

**DANGER ON THE EXCHANGE:
COUNTERPARTY RISK ON THE PARIS EXCHANGE
IN THE NINETEENTH CENTURY**

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No matter how large or sophisticated contemporary financial markets become, they continue to be battered by financial crises. How these markets should be structured to withstand shocks is an important and incompletely resolved question. In this paper, we examine how the Paris Bourse, the second most important European exchange of the nineteenth century, sought with varying degrees of success to manage the failures of its broker members. Its unique character—primarily a forward market—contrasted its rivals in London and New York. As a derivatives exchange, the Bourse was particularly vulnerable to certain types of risk and developed institutions to cope with shocks. We identify the basic regulatory regimes under which the Bourse operated in the nineteenth century and the macroeconomic, individual and institutional factors that were responsible for the broker failures, which at times of crisis threatened to undermine the liquidity of the exchange.

From its inception, the Bourse was troubled by the high number of defaulting brokers. Brokers were confronted with the problem of ensuring that customers complete their contractual obligations in the forward market, which did not have legal status until 1885. If there was a large fraud or general shock, enough customers might default to endanger the solvency of a broker. Given that brokers built up balances with each other that were only netted on settlement day, one broker's demise could bring down several of his colleagues—the problem of counterparty risk. When this problem nearly overwhelmed the exchange in 1818, the Bourse created a mutual guarantee to insure against failures. To control moral hazard, the exchange sought to monitor and discipline its members. Thus, over the course of the nineteenth century, the Bourse developed many of the essential features of twentieth century derivatives exchanges. However, setting the

appropriate financial architecture to manage risk and moral hazard proved to be difficult because any reduction of risk-taking on the exchange raised the returns to those who could evade the regulation and drove business off the exchange to the curb market. This development parallels the recent contemporary movement of the trading in derivative instruments off of the exchange to the largely unregulated over-the-counter market.

Our econometric analysis of the annual number broker failures and individual broker defaults reveals that the problem of moral hazard was neither easily nor quickly resolved. The evolving regime of regulation only began to reduce significantly reduce failures after the Crash of 1882. By the 1880s, they had apparently succeeded; but the *Coulisse* had become a dynamic market increasing its share at the Bourse's expense. Yet, when the next financial crisis hit, brokers on the curb not the Bourse failed, leading the government to impose a much tougher regulatory regime on the whole market.

THE PARIS BOURSE IN THE NINETEENTH CENTURY

The basic elements of the Paris Bourse's microstructure were set in the early nineteenth century. The Act of March 19, 1802, combined Napoleon's degree of June 16, 1802 and the Code de Commerce in 1807 gave the exchange its fundamental character. The *agents de change* or stockbrokers were given a monopoly of trade in government securities and other quotable securities, with the rest of the market left to the *Coulisse*, the free or curb market.¹ The number of brokers was fixed at 60 in 1816, and it was only raised to 70 in 1898. The capital raised by establishing partnerships was used to buy the *office* or seat and provide the operating funds for the business. The brokers formed a corporation, the *Compagnie des Agents de Change*. Although the *Compagnie* was governed by a General Assembly, the general management was delegated to an elected Governing Council or *Chambre Syndicale*, headed by a *syndic*. Together, the *Chambre* and the General Assembly set the rules for trading².

Brokers were pure agents, being forbidden to trade on their own account. Minimum commissions were fixed by the *Chambre Syndicale* and maximum commissions by the government. Although there was an active cash market for securities (*marché comptant*), most activity centered on the forward market (*marché à terme*).³ While the forward contracts were not given statutory legality until 1885, this did not usually hamper the operation of the market. In the forward market, buyers and sellers agreed to exchange a number of shares at a fixed price on the

¹ The Bourse and the *Coulisse* battled over what securities belonged to the brokers' monopoly.

² See Hautcoeur-Riva (2007) for the evolution of the Paris Bourse over the XIX century.

³ Vincens (1834, T. 1, p. 614) The forward market was estimated to be fifty times the size of the cash market.

settlement date (*liquidation*). No regulations governed margin, which was determined by the broker on the basis of the underlying securities and the client's standing. On settlement day, traders in the forward market decided if they wanted to liquidate their positions. If the current cash price was below the contract price, a buyer might not take the securities and could instead renew his position by means of a *report*. If he had contracted to buy at the end-of-the month, then on that date he would buy at the contract price and immediately sell the securities at the clearing price (*cours de compensation*) and enter a new forward contract to repurchase the securities at the next settlement date, borrowing funds for this operation. The syndic set the clearing price, which was usually the average quoted cash price on the settlement day.

The size of the forward market made default risk a major problem for the Bourse. Given the lag in time between the contract and delivery date, brokers were exposed to default risk from their customers when unexpected changes in a customer's wealth altered his or her ability to meet contractual obligations. The risk could be exacerbated by the incentive for a customer in distress to take increase risk. If a customer were unable to settle his account, the broker bought in and sold out the securities in question. If the margin were insufficient, the broker absorbed the loss. However, brokers were also exposed to default risk from their peers. This counterparty risk arose in the process of settlement. If the defaults of a broker's clients were severe, he might be unable to meet his obligations on settlement day. His default could produce losses for other brokers and produce a general crisis for the exchange.

Because the high volume of the Bourse required confidence that contracts would be completed, the brokers needed to find a solution to manage counterparty risk, a critical problem for all derivatives markets. Edwards (1984) found that the contemporary markets use a mix of expulsion, monitoring, margin, price limits, and position and capital requirements, employing both rules and discretion. However, the integrity of the exchanges is protected by a mutual guarantee fund. This mutualization of counterparty risk through the exchange ensures market liquidity and the exchanges adopt rules to manage the resulting problem of moral hazard. While this mutualization of risk should be able to protect clients and brokers from idiosyncratic shocks, Bernanke (1990) and Kroszner (1999, 2006) have argued these mutual guarantee funds provide an adequate safety net against systemic shocks because there is no record of one failing in the history of these exchanges in the United States. It is difficult to be so sanguine examining the longer history of the Bourse, which was bailed out more than once by the Banque de France.

