

## **Between macro and finance: The French reports market at the outbreak of WW1**

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The recent financial economic literature, driven by the necessity to explain market failures during the last financial crisis, concentrated on the deviations that can occur from one of the fundamental laws of economics, the Law of One Price. This law states that two (nearly) identical securities or financial products should be traded at the same price. If this is not the case, arbitrage should intervene in order to call off the difference between prices. This paper studies the behavior of the French *reports* market, the equivalent of the nowadays repo market, at the outbreak of WW1.

Up to 1914, the price of each repo contract depended not only on the general conditions of the money market, but also on the security used as collateral for each negotiation. The result was a significant dispersion of the rates (representing prices) around the money market reference rate. After the war, one only price was made for all the market, no matter the collateral employed, with zero dispersion.

By employing quantitative analysis, I show that commission prices (*courtages*) and taxes were not the cause of not functioning of the Law of One Price. I find instead that at the origin of high pre-war dispersion there was the different exposure of collaterals to funding-liquidity risk.

Even if brokers had taken their counter-measures in order to limit risk before the war, only the radical macroeconomic change that happened after WW1 brought them to perform permanent changes, such as the unification of the repo rate, which insured them against moral hazard.

The recent financial economic literature, driven by the necessity to explain market failures during the last financial crisis, concentrated on the deviations that can occur from one of the fundamental laws of economics, the Law of One Price. This law states that two (nearly) identical securities or financial products should be traded at the same price. If this is not the case, arbitrage should intervene in order to call off the difference between prices. But the Law repeatedly failed during the recent crisis, in particular on markets dealing with short-term collateralized borrowing, such as the repo market, and appears not to work even in absence of any shock.

This paper studies the behavior of the French *reports* market, that we can consider with a good approximation as the equivalent of the nowadays repo market, at the outbreak of WW1. What I find is a striking difference in the pricing of this derivative, before and after the war. Up to 1914, the price of each repo contract depended not only on the general conditions of the money market, but also on the security used as collateral for each negotiation. The result was a significant dispersion of the rates (representing prices) around the money market reference rate. After the war, one only price was made for all the market, no matter the collateral employed, with zero dispersion. So, if each repo contract was the same (or quite the same) product before the war, why did arbitrage not work in order to reduce the gap between the more than 200 prices that were done on the market?

One possible explanation, suggested but not tested by Flandreau and Sicsic (2003), is that market frictions such as commissions (*courtages*) to be paid on repo transactions were an obstacle to arbitrageurs. By employing quantitative analysis, I show that commission prices (*courtages*) were not the cause of not functioning of the Law of One Price.

I find instead that at the origin of high pre-war dispersion there was the different exposure of collaterals to funding-liquidity risk. This difference was a direct consequence of the mutualization of counterparty risk, performed by the brokers through the use of a common fund in case of distress.

As shown by Riva and White (2010), having accepted a mutualization of the risk, the brokers syndicate performed not negligible efforts to limit risk-taking from the moral hazard. But a little room remained for speculation, as shown by the bankruptcy of a Parisian broker that took place in 1911, driven by excessive positions taken into the *reports* market.

But until the general economic situation was good, the brokers' syndicate (Compagnie des Agents de Change, or CAC) could afford this kind of risk.

Radical change in macroeconomic context – in particular, the end of the Classical Gold Standard and the beginning of the so-called “bullion-gold-standard”- induced the brokers to take measures to reduce their risk, as single brokers and as an interest group. Therefore, they abolished compulsory mutual solidarity between brokers, and as a result they had to take measures to contrast risk. One example of these measures is the unification of the *reports* rate.

What is most important is that these two coupled measures (the abolition of mutual solidarity and the consequent unification of the reports rate) were questioned *but finally maintained* in 1924. That is, a measure that had been taken in the immediate following of the war for risk-fear reasons, remained in the practice of the Paris Stock Exchange even in normal times.

