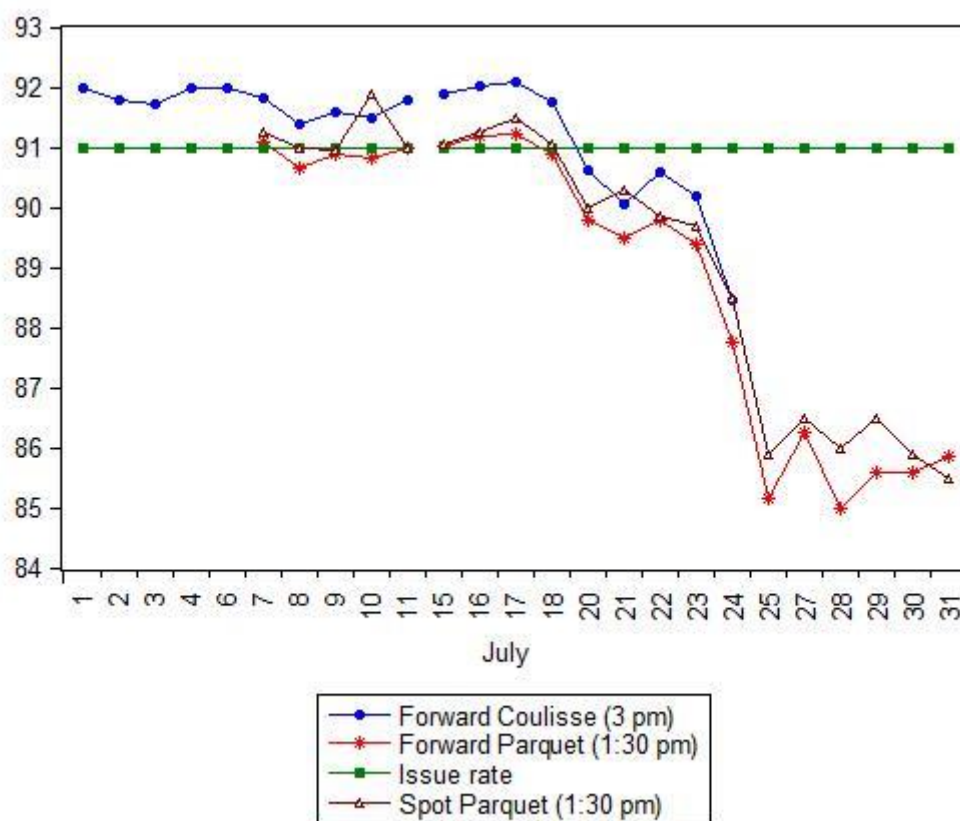
**Figure 29 -** Evolution of forward and spot prices of Rente 3 ½ % amortissable, Parquet and Coulisse. Sources: For Parquet Spot and Forward prices, Paris official stock exchange list; For Coulisse, Cote de la Bourse et de la Banque.

**Table 1 – Participation of principal banks and brokers' syndicate to the issue of the 3 ½% amortissable loan. Source: My calculations from Bank of France's Conseil Général Minutes, July 9th, 1914, and Cote de la Bourse et de la Banque, July 9th, 1914.**

| Institution | Quantity of 3 1/2 % loan purchased (total amount of capital) |
|---|---|
| Crédit Lyonnais | 197 801 888,20 |
| Société Générale | 192 307 391,30 |
| Chambre Syndicale CAC | 55 900 621,12 |
| Comptoir National d'Escompte de Paris | 54 944 968,94 |
| **Total 4 institutions** | **500 954 869,57** |
| Percentage | 56,63% |
| **Loan Total amount** | **884 614 000,00** |

**Table 2 - Composition of the special portfolio held by CDC in account for the Caisses d'Epargne, December 31st 1912.**
**Source: Rapport à Monsieur le Président de la République sur les opérations des Caisses d'Epargne ordinaires, 1912.**

| Securities | Total amount of capital (in Francs) | Percentage |
|---|---|---|
| 3% Rente | 2 251 463 232,70 | 55,60% |
| 3% Amortissable Rente | 1 306 821 051,88 | 32,27% |
| Bonds 4% 1912 State Railroads | 1 359 809,00 | 0,03% |
| 500 francs Treasury bonds, 3% amortissable | 261 408 000,00 | 6,46% |
| Short Terme Treasury bonds 2,25% | 25 000 000,00 | 0,62% |
| Railroads bonds 500 francs 3% | 125 630 302,00 | 3,10% |
| Railroads bonds 500 francs 2,5% | 17 895 277,58 | 0,44% |
| Crédit Foncier de France bonds | 17 127 060,75 | 0,42% |
| Annam and Tonkin protectorate bonds 2,5% | 8 467 860,35 | 0,21% |
| Hellenic Government loan 2,5% 1898 | 6 905 358,26 | 0,17% |
| Account at Treasury | 27 061 572,26 | 0,67% |
| Account at Bank of France | 1 000,00 | 0,00% |
| Total Portfolio | 4 049 140 525,65 | |