The Bourse, a precursor of these modern markets, first mutualized counterparty risk a crisis in 1818. It established a permanent Common Fund (*fonds commun*) in 1822 to provide credit to defaulting brokers and thereby maintain the orderly operation of the market. Over time,

the exchange developed controls to manage moral hazard from the insurance. Revenue for the common fund was raised primarily by a stamp tax imposed on the special paper used by brokers to record their operations. The Compagnie set its expected revenue higher than its expenses, typically producing a large surplus. However, only a portion of the surplus was usually transferred to the Common Fund; and the remainder was rebated to the members. The surplus may be considered as a refundable ex ante assessment against potential losses with the assessment being set in rough proportion to each broker's volume and consequently his exposure to risk.⁴

A TAXONOMY OF DEFAULTS

Defining when a broker failed is not a simple task and the management of broker failures evolved over the course of the nineteenth century. There were changes in bankruptcy law (*le droit de faillites*)⁵ and jurisprudence regulating the Compagnie des Agents de Change (the stockbrokers association), forward contracts,⁶ and partnerships formed to exploit the brokers' offices. Furthermore, the Chambre slowly increased its considerable authority to regulate and monitor the brokers; and the Minister of Finance and the Prosecutor-General (Procureur de la République) sometimes intervened directly. Complicating matters was the legal status of the different transactions executed by the brokers. The brokers' monopoly covered some (the *faits de charge*) but not all of their operations. These monopoly-controlled transactions were not fixed and changed over the course of the nineteenth century. The law obliged broker to complete the *faits de charges*. A default, the failure to complete them, was considered to be a *banqueroute*, which was punishable with a term of forced labor.⁷ It is thus not surprising that apprehensive brokers took flight or committed suicide when faced with these penalties.

Because of this evolving institutional framework, we must carefully define the reasons for a brokers' untimely exit from the Bourse; and we identify several periods, representing significant changes in the regulatory regime. But we must first provide a taxonomy of failure. We use the term default to indicate all cases in which a broker found himself in a situation where he could not complete his transactions with either his fellow brokers or his customers. We

⁴ The rebate to members was equally distributed, creating a substantial redistribution and an implicit subsidy to weaker members and a potential for increasing moral hazard.

⁵ See Hautcoeur-Levratto (2008).

⁶ See Lagneau-Riva (2008)

⁷ A *banqueroute* does not have the same meaning as bankruptcy in English, which is the equivalent of the *a faillite*, the legal procedure where a broker would have been declared to be bankrupt and processed through the courts. A *banqueroute* occurred when an individual was accused of incompetence. When the bankruptcy involved fraud or a violation of the law, it was a *banqueroute frauduleuse*, which was punishable by imprisonment for life with forced labor.

classify brokers' defaults into three categories reflecting the increasing severity of the problems faced by a broker: liquidity crisis, forced resignation, and suspension of payment.

We define a liquidity crisis for a broker as occurring when the *Chambre Syndicale* decided to offer him assistance with a prospective default. If a broker quickly revealed his situation to the *Chambre* (usually in advance of the settlement day) and had not violated the *Bourse's* rules or taken excessive risk, the *Chambre* would provide an advance from the Common Fund. This assistance was intended to enable the broker to continue his operations and avoid a default. These loans carried interest and were usually collateralized by the broker's security bond and other assets. However, this assistance brought with it oversight and supervision by the *Chambre*, controlling and often placing limits upon the activities of the broker until the loan was repaid and the broker met of all his obligations. Thus, broker's difficulties would most likely not be revealed to the public and his fellow brokers. Some of the brokers who experienced a liquidity crisis returned to profitability while others never recovered and later failed.

A default would result in a forced resignation (*démission forcée*) or "internal insolvency" when the *Chambre* decided that the broker must cease operation and leave the *Compagnie*. In exchange for departing, the *Chambre* covered the broker's position, demanding a letter of resignation. In addition to the letter, the broker transferred to the *Chambre* most of his personal wealth, as the broker had unlimited liability, with the remaining losses being absorbed by the Common Fund. A forced resignation reflected the fact that the *Chambre* considered the broker to have transgressed his legal or corporate obligations. The broker may also have aggravated the situation and threatened the position of his fellow brokers by attempting to conceal his problems from the *Chambre*. Although the Common Fund made the brokers' creditors whole, the broker and his family were often considered morally if not legally obliged to fully reimburse the fund.⁸

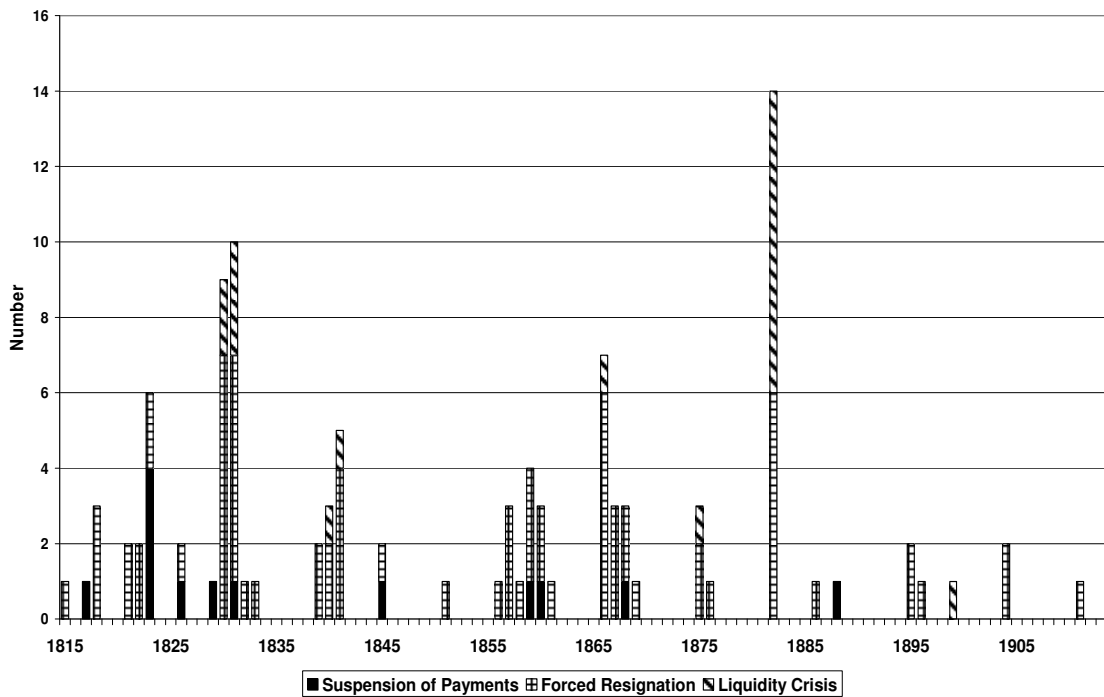
The most extreme outcome for a default was a suspension of payments or "external insolvency." In this case, when a broker defaulted, the *Chambre* refused to intervene and bail him out with the Common Fund. This event could result in a formal failure, a legal dissolution or a private negotiated settlement with the brokers' creditors. The last was usually the preferred outcome by all parties because of the substantial risks and costs of the legal system. While a broker had unlimited liability that would absorb his security bond, capital and personal wealth, his partners' position was less certain. Until the Commercial Code was modified in 1862 to establish limited liability for the partners, judges had discretion whether to impose limited or

⁸ For example, depending on the details of the marriage contract, a wife's dowry would be considered as a part of a broker's wealth, and sometimes sons covered the debts of their fathers.

unlimited liability on partners.⁹ Consequently, a defaulting broker's partner might wish to avoid the courts. Similarly, the brokers who were creditors of a defaulting broker preferred a private settlement because it was the only means for them to recover their assets as jurisprudence had determined that they did not have access to the courts. Lastly, the Chambre feared that a court case might result in an undesirable new precedent and draw the attention of Minister of Finance who might impose new regulations or lead the public to demand an end to the monopoly.

