The Failure of a Clearinghouse: Empirical Evidence

March 29, 2018

Abstract

We provide the first empirical analysis of the failure of a derivatives clearinghouse: the Caisse de Liquidation in Paris, which defaulted in 1974. Using archival data, we find two causes of losses for the clearinghouse: (i) a weak pool of investors, and (ii) the inability to contain the growth of a large position by one member. However, the failure was primarily due to agency conflicts that led to risk-shifting. Risk-shifting incentives aligned the clearinghouse’s interests with those of the defaulting member, induced delays in the liquidation of the defaulted position, and led private renegotiation attempts to fail. Our results have implications for current debates on the design and resolution of clearinghouses and of other financial institutions.
1 Introduction

Disruptions of the functioning of financial markets during the 2008 crisis were largely due to fears of counterparty risk in lending and derivative markets. One of the main regulatory initiatives to reduce this risk is the mandatory use of clearinghouses, or central clearing parties (CCPs), for standardized derivatives (Duffie, Scheicher, and Vuillemey, 2015). After two parties agree on a trade, a CCP interposes itself between them, becoming a buyer to the seller and vice versa. Subsequently, the two parties are no longer exposed to each other, and are thus insulated from bilateral default risk (Biais, Heider, and Hoerova, 2016). However, a new risk arises: the CCP itself could fail. Understanding the failure and resolution of systemically important financial institutions, including CCPs, is currently a major issue among academics and policymakers (Duffie, 2015; BIS, 2017).

In this paper, we provide the first empirical analysis of the failure of a CCP, using proprietary data from the CCP and supervisors. We use our findings to inform theoretical discussions on the design of both clearinghouses and resolution rules for financial institutions. Specifically, we study the failure of the *Caisse de Liquidation des Affaires en Marchandises* (*CLAM*) in 1974. The CLAM was the only CCP operating in the Paris Commodity Exchange, a market most active for sugar futures. Between 1973 and 1974, a six-fold increase in global sugar prices spurred trading activities. Starting in November 1974, the collapse of sugar prices triggered margin calls, causing the failure of the largest clearing member, and ultimately of the CCP. We hand-collect archive data about these events, including detailed records of exposures, prices and margins.

Our first contribution is to highlight two fundamental causes of losses for the CCP. First, the pool of ultimate investors was financially vulnerable. A large part of the open position was ultimately held by retail investors, who were both unsophisticated and non-diversified. Second, the CLAM proved unable to prevent the growth of a single large position: in a few weeks, the position of the largest member (a broker acting on behalf of retail investors) increased from about 30% to 56% of the total open exposure. When sugar prices dropped, retail investors defaulted on margin calls from their brokers, and the largest of them ultimately defaulted on margin calls from the CLAM.
Our second and main contribution is to provide evidence of agency conflicts leading to the CCP engaging in risk-shifting as it neared default. In principle, when a large member defaults, a CCP faces a trade-off. On the one hand, the CCP wants to preserve cash flows associated with the continuation of its operations ("charter value effect"). To do so, it should liquidate the defaulting member’s position at the lowest cost possible. If liquidation is properly managed, default even by a large member needs not trigger a CCP failure. On the other hand, there is a risk-shifting effect. Indeed, the liquidation of the defaulting member’s position may create a loss for the CCP. The CCP can have incentives to engage in risky bets which, if successful, avoid the loss. If the bets are unsuccessful, the loss becomes larger, but the CCP is protected by limited liability.

We show that, in our case, risk-shifting is the dominant factor explaining the default: absent risk-shifting, the CLAM would have survived the default of its largest member. To show this, the first challenge is to identify empirically value-improving and value-decreasing decisions (i.e., charter value vs. risk-shifting effects). The difficulty is that net present values cannot be readily estimated for risk-management decisions.\(^1\) We overcome this hurdle by showing that the sequence of events is uniquely consistent with risk-shifting.

When sugar prices started to fall, the largest clearing member stopped responding to margin calls. In this context, the CLAM delayed the declaration of default, and therefore the liquidation of the defaulted position. Furthermore, it continued to register transactions from the member in default. Both decisions are consistent with risk-shifting. Indeed, delaying the liquidation can be a bet on a price reversal. Were prices to revert, the member would avoid default and the CCP any equity impairment. Otherwise, the CCP would incur larger losses, but they would partly be passed on to surviving members, due to limited liability. However, an alternative interpretation is that delaying the liquidation can be efficient, if the CCP is trying to mitigate costs associated with outright fire sales.

The subsequent events constitute evidence in favor of the risk-shifting hypothesis. After sugar prices fell sufficiently low, the CLAM pushed for and obtained a temporary

\(^1\)Examples of risk-shifting strategies, discussed below, include betting on a price reversal or waiting for a bailout. To compute net present values, one would need to assign probabilities to such events. There is room for disagreement between managers (at the time of action) and the economist (ex post) about what these probabilities are.
closure of the sugar market. A possible interpretation is that the CLAM sought to “buy time” to negotiate the allocation of losses with surviving members and avoid either liquidation costs or its own default. However, an interpretation in terms of risk-shifting appears more plausible. Indeed, due to a specific rule of the exchange, existing positions in case of closure would be settled at a price significantly above the market price of sugar. The effect would have been to shift the distribution of margin calls from the defaulted member to solvent members: the member in default would have been saved, at the expense of other members. However, pushing for the closure of the market to reach this outcome was a risky bet for the CLAM, since it was based on a highly debatable interpretation of the exchange’s rulebook. If the market closure was judged legal, the CLAM would avoid any equity impairment. Otherwise, a much larger loss would be incurred, since sugar prices were falling further. The gamble was later overruled by the highest French administrative court. As additional evidence of risk-shifting, the CLAM did not use the market closure to exploit renegotiation opportunities. When the government reopened the market after one day, the CLAM refused to register transactions and continued betting on its debatable interpretation of the rulebook.

Another piece of evidence supports the risk-shifting hypothesis. After the market closed, several members offered to buy the defaulted member’s entire position. This would have allowed the market to reopen immediately, at a relatively small loss for the CLAM. However, the CLAM turned down the offer and did not make other offers. This suggests risk-shifting: the CLAM took a high-risk decision (betting on a dubious interpretation of the market’s rulebook) which, if successful, would avoid any equity impairment. Furthermore, consistent with risk-shifting theories, we show that this decision was taken when the CLAM was close to the point where its equity value is convex, due to limited liability. Therefore, the series of risk management decisions taken by the CLAM can reasonably be seen as reflecting a risk-shifting strategy.

Finally, we assess counterfactual scenarios in which the CLAM would have faced default by the same member but not engaged in risk-shifting. We study both the consequences of (i) accepting the proposal of some members to buy the defaulted position
and of (ii) liquidating positions early. We find that it is likely that the CCP would have survived. Thus, we conclude that risk-shifting is ultimately the main cause behind the CLAM’s failure.