Only a radical change in the macroeconomy can explain this choice, because the financial market in itself did not present in the interwar period reasons of fearing instability. In reverse, the 1920-1939 period was for Paris Bourse a relatively calm period compared to the *Belle Epoque*.

My contribution underlines the fundamental role of market microstructure in determining prices of derivatives, and in particular the importance of collaterals in pricing short-term collateralized loans.

This paper is related to the large literature on deviations from the Law of One price. This literature that has one of its seminal papers in Burdett and Judd (1983), that show that equilibria with dispersed prices exist in environments with identical and rational agents on both sides of the market.

More recently, Kondor (2009), theoretically finds that prices of identical assets can diverge, giving origin to losses, even in absence of any shock.

Garleanu and Pedersen (2011) study major deviations from the Law of One price in markets characterized by collateralized instruments. They find that derivatives returns are characterized both by their betas and their margins.

This article is also related to the growing literature about repo markets. In particular, Gorton and Metrick (2012), empirically show that changes in counterparty risk were strongly correlated with changes in repo rates for securitized bonds.

Ewerhart and Tapking (2009) theoretically find that efficient repo contracting typically leads to non-negligible exposures for both sides of the market. As a consequence, there is a joint benefit of using the most liquid and least risky assets as collateral in repo market transactions.

Finally, Martin, Skeie and von Thadden (2013) show how the fragility of short-term funding markets depends upon the particular microstructures, liquidity, and collateral arrangements.

Moreover, this article is related to the historical literature on Paris financial place and in general French financial markets, with fundamental papers such as Hautcoeur (1994 and 1997), White (2007), Hautcoeur and Le Bris (2010), Riva and White (2010), and others.

The remainder of the paper is organized as follows. In section 2, I will briefly present the functioning and microstructure of French repo market in the 1899-1925 period. In section 3 I present my database. In section 4, I develop my quantitative analysis. Section 5 concludes.

## 2 History and Microstructure

In practical terms, the *report* operation consisted in the continuation of a commitment from a settlement to the next. In legal terms, it was originated by the coupling of a spot and a forward operation. While selling spot, an investor A engaged to repurchase forward, in a given date and at a fixed price. From the point of view of the investor A, called the "*reporté*", the operation was exactly as an advance against securities, the rate of interest represented by the price of the operation (more or less the difference between the forward and spot prices) divided for the price of collateral (the spot price of the security). From the point of view of who bought the security, the operation was a money placement, which allowed her to employ her money for short periods of time in change of a (low) rate of interest.

Let us take a look to the market more carefully.

On the forward market, every transactions undertaken for a particular settlement date was executed, at this particular date, by the delivery of the securities in exchange for the payment of their price, or by compensation of opposite transactions. To say it in other words, once the liquidation (the settlement) was done, there did not remain contractual obligations in abeyance for this particular settlement, because the due date was rigorously fixed and could not be retarded.

It was nonetheless possible, for an investor, to give the order to continue, beyond the original settlement date, one or more of his operations. Taking an example from the *Encyclopedie* of François-Marsal, suppose that an investor (client of a broker), purchaser on the forward market of 25 securities for the settlement of end February desired, expecting a rise of the prices, to keep its 'buyer' position beyond this date. A way to wait for this rise would have consisted in taking delivery of the securities at the settlement of end February by paying the purchase price, and in keeping the securities in portfolio in order to resell them when the prices actually reached the expected level. But the use of this method would have required available funds equal to the amount of the liabilities, and very often the forward market operators did not keep these funds in cash.

That's why, with no willing nor possibility to take delivery of the securities bought for the settlement of end February, the investor resold them at the same settlement, in order to balance his position. Nonetheless, he could reestablish his bull position by buying 25 securities of the same security for the settlement of March 15th. On this date the investor had two possibilities: to sell the securities and end the investment, or to protract his position by doing the same operations of the end of February, that is to sell the securities at the 15th March settlement in order to balance its position, and to buy 25 new securities at the following settlement, that of March 31, and so on.