Figure 1 classifies all defaulting brokers that we identified in the minutes of the Chambre Syndicale and the General Assembly from 1815 to 1913. The high number of defaulting brokers in the early years and the clustering of defaults during financial crises stand out.

Figure 1
Defaulting Brokers by Type



THE EVOLUTION OF MANAGING FAILURE AND RISK

Over the course of the nineteenth century, the management of client and counterparty risk evolved significantly. To correctly assess the determinants of brokers' failures, we need to identify the major regulatory regimes. In our historical narrative, we consider the liability

⁹ Loi de 2 Juillet 1862, Article 75, Code de Commerce. If a partner did not fully pay in his share of the capital, he could refuse to contribute it upon the failure of the broker.

features of each regime and how they affected the likelihood of a default: (1) the liability of clients vis-à-vis their brokers to complete their contracts, (2) the liability of the brokers vis-à-vis their clients to complete their transactions, (3) the liability of partners vis-à-vis the partnership, (4) the liability of counterparty brokers vis-à-vis brokers and their clients, and (5) the liability of the Compagnie as a whole, that is the “solidarity” or mutualization of risk. Three other factors were also important: (6) the selection criteria for members. (7) the size of the Common Fund, the pay out rules and the monitoring and discipline of members, and (8) the willingness of the Banque de France and sometimes the French Treasury to act as a lender of last resort.

1801-1822

The first regime began with the re-founding of the Bourse in 1801. Before 1805, forward contracts were not legal. The courts changed their interpretation in this year, giving legal status to almost all types of forward contracts, a position they would retain until 1823. In these first two decades, there was no mutualization of risk; and each broker was essentially at the mercy of his creditors and the courts. For the clients, the first line of protection from a defaulting broker was his security bond. Initially this was set in 1801 at 60,000 francs, then raised in 1806 to 100,000 francs. It was capped at a maximum of 125,000 francs in 1816, at which it became fixed in 1818. While a broker had unlimited liability, the liabilities of his partners were legally uncertain. The Chambre tried to contain counterparty risk by enforcing its interpretation of the Code de Commerce’s Article 86 that a broker could not guarantee his client that a transaction would be completed if his counterparty defaulted. If this happened, the client became the creditor of counterparty broker and his broker was not held liable to complete the transaction.¹⁰

In spite of these controls, there were a surprisingly large number of failures under this first regulatory regime. For the years 1801-1814, when there is no detailed data in the archives of the Bourse, the Compagnie reported that 46 out of a total of 115 brokers lost their *offices* under less than honorable circumstances. Eighteen were officially bankrupt (*faillite*), 12 had large losses and negotiated a settlement with their creditors, 12 were removed by the government because they had broken the law, and 4 were driven to suicide by the disastrous state of their affairs.¹¹ Between 1815 and 1817, there were two defaults.

The crisis of 1818 was a turning point, forcing the Bourse to consider the mutualization of risk. Reparations for the cost of occupation after Waterloo were to be paid for by the sale of *rentes*. During the final negotiations of the peace settlement, the Banque de France supported the

¹⁰ However, competition for clients led many brokers to offer a guarantee, ignoring the position of the Chambre syndicale

¹¹ Mémoire sur la Compagnie des Agents de Change, présenté par le Comité au directeur general du Commerce, Procès-verbaux, Chambre syndicale, June 20, 1814.

sale of the *rentes* by offering discounts of 100 million francs. With its gold reserves declining precipitously, the Banque tightened credit in September 1818; the price of the *rentes* tumbled and investors defaulted on their contracts. The Chambre was worried that some brokers would be unable to complete the October end-of-month settlement and obtained a 5 million franc loan from the Banque de France. The Compagnie also secured the government's approval to manipulate the clearing price to ensure that the end-of-month settlement was completed.

But, the eve of the settlement, the broker Sahut announced that he was insolvent and would default. The Chambre arranged for a bailout of Sahut, although it was a "measure contrary to the fundamental principles of our institution." He raised 770,908 francs of the 1,454,980 francs that he needed to settle and each of the remaining brokers contributed 12,000 francs for a total of 684,000 francs. But at the next settlement date, he required more funds and two more brokers were insolvent. The remaining 58 brokers raised 1.1 million francs, but the Chambre was forced to seek a 2.4 million franc loan from the Minister of Finance. The brokers rejected joint liability for this credit and each one accepted individual liability for 41,380 francs. Although the brokers had eschewed joint liability, they repaid it in 1822 by creating a temporary Common Fund in 1819 to collect a stamp tax on the paper that they used to record their transactions.

1823-1831

After more failures in 1821-1822 provoked a political storm, a threat from the government convinced the Compagnie to create a permanent Common Fund of 3 million francs in 1822. In addition, the Minister of Finance compelled the Chambre to resign, and the courts reapportioned the liability for forward contracts. The civil courts determined that brokers could not enforce payment of forward contracts because they were "gambling debts" (Article 1965, Civil Code). Courts also denied brokers' access to the courts as creditors to defaulting counterparty brokers. In general, the refusal of the courts to recognize the broker-creditors created an incentive for them to avoid the courts and settle through mediation with clients with the Chambre servicing as a mediator.

Yet, the brokers resisted using the Common Fund to guarantee the solvency of their fellow brokers and reserved it for a general liquidity crisis. The General Assembly would give permission for use of the fund only if 55 out of the 60 brokers voted to approve. Typically, when a broker failed, the Compagnie refused any credits from the Common Fund and opened a voluntary subscription to assist him. Nevertheless, the Chambre made efforts to limit risk-taking. Common accounting rules were set to facilitate monitoring and the management of defaults. The Chambre was given the power to compel brokers to deposit money or securities with the Common Fund if it was determined that they were taking excessively large position in the market.

However, this control was abandoned after the courts determined that these deposits could not be used to protect counterparty brokers but would be used to compensate other creditors.

Capital requirements on new brokers were imposed, setting a minimum level of wealth. The additional funds needed to operate the business made a partnership a necessity.¹² Partnership agreements were regulated and subject to approval of the Chambre. The defaults of 1821 and 1822 caused numerous problems between brokers and their partners, leading the Chambre to increase its monitoring of the partnerships. In addition to capital requirements, there were disclosure rules to monitoring, requiring brokers to report income, expenses and position from their trading activity.