These findings have interesting implications. First, we show that risk-shifting incentives can severely affect CCPs. Second, while some risk-shifting decisions are observationally equivalent to efficient decisions, we argue that risk-shifting can be identified by focusing on incentives to accept or reject renegotiation plans. Instead, existing work seeking evidence of risk-shifting by focusing on asset allocations has often been inconclusive (Gilje, 2016). Third, we show that risk-shifting incentives can be a major impediment to private workouts in financial institutions. In a banking context, an example of risk-shifting akin to the CLAM’s bet on a market closure would be a bank rejecting value-increasing renegotiation plans in the hope of a bailout. Fourth, our findings are relevant for current policy debates on CCPs and resolution, as we discuss in details in the final section. A key message is that CCP capital structure and governance should be designed to mitigate risk-shifting ex ante. Ex post, however, there may be a role for resolution authorities to intervene in private renegotiations if they are inefficiently distorted by risk-shifting.

**Related literature.** Our paper is the first to empirically study the failure of a CCP. Throughout history, we know of only two other examples of CCP failures, that of the Kuala Lumpur Commodity Clearing House in 1983 and that of the Hong Kong Futures Guarantee Corporation in 1987. Simon (1981, Chap. 16) gives a brief account of the failure of the CLAM, while Cox (2015) and Norman (2011, Chap. 9.4) describe the 1987 events in Hong Kong without internal CCP data. In October 1987, following the crash in the stock market, clearing institutions in the US went under severe stress, but did not fail (Bernanke, 1990). More recently, Boissel, Derrien, Örs, and Thesmar (2017) show that lenders in the repo market behaved as if the probability of CCP default was

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2A related literature studies how central clearing affects market prices and financial stability. Theoretically, Duffie and Zhu (2011) study conditions under which a CCP can reduce counterparty risk. Empirically, Bernstein, Hughson, and Weidenmier (2014) show that the introduction of the New York Stock Exchange Clearinghouse in 1892 significantly lowered counterparty risk. Loon and Zhong (2014) also find a reduction of counterparty risk after CDS contracts are cleared.

3Official reports were produced following both defaults, but their goal is mainly to propose reforms of commodity exchanges.
large during the European sovereign debt crisis.

Our paper also relates to the literature on the design of a CCP’s capital structure and of its loss-allocation mechanisms (Elliott, 2013; Duffie, 2015; France and Kahn, 2016). A number of papers study why central clearing can improve allocations over bilateral clearing. This can be because CCPs mutualize counterparty risk and thus provide insurance (Biais, Heider, and Hoerova, 2012, 2016; Koeppl and Monnet, 2013), because they improve information disclosure (Leitner, 2012; Acharya and Bisin, 2014), or because they allow for the issuance of information-insensitive securities (Carapella and Mills, 2013). The design of clearing systems is studied by Koeppl, Monnet, and Temzelides (2012).4

Finally, our paper relates to the literature on the failure and resolution of financial institutions. Ongoing reforms promote loss-sharing mechanisms between private parties, either via renegotiations or via contingent convertible securities (Landier and Ueda, 2009; Flannery, 2014; Beck, Da-Rocha-Lopez, and Silva, 2017). Based on our finding that agency conflicts distort renegotiations, one overlooked advantage of convertible securities with automatic triggers is that they leave no room for managerial discretion. So far, the literature has primarily modeled asymmetric information as the main source of inefficiency in bank debt renegotiation (Colliard and Gromb, 2017).

2 Theoretical discussion

We inform our empirical work with theory. The main characteristic of the capital structure of a CCP is that it operates with a matched book (Duffie, 2015). For any long position with a counterparty, there is an offsetting short position with another counterparty. The operation of a matched book implies that, absent the default of clearing members, the CCP is indifferent about the level of settlement prices and about the distribution of margin calls across members. Indeed, any variation margin that is collected from a member is simultaneously paid to another member.

4 A separate literature studies the amount of margins necessary to safely clear derivatives. See, for example, Heller and Vause (2012), Duffie, Scheicher, and Vuillemey (2015), Cruz Lopez, Hurlin, Harris, and Pérignon (2017), Huang and Menkveld (2016) and Menkveld (2017).
When one or several clearing members are in default, the CCP no longer has a matched book, and its equity is at risk. The CCP faces a trade-off between two forces. First, there is a charter value effect: the CCP wants to preserve cash flows associated with the continuation of clearing. To this end, it should take decisions to ensure the liquidation of the distressed member’s position. If allowed, the CCP’s managers can use discretion to ensure the liquidation of the distressed position at the lowest cost for the CCP. This includes deciding on the timing of the liquidation, given that fire sales can occur (Shleifer and Vishny, 2011). Overall, the charter value effect gives incentives for the CCP to be tough with the distressed member, in order to preserve surviving members.

Second, there is also a risk-shifting effect (Jensen and Meckling, 1976). When the defaulting member’s position is liquidated, the CCP’s equity can be impaired. This is the case if the initial margin and default fund contribution previously collected from the distressed member are insufficient to cover the costs associated with the liquidation of its position. However, the equity value of the CCP is bounded below by zero, due to limited liability. In this context, the CCP’s managers can use their discretion over risk management to gamble for resurrection. If the bet is successful, the CCP can avoid any equity impairment. Theoretically, risk-shifting arises in the region where the CCP equity value function is convex. Any risky decision that increases expected equity value while lowering total CCP value (i.e., value of debt plus equity) is akin to risk-shifting. For example, the CCP can strategically delay the liquidation of the defaulter’s position, in order to bet on a price reversal or on a bailout of the distressed member. When risk-shifting occurs, the CCP’s interests become aligned with those of a defaulting member, at the expense of surviving members.

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5The risk for the CCP arises from prices changes between the last time it received margin calls from the defaulted member, and the time at which the defaulter’s position is liquidated.

6Theoretically, the charter value equals the present value of future rents (i.e., cash flows above the level that would ensure zero profit in a perfectly competitive market, see Keeley, 1990). In CCPs, rents can arguably be large: due to network externalities arising from multilateral netting (Duffie and Zhu, 2011), the market for clearing is typically characterized by monopolistic competition.
3 Institutional background and data

We describe the Paris sugar futures market and the 1974 crisis. We then introduce our data. Additional institutional details are in Appendix A.

3.1 The Paris sugar futures market

Before the 1974 crisis, the Paris Commodity Exchange was a fast-growing market. First, it was the only global market for futures on white sugar. Second, the market was open to foreign investors and particularly attractive for arbitrage trading in times of high price volatility. Indeed, daily limits on price fluctuations were wider than in New York and London. Third, the liquidity of the market improved over time for hedgers (e.g., sugar producers), due to the increased participation of retail investors acting as liquidity providers. In 1974, less than 1% of traded contracts ended up with physical delivery. Apart from contracts on sugar, futures on cocoa and coffee were also traded.

At the center of the trading process are 35 registered brokers. They are the only agents allowed to submit orders, and therefore act as intermediaries for other market participants. In 1974, brokers had about 1,500 clients, including retail investors. Once a trade is completed, registered brokers transmit the terms of the transaction to the clearinghouse. Brokers are liable for their clients in case they default.

3.2 The clearinghouse

All trades are novated to a single CCP, the Caisse de Liquidation des Affaires en Marchandises (CLAM). Its functioning closely resembles that of modern CCPs. The CLAM is a publicly listed company, which only clears trades in the Paris commodity exchange. Its members are all registered brokers, who clear transactions in the name of their clients. The novation of a transaction is complete once it is declared in identical terms by two brokers who are counterparties. After that, the clearinghouse bears all counterparty risk.