By the use of these continuous purchases and sales, the position could be therefore kept on, settlement after settlement. But if, staying in this example, the sale at the first settlement had been negotiated in an independent way with respect to the purchase at the following one, some prices fluctuations could have originated a difference, between the purchase and the selling, such that the conditions of the operation might have been completely distorted.

If, for instance, the selling had been negotiated at 2.600 francs and the purchase at 2.700 at the same date, the bull trader should have paid, in order to prolong his position, 2500 francs (100 each security) that, together with the fees, would have been a huge obstacle and an impediment to the continuation of the investment.

That is why, in practice, the two operations of purchase and selling were coupled, with a low difference of prices which permitted to continue the investment, without anomalous charges, from a settlement to the following. Due to the fact that it was not possible to contract on the forward market for settlement dates too far from the moment of the transaction, it was natural to give to an investor a way to pass, easily and without taking huge risks, from a settlement to the other. This

coupling of a selling and a purchase, performed the one at the first due date, the other at the following one and vice versa, constituted the stock exchange operation called *report*.

The aim of the report was generally that of postponing the settlements of a forward transaction previously concluded. Like in the most part of the other stock exchanges, at that time in Paris it was possible to negotiate on the forward market some securities (French rente, French cities bonds, stocks of Banque de France and railways companies) only for the end of the month or for the end of the next one. The other securities could be negotiated for the half or the end of a month, always without exceeding three fortnights (three settlement dates).

At the basis of this procedure there was a deliberation of the Chambre Syndicale of the Compagnie des Agents de Change, that said that forward transactions could have been negotiated only for the two next liquidations, for the securities subject to one only settlement per month, and for the next three, for the securities subject to the double monthly settlement.

The imposition of a maximum length for the forward transactions had the aim to force the investors to do, at regular and sufficiently frequent intervals, the exam of their situations.

Before beginning new deals, they had to “liquidate” their liabilities and engagements, in order to limit the hazard and not to let these engagements “float”.

The grouping of the settlements at fixed and periodical dates, on the other hand, had the objective to simplify the accounts and therefore to facilitate the settlement of transactions by balancing different transactions, avoiding useless movements of securities and money. The fixation of a settlement price (cours de compensation, which I will introduce later) also served to this effect.

The operator who, in the report, sold at a settlement in order to repurchase at the following one, was called *reporté*; the one who bought at a settlement in order to resell at the following took the name of *reporteur*. The *reporté* and *reporteur* involved in a same operation did not know each other, since their operations were performed by the intermediation of an agent de change. In theory, thanks to the reciprocal guarantee of the agents de change, even in the case of default of one of the two parties the operation could be performed without damage to the other one.

The *reporté* sold “near” and repurchased “far”. Usually he sold at a given settlement in order to balance a precedent purchasing operation which came at date. Therefore, generally the *reporté* was a forward buyer who wanted to continue his bull transaction (his speculation à la hausse) without taking delivery of the securities. He avoided receiving this delivery by reselling on a settlement and repurchasing simultaneously the same amount of securities for the following one. In table 1 we make a diagram of the situation.

February 20		Purchase for the end of february settlement	Balanced operations	End of february settlement
		Selling for the end of february settlement		
February 28	Report			
		Purchase for the 15 march settlement		15 march settlement

Evidently, if the report was renewed for the 15 March settlement, it would have implied two branches:

- As a first one, a selling on March 15 which balanced the purchase at the same date (second branch of the precedent report).
- As a second branch, a simultaneous purchase on March 31.

The *reporté* was not always a bull purchaser. For instance, he could have been an investor who owned some securities negotiated on the forward market, but who had a momentary need for funds.

Naturally, one way to get these funds could have been that of selling his securities. But if he wanted to repurchase his securities, still, he risked having to pay a high price. So he preferred to link his sale and his purchase with a report, that is selling his securities "near", immediately receiving their exchange value in cash, and simultaneously repurchasing them "far". The operation could have been repeated up to the moment when he had not anymore need for funds. This was the operation called "mettre des titres en report". Let us represent the operation.