**Table 3 – Descriptive statistics. Basket of securities used in my quantitative analyses.**

| Group | French | Foreign | Private issuer | Public issuer | Stock | Bonds | TOT |
|---|---|---|---|---|---|---|---|
| A | 5 | 0 | 3 | 2 | 1 | 4 | 5 |
| B | 11 | 4 | 14 | 1 | 14 | 1 | 15 |
| C | 4 | 5 | 5 | 4 | 5 | 4 | 9 |
| D | 2 | 5 | 5 | 2 | 3 | 4 | 7 |
| TOT | 22 | 14 | 27 | 9 | 23 | 13 | |

**Table 4 – Rating, market rate, and bank rate, for a basket of securities, on September 30, 1915. Source: my DB, from BDF archival sources and Official List of the Paris Stock Exchange.**

| rating | name | market rate | bank rate | market > bank |
|---|---|---|---|---|
| A | Banque de France, act. | 7.00 | 5.26 | YES |
| A | Crédit Foncier de France, act. | 7.17 | 5.26 | YES |
| A | Lyon et à la Méditerranée PLM 3% Fusion | 7.11 | 5.26 | YES |
| A | Orléans obl 3% | 7.11 | 5.26 | YES |
| A | Nord obl. 3% | 7.01 | 5.26 | YES |
| B | Voitures à Paris, act. | 7.45 | 6.25 | YES |
| B | Banque de Paris et des Pays-Bas, act. | 7.30 | 6.25 | YES |
| B | Canal Maritime de Suez act. | 7.20 | 6.25 | YES |
| B | Crédit Lyonnais, act. | 5.30 | 6.25 | NO |
| B | Est, act. | 7.04 | 6.25 | YES |
| B | Lyon et à la Méditerranée (Paris à), act. | 7.01 | 6.25 | YES |
| B | Midi, act. | 7.05 | 6.25 | YES |
| B | Nord, act. | 7.04 | 6.25 | YES |
| B | Orléans,act. | 7.04 | 6.25 | YES |
| B | Ouest, act. | 4.23 | 6.25 | NO |
| B | Méridionnaux (Cie Italienne des ch.de fer), act. | 7.20 | 6.25 | YES |
| B | Société Foncière Lyonnaise, act. | 7.38 | 6.25 | YES |
| B | Crédit foncier Egyptien, act. | 4.04 | 6.25 | NO |
| B | Saragosse (Madrid à), act. | 7.44 | 6.25 | YES |
| B | Espagne 4 % Extérieure | 6.03 | 6.25 | NO |
| C | Ce générale transatlantique, act. | 7.64 | 7.14 | YES |
| C | Messagerie maritimes, act. | 7.64 | 7.14 | YES |
| C | Rente Foncière Parisienne, act. | 7.36 | 7.14 | YES |
| C | Société de Crédit Mobilier, actions nouvelles | 7.48 | 7.14 | YES |
| C | Sud de la France (Ce des Ch.de fer du), act. | 7.09 | 7.14 | NO |
| C | Banque ottomane, act. | 3.24 | 7.14 | NO |
| C | Brésil 4% 1889 | 7.31 | 7.14 | YES |
| C | Lautaro Nitrate | 7.43 | 7.14 | YES |
| C | Ottomanes dites consolidation 4% 1890 | 7.57 | 7.14 | YES |
| C | Portugal 3% 1 série | 7.44 | 7.14 | YES |
| D | Suez (Soc. civile) | 7.21 | not accepted as collateral | |
| D | Lombard (Sud- Aut.), act. | 7.87 | not accepted as collateral | |
| D | Nord de l'Espagne, act. | 7.46 | not accepted as collateral | |
| D | Egypte dette privilegiée convertie 3,5% | 7.19 | not accepted as collateral | |
| D | Nord de l'Espagne obl 3% r à 500 fr 1e série, 1ere hyp | 7.22 | not accepted as collateral | |
| D | Russie consolidé | 7.10 | not accepted as collateral | |
| D | Saragosse (Madrid à), Oblig. 3% | 7.30 | not accepted as collateral | |