Counterparty risk is managed by the CLAM through initial and variation margins.

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Future on brown sugar were traded in London and New York (see Simon, 1981, for a comparison).
Upon registration of a transaction, both the buyer and the seller are subject to an initial margin requirement. Additionally, each party commits to pay variation margins when exposures move out of the money, triggering margin calls. Margin calls are computed based on end-of-day settlement prices, and must be paid before the market re-opens on the second trading day after the call. Practically, brokers hold accounts at the CLAM, and pay margins either with deposited funds or with external bank guarantees, such as letters of credit. Therefore, a member’s balance with the CCP equals

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\text{Balance on CCP account} = \text{Deposited capital} + \text{External bank guarantees} - \text{Initial margins} - \text{Variation margins}. \tag{1}
\]

A clearing member is considered in default as soon as its account balance turns negative. However, the CLAM often tolerated short-lived negative balances due to operational delays.\footnote{The collection of margins relied on the use of phone and mail services.} In this case, initial margins temporarily covered variation margin shortfalls.

To pay margins to the CCP, registered brokers collect margin payments from their clients. Typically, a client owns a margin account with his broker, where deposited funds exceed the initial margin to be paid by the broker to the CCP. For example, if the initial margin required by the CCP is 10% of the contract value, the broker requires a deposit of 15% from its clients. The 5% buffer provides additional protection against client default risk and allows reducing the frequency of margin calls to investors.

If a member fails on margin calls, the CLAM takes the defaulted position in its own name and liquidates it, so as to return to a matched book. Any loss made by the CLAM when liquidating the position is imputed to its equity. As such, the CLAM does not have the possibility to call additional resources from surviving members, as modern CCPs do.

### 3.3 The 1974 sugar crisis

Between end-1973 and November 1974, global sugar prices were multiplied by six, from 1,300 to 8,300 French francs (FRF) per ton, due to both structural and exceptional factors.
In the Fall 1974, several countries experienced sugar shortages. In the Paris Commodity Exchange, the increase in sugar prices was accompanied by an inflow of funds from retail investors. Panel A of Figure 2 shows a boom in the volume of transactions registered by the CLAM between end-1971 and end-1974, from 54,000 tons to 1.9 million tons traded per month. Sellers of futures were mostly sugar producers and brokers. In contrast, a specificity of the market is that long positions were overwhelmingly taken by retail investors. Relatedly, Table 1 shows that 96.9% of retail investors with an open position in December 1974 were holding a long position.

Starting on November 21st 1974, sugar prices started to fall. The failure of the CLAM was triggered by the failure of one large registered broker, Nataf, whose long position represented 56% of the total open position by the CLAM on the day of his failure. This position was held on behalf of about 450 retail investors. As prices dropped, Nataf received large variation margin calls, which it passed through to ultimate investors. Retail investors defaulted massively on margin calls, for reasons discussed below. During the collapse, sugar prices hit the price fluctuation limit (called “limit down”, see Appendix A) several days in a row. Since limit down prices do not clear the market, Nataf could not unwind investors’ positions. Similarly, once Nataf stopped responding to margin calls, the CLAM knew that liquidating his position would not be easy.

The quotation of prices was suspended by government decision on December 3rd, partly under the pressure of the CLAM. Subsequent attempts to re-open the market did not succeed, due to the refusal of the CLAM to register new transactions before

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9 Throughout the paper, we report monetary amounts in 1974 FRF. 1 FRF in 1974 represents 0.76 EUR in 2015, i.e., approximately 0.85 USD in 2015.

10 Structurally, highly volatile sugar prices in the 1970s can be explained by the limited share of the free sugar market (about 10% of global production), due to a large number of international agreements. In 1973 and 1974, prices of many commodities rose, following the oil shock. In the case of sugar, poor meteorological conditions and limits to exports by some countries (embargo in Poland) also contributed to the fear of a long-lasting sugar shortage. See Appendix Figure A3 for sugar future prices in Paris, London and New York. For an illustration of physical sugar shortages, see Appendix C.

11 Price fluctuation limits, which prevented market clearing, have subsequently been accused of amplifying the crisis. However, the main theoretical effect of price limits is to introduce delays (Brennan, 1986). Absent the limit, investors may have liquidated positions at much lower equilibrium prices, and may thus have defaulted on their cash payments anyways. When the market re-opened, the number of consecutive days in which the limit down could be hit was capped, and prices could subsequently freely fluctuate.
the settlement of outstanding positions was complete. During this period, the main contentious issue was to find a price to settle existing positions. The market re-opened thirteen months later, in January 1976, after the liquidation of the CLAM and the creation of a new CCP.

These events are reflected in the evolution of the CLAM’s stock price, plotted in Figure 3 from 1966 to 1975. The large increase in the CLAM’s stock price coincides with the increase in trading volume that started in 1972 and generated increasing clearing fees. During the sugar price boom (i.e., most of 1974), the stock price of the CLAM did not increase. However, since the market performed poorly in 1974 (see Figure A5), large excess returns were earned. Finally, the CLAM’s stock price did not start to collapse when sugar prices dropped, but only when Nataf was declared in default and the sugar market closed (see Panel B).

3.4 Data

To study the CLAM’s failure, we hand-collect archive data, which we describe in details in Appendix B. Most data are obtained from archives of the Department of Commerce and of the Paris Chamber of Commerce. Their archives contain a large number of legal and statistical records, which allow us to reconstruct the history of the sugar crisis. First, we collect spot and future sugar prices at an intraday frequency (opening, 12:30, 3:30pm and closure) for the 1973-1975 period. Trading volumes and the position of the CCP are known at a daily frequency. In the economic newspaper Les Echos, we also collect daily price data in the other two global sugar markets, London and New York.

Regarding the CLAM, we collect all its history of margin calls since the Fall 1973. We find information about its daily management and governance. We further collect daily data on the CLAM’s stock price and dividend distributions for the 1966-1975 period. Finally, we find several documents related to Nataf, the defaulting member. We know all changes in its account at the CLAM in the last three months of activity, including margins called and margins actually paid. We also collect data on its transactions on behalf of retail investors in the last five trading days. We also find a hand-written accounting book
containing information on the financial position of all of Nataf’s clients.

4 Incomplete risk management and CCP losses

We first use our data to show the direct causes of the CLAM’s losses.

4.1 Pool of investors and failures on margin calls

The failure of the CLAM is ultimately caused by the default of some investors. Specifically, unsophisticated retail investors were holding a large part of the long open position, and defaulted massively on margin calls from their brokers between November 21st and December 2nd, as prices fell by 23%. Ultimately, these defaults induced the broker Nataf to default on its own margin calls from the CLAM. Other brokers were also close to default.

We start by documenting the extent of defaults by retail investors. Across all clearing members, Panel B of Table 1 shows that 93.1% of the 683 retail investors with open positions on December 2nd were realizing mark-to-market losses. However, all of them did not necessarily default on payments to their brokers, since they could have held excess balances on their margin accounts.