February 28	Report	Selling for February 28 settlement; delivery of sold securities and being paid cash		February 28 settlement
March 15	New report	Purchase for March 15 settlement	Balanced	March 15
		Selling for March 15 settlement	operations	settlement
March 31	No new report	Purchase for March 31 settlement		March 31
		Delivery of bought securities and pay their price		settlement

The reporteur bought "near" and resold "far". The reason why he purchased "near" was sometimes that of balancing a previous selling transaction which had to be concluded at a given settlement, but for what he was not in possession of the securities, being a short seller. He freed himself of the obligation to give the securities, by buying for the settlement. Simultaneously he sold for the following settlement, and that operation permitted him to continue his bear speculation. His situation can be resumed as follows:

February 20		Selling for the end of february settlement	Balanced	End of february settlement
February 28	Report	Purchase for the end of february settlement	operations	settlement
		Selling for the 15 march settlement		15 march settlement

Every further operation in this sense would have implied two moments:

- As a first branch, a purchase at a given settlement counterbalancing the selling at the same settlement that constituted the second branch of the precedent report.
- As a second branch, the operation would imply a simultaneous selling for the following settlement.

But the report, in the sense that implied 'near' purchase and 'far' selling, was not a prerogative of short sellers. It was used by the holders of capitals available only for a short term, and that "employed their capitals in reports", that is purchased securities at a given settlement and simultaneously resold the same amount at the following settlement. What was the advantage of this operation? It depended on circumstances, but usually this advantage was that the securities were sold at the following settlement at a higher price of that of purchase, and the difference represented the interest paid on the employed capitals.

February 28	Report	Purchase for February 28 settlement; take possession of securities and pay cash		February 28 settlement
		Selling for March 15 settlement	Balanced	March 15
March 15	New report	Purchase for March 15 settlement	operations	settlement
		Selling for March 31 settlement		March 31
March 31	No new report	Delivery of securities by the reporteur and reception of their price		settlement

We now know the different categories of investors who, by the means of the agents de change, participated to the reports market: from the reportés side, forward buyers who protracted their positions and security-owners who needed cash; from the reporteurs side, short sellers and capital owners willing a short-term employment of their funds.

In this distinction between reportés and reporteurs we can see how the money market and the financial market came into contact. From the reportés point of view, indeed, the reports were nothing more than a help to continue their bull investments. This was the “financial” side of the operation, the one that was defined as “speculation” by many contemporary authors.

Intuitively, from this side of the negotiation came the push towards having a variety of different prices, mirroring the differences between the collaterals: the real object of the negotiation, here, were the collaterals. Reports were just a way to continue the investments.

From the reporteurs side, nonetheless, the reports were considered as short-term quite remunerative investments. In such a context it was not important what security was used as collateral to the negotiation: the only important thing was the remuneration of the invested capital: in other words, what counted was the rate of interest allocated to the invested money: a money rate. From this side of the negotiation, therefore, came the push towards having one only price, the less fluctuating as possible and with the less possible differences between a security and another. A rate, a price, anchored to the money market.

This was the situation up to WW1. During the summer of 1914 the operations in Paris Bourse, and in particular those on the forward market, were gradually suspended. The settlement of the end of July was delayed indefinitely, waiting for a substantial improvement of the political situation. This paralysis, among other consequences, caused the freeze of all the capitals that were invested in the reports market. In order to face this situation, the Bank of France intervened by giving its availability to provide the official brokers with a loan of 250 million francs at most. Behind this intervention there was the direct involvement of the Ministry of Finance that considered this operation “of national interest”.

After a sharp debate, the loan was accepted and undertaken only for 75 million francs, which were gradually repaid during the war. The debt was extinguished in 1920. In the meanwhile, the forward operations at Parquet were suspended, and with them the negotiations in reports market. During the second half of 1919, the brokers began to take measures in order to reopen the forward market, reopening that was becoming nearer and nearer.