1832-1882

The Revolution of 1830 was accompanied by a financial crisis. In the tumultuous years 1830-1831, nineteen brokers defaulted, one of whom was bankrupt and 13 of whom were forced to resign. Faced with this crisis and the need to establish credibility with the new political regime, the Compagnie employed the Common Fund, whose 3 million francs were soon exhausted. Having poorly responded to the crisis, the General Assembly granted the Chambre more discretion to manage a broker's default.¹³ Henceforth, the Chambre could provide an advance to a defaulting broker equal to the value of his security bond plus a maximum of 100,000 francs collateralized by his *office*. Beyond this, the Chambre syndicale could request authority from the General Assembly to use of the Common Fund, if two-thirds of the General Assembly approved.

Concerned about the division of liability between a broker and his partners, the Chambre required that all new partnerships take a standard, legally sanctioned-form as *sociétés en commandite*. This change enhanced the capacity of the exchange to manage counterparty risk because it improved the likelihood that loans granted by the Common Fund would be repaid as they were made not to just the brokers but to the partnership, which now had legal standing. Nevertheless, forward contracts had no legal status, in spite of efforts by the Compagnie to persuade the courts, and the potential easy default by customers left brokers facing an uncertain liability.¹⁴ Although they tempered clients' losses, the changes after 1830 do not appear to have diminished the number or frequency of failures on the exchange, as seen in Figure 1.

¹² The brokers were officially officers of the state (*officiers-ministeriels*), and only they legally owed the *office* and could carry out its functions on the Bourse.

¹³ Discretion enabled the Chambre Syndicale to act more discretely. If action required a vote of the General Assembly, any problem would immediately become public.

¹⁴ Report of Chamber of Commerce of Paris on the application of the art. 1965 Civil Code to forward contracts, 1877.

In this period's crises, the Common Fund appears to have been insufficient, and the Banque de France provided regular credits to the Bourse. Yet, this action by the lender of last resort may have induced morally hazardous behavior by the brokers. The first severe crisis would have exhausted the Common Fund, as ten brokers defaulted, but collapse was averted by the Banque's loan in October 1840 of 25 million francs. The Revolution of 1848 produced perhaps the largest market collapse of the nineteenth century, yet no broker defaults recorded. These were avoided because the Bourse closed between February 23 and March 6, the end-of-month settlement was managed by a manipulation of the clearing price, and settlement was forced on all outstanding forward contracts regardless of their term. Yet, when the Chambre received a loan of 2.4 million francs from the Banque, it resisted the idea of mutualized risk and discounted bonds with the Banque de France not in its own name but on behalf of the brokers needing assistance.

Fearful that bankers would not provide *reports* to the forward market, aid from the central bank was obtained again in May 1849. However, the loan was not used as news of the loan calmed the bankers. The Banque became apprehensive of its effect on the Bourse. When the syndic approached the Banque for a 2 million franc discount on December 22, 1852 to prevent a crisis at the upcoming settlement, the Conseil General of the Banque granted the loan but questioned whether frequent loans were engendering moral hazard.¹⁵ The Banque ensured that the collateral was endorsed by the members of the Chambre in their role as administrators not individual brokers, signaling a shift towards the mutualization of risk. Coupled with rising volume on the exchange and signs of resistance from the Banque, the Compagnie raised the Common Fund from 3 million to 4.5 million in 1852 and then 6 million francs in 1854. Then, after the crisis of 1866-1867 when ten brokers defaulted, the General Assembly increased the discretionary lending authority of the Chambre to 450,000 francs.

1883-1898

The stock market crash of 1882 was a watershed for the Bourse. Many customers and brokers were not able or willing to honor their commitments, upsetting an orderly end-of-month settlement. The Compagnie estimated that 140 million francs were needed to complete the settlement, yet it only had 60 million francs available. To head off the crisis, the General Assembly for the first time quickly assumed mutual responsibility for the January and February settlements and gave the syndic authority to contract an 80 million franc loan from the Banque, intermediated by a syndicate of banks.

Legislation giving legal status to forward contracts had been stalled for decades, but as a result of the crash they became enforceable with the passage of the Law of June 28, 1885. Now

¹⁵Procès-verbal of the Conseil général of the Banque de France December 22, 1852, p. 342-3.

brokers could legally pursue defaulting customers on the forward market, but this implied that forward contracts were now part of the *faits de charge* with severe penalties for default. This exposure was limited quickly by the Cour de Cassation to officially listed securities. Moreover, the crisis changed the Compagnie's policy vis-à-vis the clients' losses from a defaulting broker. Before 1882 the Compagnie generously repaid clients, thereby attracting business. Now it forced institutional investors to absorb the losses, reducing its comparative edge vis-à-vis the Coullisse until it restored its previous position in 1895.¹⁶ In 1890, the brokers gained additional protection when they were allowed to proceed against defaulting customers and given the legal right to demand margin. The new legislation of 1890 finally imposed liability on a broker to complete a client's transaction if his counterparty failed. Combined with the lowered levels of activity on the market, these controls on risk seem to have limited failures, as seen in Figure 1.

1899-1913

No widespread crisis afflicted the Bourse in the last fifteen years before the First World War. As seen in Figure 7, the Common Fund that had been fully replenished by 1889 was maintained at a relatively high ratio relative to volume in the years before World War I. There was thus an ample cushion for the failures that did occur; but having accepted a mutualization of the risk, the Compagnie exerted considerable efforts to limit risk-taking from the moral hazard. New brokers were more carefully screened; and the Chambre Syndicale sought to ensure that only brokers from wealthy, "grand bourgeois" families could acquire an *office*. Higher wealth meant that the brokers had more capital to cover losses from defaults, but the agents de change also appear to have become more homogeneous¹⁷ perhaps ensuring that there they could monitor one another more closely and exercise greater moral suasion.

After trades off the Bourse in 1893 were fully legalized in 1894 a boom began in South African gold mining stocks, focused on the Coullisse. When this market crashed in 1896, many brokers on the Coullisse failed.¹⁸ The Bourse's monopoly was reinforced by Government, which made again trading in listed securities off the exchange illegal. In return, the Bourse accepted the "solidarity" or joint liability of the brokers for all trades in listed securities, which became law on April 13, 1898. As the government clamped down on the Coullisse and the Chambre Syndicale sought to limit risk-taking, trading in riskier securities migrated to the Marché Libre, the unregulated "third" or "free market."

¹⁶ It is the case for the Vuaflard's and Bex's defaults, respectively in 1886 and 1888.