For reasons of data availability, the transmission of investor losses to brokers can only be seen by focusing on Nataf. Panel A of Table 2 shows, for retail clients of Nataf, the average price at which they bought sugar futures. The main finding is that more than 90% of investors bought futures at the high prices that were reached in October and November, just before the collapse. Therefore, they were highly exposed. Then, Panel B shows the percentage of retail investors with negative balances on their account with Nataf, after taking into account excess balances and external guarantees. At the settlement price on December 2nd (6,217 FRF/ton), 49.6% of investors had a negative balance vis-à-vis

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12 During the boom, no clearing member had major difficulties to pay variation margins. Indeed, sellers of sugar futures were producers or dealers, who were simultaneously benefiting from high spot prices.

13 The participation of retail investors in futures markets was encouraged by public authorities in order to build an active futures market for the countries of the European Economic Community (Menu, 1980). For example, retail investors benefited from a tax abatement on gains in futures markets.
Nataf. Furthermore, Panel C shows that the magnitude of investors’ losses can be large. At the 25th percentile of the profit-and-loss distribution, the loss equals 62,900 FRF per investor.

What triggered retail investors’ defaults? To answer this question, we systematically explore judicial documents from a series of procedures that started after the closure of the market. The main cause of investors’ default is undoubtedly the lack of sophistication. In many instances, retail investors did not answer to margin calls because they were not aware of their existence. Between 1974 and 1975, there were 44 judicial procedures opposing investors to their brokers, all of them either for “fraud” or “abuse of confidence”, because investors were ignoring basic feature of the functioning of the market. Summarizing all cases, the prosecutor writes “The plaintiffs, who ignored everything of the workings of the Commodity Exchange and of speculation on commodities, had been initially canvassed either by a representative of their bank, or via an introducing broker linked to a registered broker. They were told that, by buying and selling commodities, they could obtain a return of about 20% at no risk.” As a last piece of evidence, a law designed for investor protection was voted soon after. Furthermore, another cause of default by investors was their lack of diversification. Judicial documents mention investors holding a significant fraction of their wealth in sugar futures. However, there are no documents to quantitatively document this claim.

The fact that investor losses induced Nataf to fail on its own margin calls can be seen by studying its account balance at the CLAM, computed as in Equation (1). Panel B of Figure 7 shows that Nataf’s balance turned negative on November 25th, and subsequently became more negative every single day but one. Furthermore, the impact of investor defaults on brokers was aggravated due to the tendency of brokers, including Nataf, to specialize in the collect of orders either from sugar professionals or from retail investors. Therefore, they were de facto specializing in the collect of long or short positions and benefited from very limited offsets across clients. Their positions were therefore “crowded”,

\[\text{Equation (1)}\]

\[\text{Panel B of Figure 7 shows that Nataf’s balance turned negative on November 25th, and subsequently became more negative every single day but one.}^{14}\] Furthermore, the impact of investor defaults on brokers was aggravated due to the tendency of brokers, including Nataf, to specialize in the collect of orders either from sugar professionals or from retail investors. Therefore, they were de facto specializing in the collect of long or short positions and benefited from very limited offsets across clients. Their positions were therefore “crowded”,

\[\text{\footnotesize(14)Registered brokers such as Nataf were individuals who benefited from a special legal status (Tardieu and Porteu de la Morandière, 1974). Therefore, there is no quantifiable equity of Nataf. Its willingness to contribute own funds depended on the value attached to preserving the legal privilege.}\]
in the sense of Menkveld (2017).

To put these findings into perspective, we stress that, in the London sugar market, retail investors did not play a significant role. Clearing through the International Commodities Clearing House (ICCH) was broadly opened to about 280 members (Rees and Jones, 1975), and diversified financial institutions played an important role. Diversified financial institutions were also playing a major role in the New York sugar market (Simon, 1981). Therefore, the same price dynamics (see Figure A3) had very different effects on investor defaults in Paris and in these other two markets.

4.2 Risk management via initial margins

If collateralization is sufficient, defaults by investors should not trigger any CCP default. We show that the CLAM maintained high collateralization, but feared a destabilizing effect of procyclical margin calls in case requirements had been raised further.

In Panel A of Figure 4, we plot the level of initial margin requirements between end-1973 and end-1974. With the exception of a short-lived peak in January 1974, initial margins have been increasing over the period. Normalizing initial margin requirements by the nearest-term future price, in Panel B, shows that margin levels have been remarkably stable during the sugar price boom, representing about 10% of the future price. This is still true within the last few weeks of operations. This level of margins is consistent with the daily price fluctuation limits imposed by the exchange, which were set at about 10% of sugar prices (see Appendix A). Therefore, as long as variation margins were paid, the initial margin collected by the CLAM was sufficient to cover shortfalls for one trading day under any scenario. Furthermore, this level of margins is markedly higher than the one that prevailed in London (2% of the sugar price).

Next, we ask whether initial margins kept up with the volatility of sugar prices. First, we show in Figure 5 (Panel A) that volatility - measured both by daily returns and by

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15 The January 1974 peak follows a large increase in sugar prices. Many investors closed their long positions to cash in their gains and buy futures at the new price. Therefore, the CLAM had to disburse cash. Since a sizable part of variation margins for investors with short positions were not paid in cash but with bank guarantees, the CLAM faced a liquidity shortage. The increase in margins induced investors to keep existing positions until maturity. The increase in margins was reverted after a few days.
the difference between highest and lowest trading prices every day (normalized by the mid-price) - was lower during the main phase of the boom than in early 1974. Next, to better assess the CLAM’s response to volatility, we estimate its 98% Value-at-Risk (VaR) each day. We do so both at a low frequency (daily frequency, using the 200 preceding trading days) and at a high frequency (using intraday data over the past 30 days).\footnote{For the high-frequency VaR, we have data at four points every day. We transform the intraday VaR using the square-root-of-time rule (i.e., we multiply the intraday VaR by the square root of four). Note that VaR calculations were not common in the 1970s.} We normalize this VaR by the daily initial margin requirement per ton of sugar. A value of this ratio below one means that initial margins are sufficient to cover shortfalls due to large price changes at a one-day-horizon (at the 2nd percentile of the returns distribution). Panel B of Figure 5 show that this is overall the case, even though the high-frequency VaR captures a potential weakness in the last weeks.

Another question is whether the quality of margins deteriorated during the boom. Indeed, the use of bank guarantees to pay margins was widespread. Since bank guarantees do not represent actual cash inflows for the CCP, but off-balance sheet assets, they are of lower quality. To measure the quality of margins posted, we use daily data on the margin account held by Nataf at the CLAM in the three months preceding its default. The decomposition of assets posted by Nataf, and of its margin calls, are plotted in Panel A of Figure 7. While bank guarantees represented a large share (56.9%) of total margins in September 1974, subsequent margin calls were paid almost exclusively in cash. By end-November, the ratio of bank guarantees to total margins had fallen to 32.2%. Therefore, there was an increase in the quality of margins posted by the largest clearing member.