As decided in the chambre syndicale meeting of METTI LA DATA GIUSTA the operations on the repo market were to be done, at the reopening of the market, not anymore “security by security”, “à la criée”, but starting from the negotiation of the “taux de l’argent”, that is, the “money rate”, and then applying this rate to the securities. As a consequence, strikingly differently from the pre-war situation, all repo contracts were negotiated at the same rate, representing the same price, no matter the collateral used.

A measure that was taken by the CAC contextually – during the operations for the reopening of the forward market – was the decision of “temporarily” suspending the mutual guarantee between brokers in case of distress of one of them. The suspension was motivated with the necessity of limiting moral hazard. The only type of guarantee that remained was the one by which the syndicate’s fund intervened to protect *the broker’s clients* in case of bankruptcy of a broker.

This abolition of mutual guarantee between brokers was questioned in 1924 (data esatta), after a period of distress on the Parquet, that brought the syndic to reflect on the necessity of re-establishing it in times of trouble. But the measure was maintained. Once again, the main motivation was limitation of risk due to moral hazard.

Therefore, a measure that had been taken in the immediate following of the war for risk-fear reasons, remained in the practice of the Paris Stock Exchange even in normal times.

Only a radical change in the macroeconomy can explain this choice, because the financial market in itself did not present in the interwar period reasons of fearing instability, and the report market too never experiences major problems.



### 3. The database

I based my analysis on a set of variables and indicators coming from different sources. I chose to use a monthly frequency because of the availability of the existing indicators and because only a part of the reports were negotiated at the settlement of the 15th of each month. The original dataset was constituted of 129 months (March 1903 to December 1913 included). Having chosen a first-difference approach in order to contrast the problem of autocorrelation which normally affects time series analyses, at the end my estimations have been run on 128 delta observations.

The data on reports prices and settlement prices have been collected mainly by me on the original stock listings which are conserved at the archives of the Ministry of Economics and Finance in Savigny-le-Temple.

In theory, every security negotiated in the forward market could be used as a collateral for a repo negotiation. In practice, every settlement saw a slight change in the reports negotiated: at the beginning of my data we have around 150 reports negotiated in each settlement (in 1903), while in 1914 the reports negotiated on Paris parquet reached the number of 280. All sectors are represented: French and foreign public bonds, French and foreign private companies stocks and bonds.

For every settlement date I calculated the reports yearly rates by using the following formulas:

$$r = 24 p / c$$

for the reports exchanged twice a month, at the 15th and end-of-the-month settlements, and