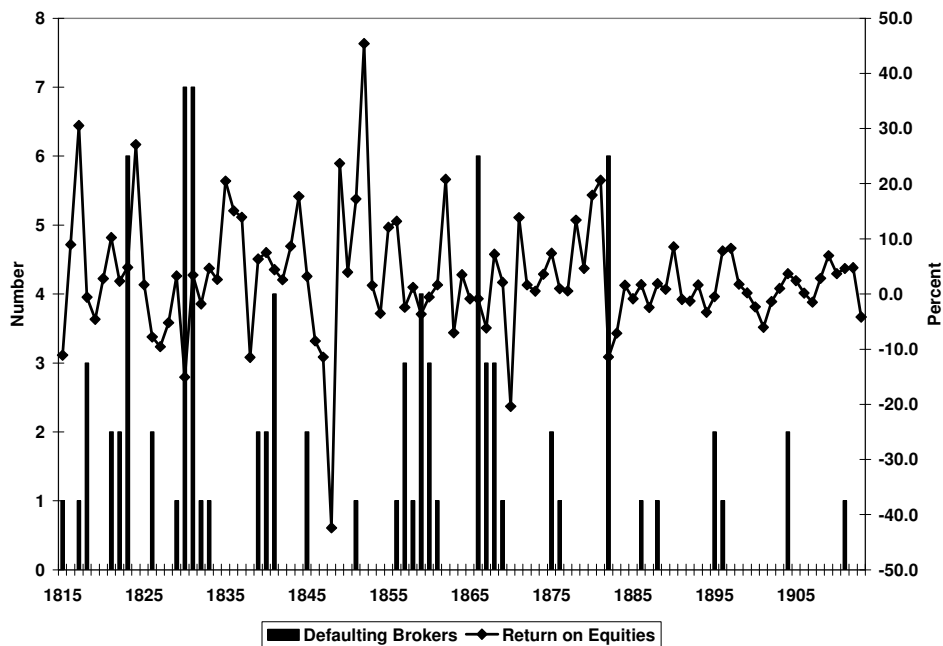
¹⁷ Verley (2007).

¹⁸ During this crisis, to prevent any spillover risk from brokers on the Coullisse, the Chambre limited relationships between its *agents de change* and the *coullissiers*.

EXPLAINING WHY BROKERS FAILED

Our first effort to explain why brokers failed examines the number of annual defaults. For these time series regressions, the dependent variable is the number of defaults per year, measured by the number of brokers who suspended payments or were forced to resign. By excluding the brokers who had liquidity problems, it identifies the brokers who the *Chambre* believed were insolvent and did not merit a loan.

Figure 2
Defaulting Brokers and Annual Stock Returns

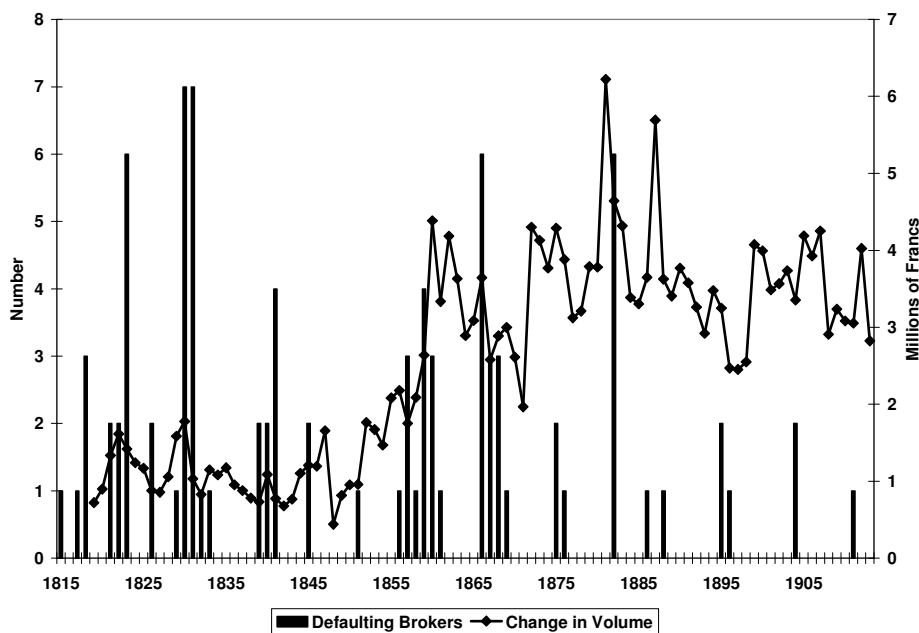


Major changes in equity or bond prices would have induced brokers' clients to default, and there are several indices for the Paris market in the nineteenth century. Arbulu (1998) constructed the broadest measure for equities being an unweighted index of equities listed on the Bourse for the whole of the century. Using this index, we calculated yearly returns (EQUITIES). We show these returns with the number of defaulting brokers in Figure 2, where some but not all large negative returns correspond to a high number of defaulting brokers.

To take into account the effect of the bond market on defaults, we use the annual return on the French government's perpetuals, the *rentes* (RENTES). At the beginning of the nineteenth century, French government securities dominated the market; by mid-century there were large issues of foreign and domestic corporate bonds and finally equities. While speculation had centered on the *rentes* early in the century, they became the safest long-term security. Thus, in a crisis there might be a flight to quality; a major reversal in their role. Brokers' clients' propensity

to default would also have been sensitive to the rate at which they could borrow for their *report*. Unfortunately, we only have a measure of the interest rate on the *reports* for the years 1875-1914 (Flandreau and Sicsic, 2003). Instead, we use another short-term market, the open rate of interest (Arbulu, 2007), which is available for the whole century. Obviously, this variable (INTRATE) does not capture the risk premium embedded in the interest rate on the *report*. However, the open rate did move sharply during financial crises in comparison with the long-term *rentes*.