**Table 5 – Regressions results. Robust standard errors in parentheses.**

|  | Ordered Logit | Ordered Probit | OLS |
|---|---|---|---|
|  | Odds ratio | Coefficient | Coefficient |
| liquidity | 0.704 | 0.881 | 0.936 |
|  | (0.31) | (0.21) | (0.18) |
| volatility | 0.787 | 0.896 | 0.921 |
|  | (0.15) | (0.09) | (0.07) |
| return | 1.013 | 1.010 | 1.009 |
|  | (0.02) | (0.01) | (0.01) |
| french | 14.995* | 4.540** | 2.978* |
|  | (16.82) | (2.52) | (1.22) |
| private | 1.930 | 1.386 | 1.123 |
|  | (3.44) | (1.21) | (0.71) |
| stock | 0.505 | 0.635 | 0.875 |
|  | (0.73) | (0.47) | (0.45) |
| _cons |  |  | 9.375*** |
|  |  |  | (4.67) |
| cut1 |  |  |  |
| _cons | 0.194 | 0.466 |  |
|  | (0.24) | (0.31) |  |
| cut2 |  |  |  |
| _cons | 0.756 | 0.994 |  |
|  | (0.79) | (0.58) |  |
| cut3 |  |  |  |
| _cons | 11.965* | 4.894** |  |
|  | (11.63) | (2.77) |  |
| Pseudo R2 | 0.152 | 0.144 |  |
| R2 |  |  | 0.303 |
| N | 36 | 36 | 36 |

# Conclusion

In this thesis, I have studied the relationships between the money and financial markets in France between 1880 and 1914. This research brought me to identify the repurchase agreements market as the true pillar of the money market of the time. It represented the primary outlet for short-term investments not only of banks, but also of industrialists and liquidity holders in trade and manufacturing who wanted to invest their treasuries taking low risk.

In the first chapter of this thesis I study the introduction of a Central Clearing Party in this repo market. I build a new and large original database including hand-collected repo rates, macroeconomic variables and security-specific factors covering the period 1880 to 1913. I perform a structural break analysis and I apply a difference-in-differences estimator to a panel data model.

The aim is that of studying the impact of the 1898 reform introducing the CCP. I find that this regulatory change strongly reduced counterparty risk. The reduction in risk, which I measure through a reduction in the dispersion in repo rates, was effective when the brokers guild introduced monitoring measures in order to deal with moral hazard issues.

In the second chapter of this dissertation, I study the links between the central bank and the markets for short-term loans against securities in France between 1890 and 1913. Using a new original database and a standard VAR approach, I find that the Bank of France developed its advances on securities facilities starting from the early 1890s in order to build a direct channel with small borrowers.

Through regular improvements, this instrument became an important monetary policy tool used to transmit expansionary shocks directly to the economy. The growth of this facility put competitive pressure on large commercial banks, which at the end of the 19th century started using advances on securities as a way to diversify their short-term collateralized investments.

As a consequence, when a shock hit the economy, the private sector had easy access to liquidity by borrowing against securities. Finally, this chapter presents evidence of a bank lending channel taking place in the first years of the 20th century through advances. Deposit banks themselves had direct access to the BoF advances facilities in times of trouble, and in turn transmitted liquidity to the private sector. The magnitude of this effect was small, but its existence is certified by statistical evidence.

In the third chapter of this thesis, I study a further interaction between the central bank and the repo market. In particular, I take into account the role played by the Banque de France in the management of liquidity during WW1. In this chapter, I show both qualitatively and quantitatively that during WW1 the Bank of France did not perform its natural Lender of Last Resort (LOLR) role, and applied credit rationing especially towards the stock exchange. The reasons of this behavior must be sought in concerns about the renewal of the monopoly of notes issue and about the possible devaluation of the French Franc.

The choice of not acting as a LOLR had long-standing consequences on the financial market. The repo market experienced a substantial contraction with respect to the pre-war period, and never returned to the previous situation. On the contrary, the decision to massively finance the State brought to the development of a large market for short-term Treasury bills, which ended up partially substituting the repo market after the end of the War. A new segment of the money market had been created, providing new investment opportunities for short-term investors.

These findings allow me to point out some potential research paths that remain to be explored. Firstly, there is a consensus in the literature about the fact that the reports market, the true keystone of the financial market before World War One, lost its importance during the interwar period. Nonetheless, no existing study takes into account the role the repo market played after 1914. Repo transactions were done, and repo prices were published on the official list, until the official creation of Euronext on September 22, 2000.

It would be interesting to understand why repos survived for 86 years after their loss of importance, by studying their economic role in a world in which they were not anymore the main money market instrument. Moreover, an ongoing project focusing on the study of the banking system during the interwar period finds that deposit and investment banks continued to have on the asset side of their balance sheets non-negligible investments in repos (Sysri30 project based at the Paris School of Economics, P.I. Eric Monnet and Angelo Riva).

A second research path that remained to be explored deals with an international comparison of the different instruments used during the Nineteenth and Twentieth centuries to provide short-term financing to stock exchanges. Future research should assess the relative importance of the reports market in France, of the call loans in Britain and the US, and the riporto and reportieren instruments in Italy, Germany and Austria.

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