A final question is whether initial margins should have been higher given that the increase in sugar prices is akin to a bubble.\footnote{While the rise and fall of sugar prices may \textit{ex post} be considered as a bubble, it was not seen as such when it occurred. A large number of newspaper articles show that high prices were interpreted as reflecting the sugar market’s fundamentals, in particular the shortage of physical sugar in many countries. In the French economic newspaper \textit{Les Echos}, a daily chronicle was devoted to commodity markets. In 1974, fundamental factors explaining rising sugar prices are discussed almost every day.} Specifically, when initial margin requirements were raised, they were applying to new trades only, not to outstanding positions. Thus, for an investor with a long position, 10% of initial margins when prices were 2,000
FRF represented only 2.5% of margins when prices reached 8,000 FRF. However, this can hardly be interpreted as evidence of weaker collateralization. Indeed, in order to make losses on this position, such an investor needs prices to fall back below 2,000 FRF, so that collateralization will at least be 10%. Instead, for investors with short positions during the boom, collateralization remained at 10%, since variation margins were called. The main concern comes from situations in which volatility has increased and initial margins are not called retroactively on outstanding positions. This fact might have contributed to the weakness of the CLAM. Interestingly, when asked why initial margins had not been retroactively raised for outstanding positions, the CEO of the CLAM answered that “a sizable change would lead to large initial margin calls, which would themselves induce massive liquidations in a tight market.” Therefore, while we do not see significant mismanagement of margin levels by the CLAM, the fear of fire sales due to procyclical margin calls can explain why margins were not raised further.

4.3 The build-up of the Nataf position

Next, we show that flat initial margin requirements across members proved unable to prevent the growth of a large member position. The view of the CLAM was that initial margins of 10% are enough to absorb any losses at a one-day horizon if the price fluctuation limits are themselves equal to 10%. Theoretically, margins are a sufficient instrument for risk management in this context only if any position can be liquidated by the CLAM at a price above or equal to the limit-down. However, by definition, limit-down prices are not market clearing prices. Therefore, if the CLAM inherits a large position, it may be unable to liquidate it. The larger the position, the more likely it is that frictions associated with its liquidation are large (e.g., time period needed and fire sale discounts). This form of illiquidity provides a rationale for containing the build-up of large positions.

While Nataf had been a major member for years, its position had remained limited (9% of the open position in January 1974, and 20% in April). To precisely document the build-up, which ultimately led to a position representing 56% of the CCP’s open position, we approximate Nataf’s exposure using data on initial margins paid. In Figure 6, we plot
this exposure in tons of sugar (Panel A), as well as its share within the total open position of the CLAM (Panel B). As we see, Nataf’s open position increased massively in the last weeks of operations, from about 55,000 tons to about 100,000 tons. Similarly, its share within the total exposure increased from 32% in October to about 60% in November.\textsuperscript{18}

While the CLAM was allowed to vary initial margins for particular brokers, based on their risk characteristics or the size of their position, a confidential report produced by the Bank of France in 1975 concludes that it never did. Focusing only on initial margins and not containing large positions when markets are potentially illiquid can be seen as a risk management failure by the CLAM.

5 Agency conflicts: CCP risk-shifting

Even if a large clearing member defaults, this is not sufficient to trigger the default of a CCP. Indeed, this member’s position may be liquidated at low or limited cost for the CCP. In this section, we show that agency conflicts within the CLAM led to risk-shifting and to the inefficient liquidation of Nataf’s position. Counterfactual simulations suggest that, absent risk-shifting, the CLAM could have survived the default of Nataf.

5.1 The declaration of default

We start by documenting two instances in which the CLAM deviated from its own rule-book. First, the CLAM delayed the declaration of Nataf’s default to the professional association of registered brokers. For one or two days, the delay is not necessarily evidence of a distortion. Indeed, temporary shortfalls in variation margins could occur for operational reasons and were often paid for quickly. Furthermore, as the market supervisor notes in an inspection report, “Nataf paid margins as no other broker before him did, covering not only variation margins with cash, but also a large part of initial margins and, for certain days, all initial margins or more”. Therefore, until November 25th, the CLAM could have been thinking that the shortfall (2 million FRF) was not unusual.\textsuperscript{18}

\textsuperscript{18}Nataf built a large position in part due to its superior use of technology (phones) to reach investors.
Initial margins paid by Nataf were still far larger (74 million FRF).

After this date, however, it became clear that the shortfall on Nataf’s account was not due to operational delays, but to exceptional price changes. Therefore, the shortfall should have been treated as a default, even though Nataf managed to bring additional cash and bank guarantees for an amount of 21 million FRF between November 27th and December 1st. Instead, the CLAM waited until Nataf’s shortfall was larger than its initial margin to declare its default, which occurred on December 2nd, as Figure 7 shows. Therefore, on the day default was declared, there was no more initial margin left to bear the cost associated with the liquidation of Nataf’s position. A direct consequence of delaying the declaration of Nataf’s default is a delay in the liquidation of its defaulted position, amid falling sugar prices. Moreover, the CLAM continued to register trades executed by Nataf during the period in which its account balance was negative.

Both decisions to delay liquidation and to continue registering trades are clear deviations from the CLAM’s own rulebook (CLAM, 1971). A potential interpretation is that the CLAM engaged in risk-shifting. Indeed, liquidating a large position in an illiquid market could have induced a significant loss for the CLAM. Delaying the declaration of default is a bet on a price reversal. With some probability, prices revert, Nataf does not default, and the CLAM avoids any equity impairment. With the complementary probability, prices continue to fall, the loss for the CLAM becomes larger, but its equity value is bounded below by zero. Therefore, the residual part of the loss is shifted to creditors (i.e., the surviving members).

While plausible, an interpretation of the delay in terms of risk-shifting is not the only potential interpretation. An alternative view is that the CLAM’s managers efficiently tried to mitigate costs associated with the outright liquidation of Nataf’s position, in particular fire sale costs. At this stage, we cannot reject this interpretation, but present below additional evidence that casts doubt on it.
5.2 The closure of the market

After Nataf was declared in default on December 2nd, other clearing members with long positions were also close to default. On the next day, another fall of sugar prices to the limit down would have induced the default of two additional members, while a collapse of prices over a longer period would have threatened up to 8 or 10 members. Since the CLAM takes the entire position of defaulted members, it would have had extremely large exposures to liquidate.

In this context, the CLAM departed from standard procedures in another dimension. Together with the professional association of registered brokers, the CLAM pushed for the suspension of trading in the sugar market. On December 3rd, under this pressure, the Minister of Commerce authorized a temporary closure of the market. One potential interpretation of this decision is that the CLAM’s management efficiently tried to “buy time”, in order to renegotiate existing commitments and avoid losses due to the liquidation of large positions. If this view is correct, we should expect renegotiation to occur after the market’s closure.

In contrast, the closure of the market and subsequent events give strong indication that the CLAM is gambling for resurrection. Indeed, according to Article 22 of the market’s rule book, if trading is suspended due to force majeure, the settlement price for outstanding positions must equal the average price in the last 20 trading days. In this case, the price mandated by Article 22 was around 7,400 FRF per ton, i.e., about 1,200 FRF (or 20%) above the settlement price on December 2nd. At that settlement price, Nataf would have had a positive account balance, and therefore would not default. Consequently, the CLAM would not default either. Betting on the market’s closure de

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19 The exposure of brokers with a long position is reported in Appendix A2. As can be seen, many have an account balance turning negative if prices fall below their level on December 2nd (6,217 FRF per ton). This, however, does not establish that these brokers would default, since they could mobilize additional resources to pay margins. Information on the number of other potential defaults is based on interviews given by the presidents of the CLAM and of the professional association of registered brokers.