Figure 3
Defaulting Brokers and Volume



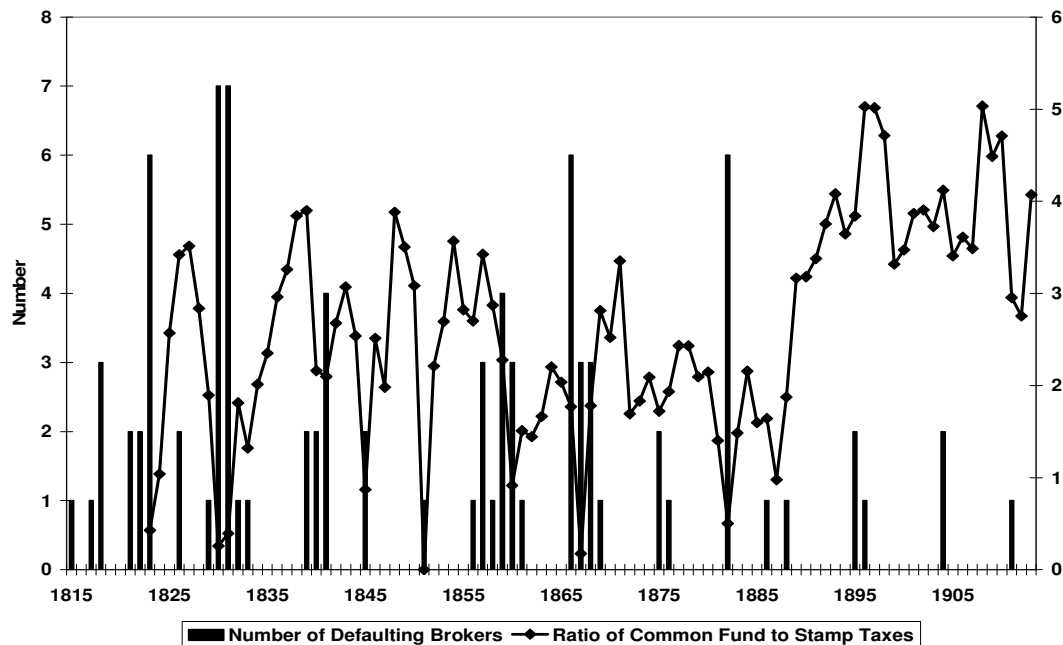
Brokers were also exposed to shifts in income from the volume of trading that moved sharply with booms and crashes. There is no volume index for the Bourse, but there is the revenue from the stamp taxes (*timbres*) levied to collect revenue for the Common Fund from 1819 to 1913.¹⁹ This measure is used as a proxy for volume on the exchange and the percentage change in annual volume is used as a contributing factor. The yearly innovation in volume is graphed in Figure 3, large declines in some years correlate with numerous defaults.

Brokers could control risk by increasing their capital. Unfortunately we do not have a measure of individual brokers' capital that they and their partners raised. The only proxy we have is the price of the *office* that reflects not the capital but the value of the seat. However, for much of the period, the Chambre regulated the price of the seat. There were only 60 seats and prices for the *offices* moved relatively slowly compared to the market, suggesting that it is

¹⁹ *Rapports annuels de la Commission de Comptabilité de la Caisse Commune à l'Assemblée générale de la Compagnie des agents de change.*

perhaps a reasonable proxy for capital. To measure the risk to which a broker would be exposed we use the ratio of a seat price to our measure of volume (SP/VOLUME). If this ratio falls, it would imply that brokers are more exposed to risk as volume is increasing relative to capital.

Figure 4
Defaulting Brokers and the Common Fund



Moral hazard might also have contributed to the default of a broker if risk taking was not adequately controlled by the Chambre. Although the Chambre's efforts to limit risk-taking are hard to measure, the size of the Common Fund was regularly reported. The size of the fund relative to volume (CF/VOLUME) would represent a measure of the collective risk to which brokers were exposed. If volume rose and the fund did not rise, this would be an indication of increased risk. Figure 4 graphs this ratio and the number of defaulting brokers. Large declines in the ratio are associated with increases in defaults. While the fund frequently did not keep up with volume increases in the first three quarters of the century, it appears that in the aftermath of the crash of 1882, there was a major change and the fund was adjusted as volume rose.

The variables measured as percentage changes were all stationary. Using Augmented Dickey-Fuller tests we rejected the hypothesis that there were unit roots in the time series. However the SP/VOLUME and CF/VOLUME variables required first differencing to achieve stationarity. In our narrative, we identified the important regimes that regulated the Bourse. In a simple effort to capture regime shifts, we use dummy variables for each regime.

Higher returns to stock and bonds, increases in volume, the capital relative to volume, and the common fund relative to volume should reduce the number of defaults and therefore the coefficients on these variables should have negative signs. The interest rate is posited to have a positive sign reflecting the fact that when credit is tighter there should be a higher number of broker failures. The correlation (0.642) between the returns to the equities index and the *rentes* is fairly high. Given the relatively modest time span of the data and the potential for multicollinearity, regressions with both variables and these variables separately are reported.

The number of defaulting brokers that we seek to explain is count data. For this type of regression, a Poisson distribution assumes that the (conditional) mean is equal to the (conditional) variance. In our annual data, the mean number of broker failures per year for 1815-1913 is 0.88 while the variance is 2.61, showing evidence of overdispersion. In this case a negative binominal regression is typically used as it has a Poisson model nested within it. The results are reported in Table 1, where the likelihood ratio tests for the parameter α rejects the Poisson distribution.

Given the negative sign on returns for equities and the *rentes*, falling asset prices increased the number of broker failures. An increase in the interest rate signaled a decline in broker failures because it increased the cost of speculating. Higher volume, which would have buoyed broker's incomes, also reduced the number of defaults. The capital relative to volume is a relatively weak variable, although it has the correct sign, probably because it is a weak measure of capital for brokers. However, broker defaults were quite sensitive to the size of the Common Fund relative to volume. Increases in the fund relative to volume lowered defaults. The dummy variables for the several regulatory regimes tell a story that is consistent with our narrative. In the first years of the Common Fund, there was little effort to control broker risk. It appears that after the crisis of 1830-1831 and the change in regulations, there was a modest reduction in broker failures. However it was not until after the crash of 1882 that the Bourse imposed rules that reduced risk-taking and forward contracts were legalized. This regime appears very similar in its consequences for default compared to the period after 1898.