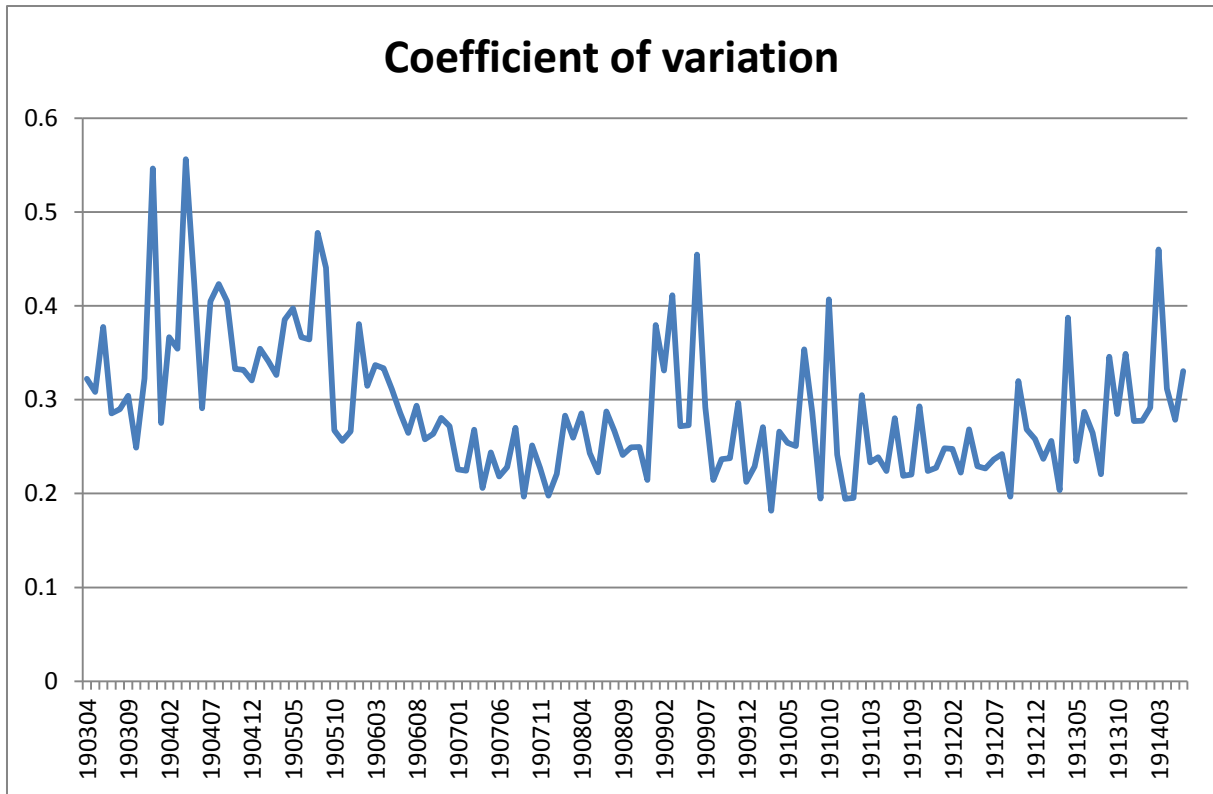
$$r = 12 p / c$$

for the reports negotiated only once a month, like the French Rente and the French railways companies.

In the formulas,  $r$  stands for the report rate,  $p$  for the price of the report and  $c$  for the cours de compensation, that is the settlement price.

In the following graph I show the dispersion of the rates, using the coefficient of variation.

The coefficient of variation is a measure of variability that permits to compare between them variables that have very different means. It is simply the fraction standard deviation / mean.



So, before the war, the CV fluctuated but never went below 0.2. After the war, it went to zero. The quantitative analysis tries to explain this puzzle.

#### 4. Quantitative analysis

One possible explanation of the high dispersion of reports rates can be the presence of market frictions, such as commissions (courtages) or taxes, that discouraged investors to perform arbitrage between repos on different securities.

A simple example randomly taken among the negotiations that were done at Paris parquet can show that this is not the case.

Take for instance two repos representing the 5% lowest and the 5% highest values of the distribution on 31/10/1903. Applying a commission rate of 5% and a tax rate of 0.25% on the two negotiations, I obtain a little difference in gross rates for repos on the same collateral, that cannot account for the huge difference between rates on repos on different collaterals, as shown by the following table.

31/10/1903	prix	comp	rate	commission	tax	sum	commission+tax	price	rate	gross rate	difference
Ch de Fer Lombards obl 4%	0.7	318	4.91%	5%	0.25%	5.25%	0.0341	0.6841	4.91%	5.16%	0.26%
Raffineries et sucreries Say act ord 500 fr	0.5	1010	1.19%	5%	0.25%	5.25%	0.0263	0.5263	1.19%	1.25%	0.06%
difference									3.72%		

Therefore, I have to look for another explanation. First of all I try to understand what determined the overall repo rate, the “market” one. Was it linked to the fluctuations of stock market, that could explain the dispersion between rates, or it was linked to the money market? In order to test this I perform a first-difference regression, using as a dependent variable the mean of the rates (very similar to the median, due to the high number of observations, and highly representative of the market), and as independent values the Paris “open market” rate and the mean of settlement prices.