20 In theory, the professional association of registered brokers should not favor one type of counterparty against another. However, the association was largely controlled by brokers with long positions. The brokerage firm run by the president of the association, Georges Maurer, had the second largest long position in sugar futures, after Nataf.
facto amounts to shifting margin calls from Nataf and other distressed brokers to solvent members (sugar producers with short positions). Therefore, pushing for the closure of the market can be seen as an attempt to manipulate settlement prices. However, the bet on Article 22 was risky, since its applicability was highly debatable. If the use of Article 22 is legal, the CLAM avoids any impairment of its equity. If it is not legal, losses become larger (prices continued to fall in New York and London during the closure in Paris), but equity is protected by limited liability. The use of Article 22 was immediately challenged in court and, after several months, overruled. Indeed, no extraneous reason prevented the market from functioning.\footnote{Article 22 mentioned “general mobilization in case of war and cases of force majeure, among others” as potential reasons for closure. Furthermore, it was known that in 1933-1935, the Council of State had invalidated a similar decision in the cereals futures market (Simon, 1981).}

The interpretation of the market’s closure in terms of risk-shifting is further supported by an additional event. One day after agreeing to the closure of the market, the minister of commerce declared that it could re-open. While the CLAM had not been renegotiating during the temporary closure, as we show in the next section, it strongly opposed any re-opening. Specifically, it claimed that the only possible outcome was a settlement of existing positions based on Article 22, and that it would not register any new transaction before the settlement of these positions was complete. The CLAM kept betting on Article 22, and the market remained closed.

\subsection*{5.3 Failed renegotiation plans}

Decisive evidence showing risk-shifting by the CLAM is seen by focusing on its attitude via-à-vis renegotiation plans. Immediately after the closure of the market, a number of attempts to agree on a settlement price and to negotiate a recovery took place. These proposal were initiated mostly by sugar producers, represented by Marcel Varsano.\footnote{Varsano was both the president of the market’s technical committee and the head of a large sugar dealing firm (Sucre et Denrées, which had a short position).} Together with the market’s technical committee, sugar professionals strongly opposed the implementation of Article 22, and refused to pay margins on its basis. Instead, Varsano proposed that sugar professionals buy the defaulted exposure of Nataf, and eventually
that of other brokers in distress, at the settlement price on December 2nd, 6,217 FRF. This proposition was generous, since this price was not a market price, but a limit down price: therefore, sugar professionals would have been foregoing potentially large gains.

However, the CLAM refused this proposal, and did not propose any other settlement price. Under this proposal, the equity of the CLAM would have been impaired to a limited extent, but its default would have been avoided and the market could have reopened quickly. Instead, the CLAM acted as if the implementation of Article 22 would be upheld in court, and continued betting on it. In the subsequent weeks, global sugar prices continued to fall (see Panel B of Figure 1), and sugar sellers revised their renegotiation proposal. Until the resolution came to an end, they maintained an offer to buy the defaulted position of Nataf, and eventually that of other brokers, at a price of 5,700 FRF, even after prices fell far below this level. This came to be known as the “Varsano proposal”. Even though the proposal would have accelerated a reopening of the market, it was never accepted by the management of the CLAM.

The rejection of renegotiation proposals is conclusive evidence in favor of risk-shifting. Indeed, the Varsano proposals can be seen as value-increasing outcomes that were rejected because the CLAM’s managers, in the interest of equity holders, gambled for resurrection. Therefore, this result suggests a broader conclusion: weakly capitalized or poorly governed CCPs may fail to accept value-increasing renegotiation plans near distress.

Formally, a necessary condition for risk-shifting to exist is that the CLAM should be close to the region where its equity value function is convex due to limited liability. To show this, Figure 8 plots the CLAM’s equity value as a function of the settlement price for outstanding positions. For settlement prices above 6,300 FRF per ton, no broker is in distress and the CLAM is indifferent to the settlement price (see Section 2). Below this threshold, Nataf defaults and the CLAM is unlikely to recover any additional margin it calls. Therefore, losses are absorbed by the CLAM’s equity until the limited liability constraint binds (around 5,900 FRF per ton). On December 2nd, when the market closed, the CLAM was close to the region where its equity value is convex (6,217 FRF per ton). Furthermore, since this price was a limit down price, the market clearing price must have
been even closer to the convexity.

Why did risk-shifting incentives dominate incentives to preserve the CCP’s charter value? The first reason is that the CLAM had relatively little equity to absorb losses (see Panel B of Figure A4). The second reason is that the governance of the CLAM was dominated by brokers with long positions and no interest in hedging. In particular, the President of the CLAM was a former broker, whose own brokerage firm was still operating, with a long (albeit small) position in sugar futures. Instead, theory suggests that preserving charter value of the CCP is more likely to be a concern for hedgers, since they derive more value from the continuation of clearing services. In this respect, the situation faced by the CLAM was similar to that described by Franks and Nyborg (1996), where inefficient liquidations arise if control rights are not given to creditors with the largest benefit from keeping the firm as a going concern.

5.4 Counterfactual scenarios

An important question is whether the CLAM could have survived, in spite of the default of Nataf, if it had not engaged in risk-shifting. We study two counterfactual scenarios, which suggest that this is indeed the case. We conclude that agency problems are the main reason behind the CLAM’s failure.

A first counterfactual is one in which the CLAM would have accepted the renegotiation proposal on December 3rd. This would have allowed the market to re-open on the next day. The only reason why accepting would have threatened the CLAM is if the resulting loss for equity holders was too large to ensure continuation. Specifically, a loss of 8.6 million FRF would have been recorded, i.e., 27.0% of the CLAM’s market equity and 26.3% of its book equity. When compared to the CLAM’s net income in 1973 (5.1 million FRF) and 1974 (23.0 million FRF, as estimated before losses are imputed), the loss does not look unbearable. Furthermore, the CLAM’s assets consisted almost exclusively of liquid assets and real estate, which could have been respectively sold or used as collateral. Therefore, it is reasonable to hypothesize that the CLAM could have survived if it had accepted renegotiation proposals.
As a second counterfactual, we ask what share of Nataf’s position the CLAM could have liquidated if it had declared default on November 25th (i.e., on the day Nataf stopped responding to margin calls) and if it had not registered any new trade by Nataf. We start by reconstructing Nataf’s position on that day, which amounted to 1,860 contracts. Then, we reconstruct the trading volume in the Paris exchange every day, after excluding all buy orders executed by Nataf. Indeed, we are interested in the CLAM’s ability to liquidate by selling futures to counterparties other than Nataf. Finally, we assess counterfactual scenarios by assuming that a percentage \( k = \{50\%, 100\%, 125\%\} \) of observed transactions could have been executed every day with the CLAM as a seller.\(^{23}\) While it is unlikely that the CLAM could be the short counterparty in 100% (or more) of the observed transactions in Paris, the last two scenarios reflect the fact that it could also have hedged in London and New York.\(^ {24}\) In these two markets, there was also limited trading volume, despite limit downs.