Table 1
Broker Defaults, 1819-1913
Negative Binominal Regressions

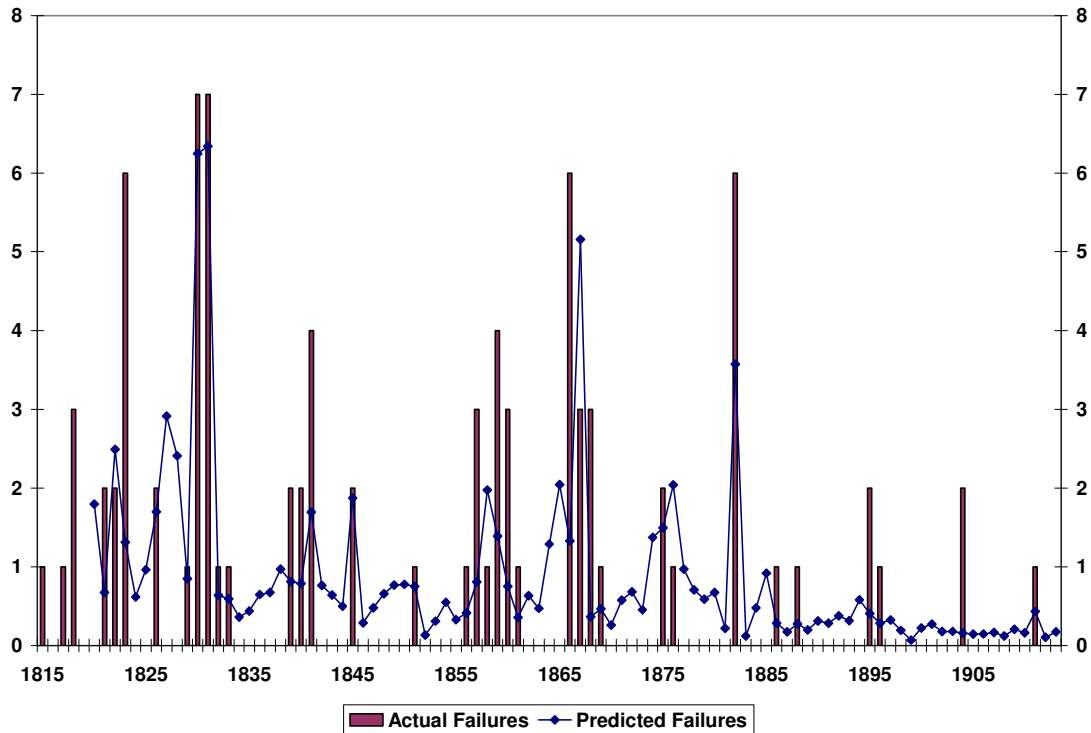
Variable	Negative Binomial 1819-1913	Negative Binomial 1819-1913	Negative Binomial 1819-1913
Constant	1.389 (0.909)	1.263 (0.864)	1.485 (0.984)+
EQUITIES	-2.105 (2.788)	-2.879 (2.225)	
RENTES	-2.090 (4.686)		-4.309 (3.740)
INTRATE	-0.533* (0.244)	-0.477* (0.208)	-0.572* (0.243)
VOLUME	-2.646* (1.054)	-2.526* (1.018)	-2.856** (1.027)
SP/VOLUME	-1.778 (1.596)	-1.556 (1.522)	-1.818 (1.601)
CF/VOLUME	-0.526+ (0.276)	-0.560* (0.267)	-0.542* (0.275)
DUM 1823-1830	-0.727 (0.984)	-0.620 (0.958)	-0.802 (1.601)
DUM 1831-1882	-1.431 (0.928)	-1.299 (0.881)	-1.560+ (0.917)
DUM 1883-1897	-2.342* (1.052)	-2.211* (1.012)	-2.454* (1.047)
DUM 1898-1913	-3.126** (0.909)	-2.972** (0.865)	-3.286** (0.904)
R-2	0.120	0.119	0.118
No. of Obs.	94	94	94
α (Likelihood Ratio Test Probability)	.962 (0.462) Prob> χ^2 = 0.00	.981 (0.464) Prob> χ^2 = 0.00	.981 (0.471) Prob> χ^2 = 0.00

+ significant at the 10 percent level, * significant at the 5 percent level, **significant at the one percent level

Figure 5 displays the actual broker failures and the failures predicted by the negative binominal model. The model explains much of the variation in the observed broker defaults, picking up most of the crises in spite of the limitations of the data. Perhaps, the most prominent differences are in 1895, 1896 and 1904. Some of these defaults, especially those in 1895 and 1896 were the consequence of brokers from the Bourse becoming involved in the Coulisse after regulations were tightened by the Compagnie. The controls imposed after the crash of 1882

appear thus to have eliminated systemic problems emanating from counterparty risk and the moral hazard from the mutual guarantee of the Common Fund.

Figure 5
Actual and Predicted Annual Failures, 1819-1913



Naturally, the time series data only capture some of the determinants of why brokers failed. To more carefully identify the causes of default we have collected data on all brokers between 1815 and 1913. The names of the 526 brokers for the 60 and later 70 *offices* they held, the date of their nomination to the *office*, and the date of their official departure, as well as the names of the syndics, were obtained from the Compagnie’s *Filiation des charges* (1961). Which brokers defaulted and the circumstances of the default were found in the minutes of the *Chambre Syndicale* and the *General Assembly*. We were also better able to pinpoint the date of default, which often differed from the official date of departure from office. Using this information we were able to compute the time a broker was in office, or duration, measured in days (*DURATION*). The minutes revealed that brokers who took over the *office* of a defaulting broker faced considerably difficulties. Apparently, there were continuing problems with the book of the broker that were not resolved upon his dismissal. It was widely believed that these *offices* became *charges maudites* or “cursed seats” as they raised the probability of the next broker failing. To test for this problem we included a dummy variable (*PREDECESSOR*) for the

preceding broker failing. We use the same series of dummy variables for the regulatory regimes, previously described, both for the time when a broker took office and the time when he departed. Similarly we employ the variables used in the time series on equity and bond prices, the proxy variable for volume, interest rates, seat prices, and the Common Fund for the beginning and end of a broker's time in office. We include a dummy variable if the broker was a syndic—the chief officer—of the Compagnie (SYNDIC). Although one syndic failed, we presume that being a syndic should reduce the probability of default as more trustworthy, sound brokers would be elected to this position.

We first look at what were the determinants of a broker's duration in office using a proportional hazard model and secondly at what were the causes of failure using a logit regression. By using the hazard model we can examine what effect the initial conditions had on the length of time that a broker would stay in his *office*. In contrast, the logit focuses on the conditions that prevailed in the year leading up to the closure of the broker's office. For our logit and proportional hazard models, a default is assigned a value of one; otherwise if the broker simply exited from the Bourse, he is assigned a value of zero. For the hazard model, a default represents “censoring,” that is an abnormal termination of the time in office. In our analysis we must restrict ourselves to the years 1819 and later as that is the first year when there is information on the stamp taxes that we use to estimate volume. An issue arises for the logit regressions because some 61 of the 526 brokers continued in office well past 1913. Our study terminates in 1913 because conditions changed drastically during World War I. We have treated this issue in two ways. First, we exclude those brokers who continued their operations past 1913 and secondly, we include them, using the data for 1913. These two approaches yielded similar results and we report only the results when all brokers are included.

To analyze the factors affecting duration of broker in office, we employ a proportional hazard model with an assumed Weibull distribution, as this specification is appropriate for data that contain observations with both short and long durations. It also permits us to test for duration dependence, that is, whether there was any increased likelihood of survival over time. The results for the proportional hazard model are presented in Table 2. As might be expected most of the variables at the outset—the growth of volume, and the changes in the interest rate, seat price to volume, and Common Fund to volume—have little effect on how long the broker will survive. However, positive equity and *rentes* returns seem to have given a broker a modest fillip, as the coefficient on the hazard ratio is significantly less than one, indicating a lower hazard and longer survival time. While becoming the syndic did not affect survival time, taking over an

office from a defaulting broker was disastrous. The coefficient on the hazard ratio for the preceding broker defaulting is far larger than one, decreasing survival time.