The Paris “open market” rate represents a rate for loans which were negotiated among big credit institutions, and it is often used in literature as highly representative of the ‘surest’ money market negotiations. As a variable to measure stock market fluctuations, I used the mean of settlement prices because of its high representativeness of all the sectors and securities that were negotiated on forward market.

	(1) mean_rate
mean_colla~1	<b>0.316</b> (0.447)
openmkt	<b>0.291**</b> (0.103)
_cons	<b>0.0114</b> (0.0169)
N	<b>128</b>

Standard errors in parentheses  
\* p<0.05, \*\* p<0.01, \*\*\* p<0.001

Regression results show that the only significant parameter in order to explain repo market fluctuations is the open market rate. That is, the repo market was a money market, linked to money market fluctuations and not to stock market ones. So repo market fluctuations (as a whole) cannot be explained by stock market fluctuations.

In order to understand the high dispersion between rates, I perform a second regression. Here I try to assess the determinants of each repo rate, running a GLS regression on each rate (as dependent

variable), and as independent variables on the price of the negotiation, on the spot price of the collateral, on the spread between each rate and the open market rate, and on the “beta” (that is, the coefficient of correlation) between each rate and the market rate.

The GLS regression on panel data does not give very easy results to be interpreted.

	(1) rate
prix	<b>0.976***</b> (0.00108)
collateral	<b>-1.151***</b> (0.00549)
beta	<b>-0.0198***</b> (0.00563)
spread	<b>0.0000866</b> (0.0000470)
_cons	<b>0.0177***</b> (0.00435)
N	23774

Standard errors in parentheses

\* p<0.05, \*\* p<0.01, \*\*\* p<0.001

What is important is that the only parameter that significantly increases the rate of each collateral is the price of the repo transaction, that once taken into account the spot price of the collateral and the coefficient of correlation between the security and the overall repo market, represents the impact of forward price of collateral.

What matters, therefore, in explaining repo rates dispersion, is most of all a piece of information contained in its collateral, very probably its exposure to risk.

## 5. Conclusions

The recent financial economic literature, driven by the necessity to explain market failures during the last financial crisis, concentrated on the deviations that can occur from one of the fundamental laws of economics, the Law of One Price.

In this paper I studied the behavior of the French *reports* market, that we can consider with a good approximation as the equivalent of the nowadays repo market, at the outbreak of WW1. What I find is a striking difference in the pricing of this derivative, before and after the war. Up to 1914, the price of each repo contract depended not only on the general conditions of the money market, but also on the security used as collateral for each negotiation. The result was a significant dispersion of the rates (representing prices) around the money market reference rate. After the war, one only price was made for all the market, no matter the collateral employed, with zero dispersion.

What I found is that market frictions are not responsible for this dispersion. What matters in the determination of each repo rate is surely its link with the general repo market, but most of all its collateral.

This means that at the origin of the dispersion of repo rates there was the different exposure of collaterals to funding-liquidity risk. This difference was a direct consequence of the mutualization of counterparty risk, performed by the brokers through the use of a common fund in case of distress.

As shown by Riva and White (2010), having accepted a mutualization of the risk, the brokers syndicate performed not negligible efforts to limit risk-taking from the moral hazard. But a little room remained for speculation, as shown by the bankruptcy of a Parisian broker that took place in 1911, driven by excessive positions taken into the *reports* market.

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Radical change in macroeconomic context – in particular, the end of the Classical Gold Standard and the beginning of the so-called “bullion-gold-standard”- induced the brokers to take measures to reduce their risk, as single brokers and as an interest group. Therefore, they abolished compulsory mutual solidarity between brokers, and as a result they had to take measures to contrast risk. One example of these measures is the unification of the *reports* rate.

What is most important is that these two coupled measures (the abolition of mutual solidarity and the consequent unification of the reports rate) were questioned *but finally maintained* in 1924. That is, a measure that had been taken in the immediate following of the war for risk-fear reasons, remained in the practice of the Paris Stock Exchange even in normal times.

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