We show the results in Figure 9. Panel A shows that the CLAM could have offloaded 37% of all of Nataf’s position, if it could have been counterparty in 50% of all short transactions. With \( k = 100\% \), 73% of the position could have been liquidated by December 2nd. Next, assuming the CLAM had liquidated positions every day at a price equal to the settlement price, we plot its potential loss (Panel B). With \( k = 100\% \) the initial margin posted by Nataf would not have been sufficient to cover all losses, but the loss for the CLAM would have been limited (9.8 million FRF, as compared to an amount of 72 million FRF of initial margins on November 25th). With \( k = 125\% \), i.e., if the CLAM had hedged in other markets, Nataf’s initial margins would have been almost sufficient (loss of 0.89 million FRF only). Furthermore, even if the CLAM was unlikely to liquidate the entire position of Nataf, renegotiation between parties would have been easier with a smaller realized loss. Overall, this second scenario confirms that the CLAM could have survived if it had declared Nataf’s position in due time and started liquidation immediately.

\(^{23}\)One limitation is that we assume that trading patterns would have been the same if the default of Nataf had been declared.

\(^{24}\)This is plausible since the CCP in the London Market (ICCH) was a counterparty of the CLAM in some transactions.
5.5 Distorted incentives for brokers

Before concluding, we show evidence, on the brokers’ side, of a distortion that resembles the one found for the CLAM. Specifically, brokers in the sugar market operate with almost-matched books: they execute orders on behalf of clients and take little or no exposures in their own name. When there are no concerns about the default of the CCP or of ultimate investors, brokers are indifferent about the execution price obtained by each investor. Instead, when some investors are more likely to default, brokers may have an incentive to execute trades at prices that favor these investors, at the expense of other investors. If this is the case, brokers can shift margin calls from distressed investors to solvent investors. This is akin to the attempt of the CLAM to shift margin calls from Nataf to brokers with short positions. This distortion can operate via a channel documented by supervisory evidence: In 1974, all trades by a broker within a given day were typically registered at the CLAM only at the end of the day. This practice allowed reshuffling counterparties across trades before novation, to favor certain counterparties at the expense of others.\footnote{When the exchange reopened in 1976, new rules mandated the immediate registration of trades.} While this practice did not change the price level, it affected the cross-sectional distribution of margin calls.

To show evidence of distortions, we use a record of transactions executed by Nataf during 5 days of falling prices (November 22nd to 28th). There are 314 trades, for 67 investors, for which we know execution prices and trade size. We match these transaction data with data on the open position (in notional terms) and account balance of each investor as of December 2nd. Our hypothesis is that investors that are more exposed to the fall in sugar prices should obtain more favorable execution prices relative to other investors, after controlling for trade characteristics (maturity, trade size).

For a trade $j$ executed for investor $i$ on day $t$ and with maturity $m$, we estimate

$$\text{Exec. price}_{i,j,m,t} = \beta_0 \cdot \text{Exposure}_{i,t} + \beta_1 \cdot \text{Trade size}_{i,j,m,t} + FE_m + FE_t + \epsilon_{i,j,m,t}, \quad (2)$$

where $\text{Exec. price}$ is the execution price of the trade and $\text{Exposure}$ is a measure of investor exposure.
i’s exposure to the price collapse. Trade size controls for the size of each trade, expressed in number of tons. Finally, maturity and day fixed effects ($FE_m$ and $FE_t$) are included, to isolate price dispersion within a given day and contract maturity. The characteristics of investors sending either buy or sell orders are compared with those of the entire client base of Nataf in Panel A of Table 3. Overall, retail investors with long positions whose orders were executed had been buying futures at a lower price than other investors, and therefore face lower losses. Surprisingly, we do not see a higher proportion of executed sell orders for distressed investors.

We estimate Equation (2) separately for buy and sell transactions. We use two measures of Exposure. First, the average price at which the outstanding position has been bought. This idea is that, if existing positions have been bought at high prices, an investor with a long position will see his account balance turning negative more quickly when sugar prices drop. Our second measure of exposure is the size of an investor’s existing position, expressed in number of contracts. The idea is that brokers may have stronger incentives to avoid default by investors with larger position sizes.

Estimates are in Panel B of Table 3. Evidence from buy orders shows distortions in execution prices. Investors which are more exposed to the collapse in sugar prices are given significantly cheaper execution prices when buying sugar futures. This is true regardless of the variable used to measure exposure, and suggests that Nataf had incentives to help investors closer to distress. Evidence is consistent for sell order: sellers closer to distress get higher execution prices. However, estimates for sell order are weaker than for buy orders, and significant in only one case. A potential reason is that sell orders correspond to investors liquidating their positions. Thus, the concern that they may default on their margin calls in the future is presumably smaller, so that incentives to distort execution prices are lower than for buy orders.

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26 A concern is that the inclusion of both maturity and time fixed effects in a small sample implies that our estimates are based on limited day-maturity variation. However, most observations (47.8%) are concentrated on one day in which the limit down was not hit. Moreover, trading is itself concentrated within a few contract maturities (32.8% and 26.4% of trades for the March 1975 and the May 1975 maturities, respectively). Therefore, our estimates are based on sizable within maturity-day variation.

27 This variable is constructed using data on notional exposures and on the market value of positions.

28 Another possibility is that the test lacks statistical power, due to a smaller number of observations.
5.6 The resolution of the CLAM

The shift from a tentative recovery to a resolution plan occurred in June 1975. After a series of judicial procedures, described in Appendix Table A1, the decision to close the market was overturned by the Council of State. Thus, positions could not be settled based on Article 22. Since the CLAM’s equity was insufficient to absorb losses at current prices, an administrator was appointed by the government to resolve the CCP. The final plan, approved by all parties in December 1975, has three main features.29

First, the positions of sugar future sellers were settled at a price of 6,017 FRF, i.e., 200 FRF below the price prevailing on December 2nd. At the time the plan was agreed upon, sugar prices had been further falling to a level of about 1,500 FRF per ton. Therefore, sellers forgo a large part of their gains. Second, the professional associations of sugar producers and of beet producers paid an additional 15 million FRF to make the final agreement feasible. This is consistent with the idea that members with an interest in hedging attach more value to the continuation of clearing services and are therefore willing to absorb a larger share of losses to obtain a quick reopening. Third, there was no direct cost incurred by the government, while large equity holders (banks and insurers) lost almost everything: they sold their shares for 1 FRF per share.

6 Policy implications

Our findings have important implications for current policy discussions.

6.1 Potential for risk-shifting in the current context

Risk-shifting can arguably still be a dominant force leading to CCP failures today. Indeed, modern CCPs remain thinly capitalized relative to their largest potential clearing obligations. Moreover, while the structure of CCP default waterfalls (i.e., loss allocation schemes in case of member default) now enables sharing losses with surviving members,

29Details on the allocation of losses are in Appendix Table A4.
which mitigates risk-shifting, other factors amplify the potential for risk-shifting. In particular, compared to the CLAM, modern CCPs have become significantly larger, and are potentially “too-big-to-fail” (Tucker, 2013). To the extent policymakers provide implicit or explicit guarantees to CCPs, additional convexity in CCPs’ equity value function is created, thus potential for risk-shifting.