Table 2
Individual Broker Defaults, 1819-1913

Proportional Hazard Model Regressions (Weibull Distribution)

Variable	Hazard Ratio (Std. Error)	Hazard Ratio (Std. Error)	Hazard Ratio (Std. Error)
EQUITIES	0.442 (0.709)	0.106+ (0.134)	
RENTES	0.012 (0.037)		0.005* (0.011)
INTRATE	0.877 (0.148)	0.980 (0.153)	0.856 (0.138)
VOLUME	1.401 (0.921)	2.018 (1.262)	1.239 (0.755)
SP/VOLUME	0.763 (0.795)	1.442 (1.384)	0.732 (0.760)
CF/VOLUME	1.216 (0.223)	1.147 (0.206)	1.206 (0.222)
DUM 1823-1831	0.496 (0.268)	0.701 (0.333)	0.451 (0.231)
DUM 1832-1882	0.308* (0.146)	0.453* (0.178)	0.283** (0.126)
DUM 1883-1898	0.071** (0.053)	0.102** (0.071)	0.066** (0.049)
DUM 1899-1913	0.033** (0.037)	0.050** (0.054)	0.032** (0.035)
SYNDIC	0.369 (0.375)	0.384 (0.391)	0.355 (0.359)
PREDECESSOR	9.512** (2.738)	9.565** (2.737)	9.463 (2.738)
P	0.789 (0.079)	0.781 (0.078)	0.789 (0.079)
LR Chi-2 (12)	85.41**	83.33**	85.15**
No. of Obs.	439	439	439

+ significant at the 10 percent level, * significant at the 5 percent level, **significant at the one percent level

Starting out as a broker before the advent of the Common Fund reduced survival time and even the period 1823-1831 caused no significant increase in survival time. Only with the reforms of the 1830s is there a coefficient significantly smaller than one for the period 1832-1882. Changes in the regulatory regimes for 1883-1898 and 1899-1913 greatly increased the chances of survival, as indicated by their very small coefficients. The estimated coefficient p in the

proportional hazard model is significantly less than one implying that as more time spent as a broker, the lower likelihood of failure, suggesting that experience was an important factor in lowering defaults. After 2 years, a broker was 86 percent as likely to default as in the first year; and after 5 years, the broker was 71 percent as likely to default as in the first year.²⁰

Table 3
Individual Broker Defaults, 1819-1913
Logit Regressions

Variable			
Constant	0.971 (0.756)	0.591 (0.680)	1.090 (0.743)
EQUITIES	-1.951 (2.417)	-3.589 (2.029)+	
RENTES	-4.689 (3.936)		-6.550* (3.238)
INTRATE	-0.548* (0.227)	-0.402* (0.188)	-0.593** (0.222)
VOLUME	-3.918** (1.035)	-3.698** (1.006)	-4.076** (1.017)
SP/VOLUME	-3.795** (1.446)	--3.394* (1.399)	-3.757** (1.446)
CF/VOLUME	-0.480* (2.330)	-0.548* (0.229)	-0.519* (0.227)
DUM 1823-1831	-1.285 (0.815)	-0.869 (0.722)	-1.428+ (0.799)
DUM 1832-1882	-1.529* (0.737)	-1.149+ ((0.656)	-1.695* (-0.711)
DUM 1883-1898	-1.559+ (0.934)	-1.184 (0.872)	-1.693+ (0.925)
DUM 1899-1913	-2.136* (0.997)	-1.647+ (0.903)	-2.342* (0.966)
SYNDIC	1.483 (1.206)	1.232 (1.215)	1.596 (1.191)
PREDECESSOR	4.860** (1.119)	4.783** (1.121)	4.935** (1.119)
DURATION	-0.0004** (.00001)	-0.0004** (0.0001)	-0004** (0.0001)
Pseudo- -2	0.346	0.342	0.344
No. of Obs.	498	498	498

+ significant at the 10 percent level, * significant at the 5 percent level, **significant at the one percent level

²⁰ For two years this calculation based on the number of days is $(730/365)^{0.789-1}$

The logit regressions in Table 3 strongly confirm the time series results. In the year before a failure, negative returns on equities and the *rentes* contributed to broker defaults. Even more significantly, a decline in our measure of volume increased the probability of a broker defaulting. As in the times series, a rise in the open rate of interest from the previous year reduced the likelihood that a broker would default. If volume rose relative to our measures for brokers' capital and the Common Fund, there was an increased probability of brokers defaulting. If a broker was a syndic of the Compagnie, it does not appear to have influenced the likelihood that he would default. However, the *charges maudites* were clearly a problem. Experience was an important factor, decreasing the likelihood that a broker would fail, as the longer the duration, the more time a broker was in the *office*, the less his chance of defaulting. The results for the regime dummies again corroborate those for the time series regressions. Operating under the more restrictive later regimes, 1883-1898 and 1899-1913 significantly reduced the likelihood broker default. There are weaker effects for earlier regimes. But, it is important to note that duration is strongly and positively correlated with the last regime (0.59), and when duration is dropped from the regression, the effects of this regime are even stronger. Obviously, the regulatory regime in place at the time strongly influenced the time a broker was in office.

LESSONS FOR TODAY?

To lower counterparty risk so that a broker's failure did not endanger his brethren on the Bourse and provoke a more general liquidity crisis required a tight regulatory regime. For much of the nineteenth century, brokers resisted strong controls and rules that would have disciplined risk-taking. Consequently, the Common Fund was sometimes inadequate for covering the losses experienced by brokers. To avert a general crisis, Chambre Syndicale was often forced to ask for assistance from the Banque de France or even resort to extraordinary measures such as manipulating the clearing price in the forward market. The exchange limited its self-regulatory response because if its competition with the Coullisse, as enforcing risk controls lowered the returns for its brokers relative to their largely unregulated rivals on the curb market. With a mutual guarantee fund and appropriate monitoring, the benefit from controlling counterparty risk is that the clients should be able to trust the agents on the Bourse more than the brokers off the exchange who were not monitored by their peers. But the tightening regulatory regime and the change in policy vis-à-vis institutional investors' losses after 1882 led business to move off of the exchange. In the late 1880s, the Coullisse grew rapidly taking on more risk. When it was felled by a financial crisis and multiple broker failures in 1895-1896, the Bourse secured government intervention and legislation after 1898 that reinforced its monopoly and weakened the curb

market. Unfortunately, World War I ended this experiment but the experience of the Paris Bourse is a cautionary tale about the conundrum of managing risk on an exchange.

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