One may argue that the use of the instruments that the CLAM used for risk-shifting is now more constrained. For example, risk-shifting in our context was exacerbated by the possibility to bet on Article 22. While this specific aspect of the Paris market may not exist today, similar distortive devices are widespread. Fundamentally, Article 22 amounts to an exogenous device that the CLAM could use to delay the declaration of Nataf’s default and impairments to its own equity. Nowadays, expectations of bailouts for defaulting members could play a similar role: a CCP may find it optimal to delay the liquidation of a member’s position, expecting that this member will soon be bailed out by a government. Finally, one may argue that the possibility to delay the liquidation of defaulted exposures is now restricted by regulation. However, a CCP engaging in risk-shifting could hide information to the regulator about the true actions it is taking in order to return to a matched book. Finally, the distortions of incentives during renegotiations could still exist today in CCPs, and in financial institutions more broadly.

6.2 Limiting risk-shifting

To limit risk-shifting incentives, CCPs could be better capitalized. However, given the size of cleared markets, it is unlikely that CCPs can operate with equity levels that completely rule out risk shifting. In this context, the governance structure of a CCP can also play a role. Our findings highlight the importance of two types of members: (i) hedgers, who value the continuation of clearing services, and (ii) liquidity providers, who derive little value from future clearing services. A governance structure that gives more weight to hedgers is less likely to allow for risk-shifting strategies.

Part of the reason why risk-shifting incentives were large at the CLAM is because all losses were borne by equity holders. Instead, modern CCPs have richer pre-specified
procedures to share losses with surviving members. In a typical case, only one tranche of equity is impaired before additional resources are called from members (e.g., replenishment of the default fund), or losses are directly imposed onto members (e.g., in case of contract tear-ups, see Duffie, 2015). In this case, equity holders share losses with CCP members, either fully or up to a pre-specified limit. An overlooked benefit of default waterfalls is that they mitigate ex post risk-shifting. We stress, however, that sharing losses with members comes at a cost. First, the reason to establish CCPs in the first place is to insulate members against default losses. Second, imposing losses to equity holders is also necessary to give them “skin-in-the-game”, i.e., incentives to properly manage the CCP. Thus, fully insulating equity holders from losses is unlikely to be efficient, even if it reduces risk-shifting. In practice, indeed, the resources of surviving members that can be impaired are often capped (e.g., limits on replenishment of default funds are widespread). Thus, while our study is silent on the optimal design of CCP capital structure, we show that potential risk-shifting incentives should be an important part of policy discussions even when default waterfalls are in place.

Relatedly, our findings have implications for the current debate on the trade-off between rules and discretion in CCP management. While discretion over risk-management can enable a CCP to use more information about member’s conditions, we show that managerial discretion can also be used to lower total CCP value. Thus, if risk-shifting incentives are large enough, a management of CCPs based on strict rules, near distress, can reduce expected default costs. Moreover, our findings give ground to the idea that, if private attempts to negotiate a recovery are inefficiently distorted by risk-shifting incentives, the early intervention of a resolution authority is desirable. The current regulatory environment is evolving in this direction. In the case of the CLAM, the re-opening of the sugar market, more than a year after its closure, could arguably have been accelerated if an administered resolution plan had been implemented earlier. Or study gives support to the view of Duffie (2015), according to which a key question when a CCP fails pertains to when a resolution process should override contractual default management processes.
6.3 Design of margin requirements

Our results also have implications for the design of margin requirements. Current CCPs employ margining system that are more sophisticated than those used by the CLAM. For example, most modern CCPs adjust initial margin requirements for concentration risk, i.e., penalize large exposures. Our analysis gives support for this practice. However, our study also shows that crowded trades, i.e., correlated positions across members, regardless of the absolute size each member’s position, can be a risk for CCPs. This point has recently been made in different contexts by Cruz Lopez et al. (2017) and Menkveld (2017). It remains highly relevant, since current margining methodologies compute margin calls on a member-by-member basis, regardless of correlated exposures across members.

Relatedly, current policy discussions highlighted concern for the procyclical effects of margin requirements, which could trigger distressed sales when markets are most illiquid. We show that, in the case of the CLAM, the fear of procyclical effects partially explains why initial margins on existing positions had not been raised further. A clear trade-off appears, and additional research is needed to design margin requirements that are robust to volatility spikes while not inducing excess procyclicality.

Finally, our results highlight the need for CCPs to monitor the pool of ultimate investors. While retail investors may no longer play a significant role in derivatives markets, the issue still remains important today. First, the membership of CCPs is expanding quickly to increasingly opaque institutions. For example, it is now common for asset managers or hedge funds, whose creditworthiness is hard to assess, to be CCP members. Second, the practice of client clearing is growing: investors clear trades through a broker, implying that CCPs have limited oversight over these investors. For CCPs, margins can mitigate these problems via their role of screening device: by asking for higher margins for more opaque investors, a CCP can exclude those who are financially more fragile.
7 Conclusion

CCPs are becoming critical institutions, due to regulatory requirements to centrally clear standardized derivatives. We conduct the first empirical study of the failure of a CCP. We argue that two causes led to losses for the CLAM in 1974. First, the composition of the pool of investors, which comprised unsophisticated and non-diversified retail investors, implied that many defaults occurred when sugar prices dropped. Second, the CLAM failed to contain the growth of a large position by one of its member. However, the main cause of the CLAM’s failure is to be found in its risk-shifting decisions, i.e., delaying the declaration of default, pushing for the closure of the market and rejecting renegotiation plans. These findings have important implications for current policy debates: the design of CCPs and resolution frameworks should consider the risk of risk-shifting.
References


Table 1 – Descriptive statistics on sugar futures brokers and investors

This table provides descriptive statistics on sugar futures brokers and investors. Panel A describes registered commodity brokers (35 institutions) plus the International Commodities Clearing House, a London-based CCP affiliated with the CLAM. Exposures are described as of December 2nd, 1974, i.e., the date on which the default of Nataf was declared, before the market was temporarily closed. Panel B describes individual investors, as reflected in sub-accounts opened and managed by brokers at the CLAM in the name of their individual clients. We consider that a broker/investor holds a long (resp. short) position if the number of future contracts bought is strictly larger (resp. strictly lower) than the number of future contracts sold, regardless of the market value of his portfolio. The total number of brokers/investors holding long and short positions, as well as the total number of brokers/investors realizing gains or losses, do not sum up to the total number of brokers/investors, due to the existence of accounts with a balanced position. See Appendix B for details on the data.

Panel A: Registered commodity brokers

<table>
<thead>
<tr>
<th>Number of brokers + affiliated CCP</th>
<th>N. Obs.</th>
<th>% Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>36</td>
<td>100.0</td>
</tr>
<tr>
<td>Of which:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign</td>
<td>6</td>
<td>16.7</td>
</tr>
<tr>
<td>Holding accounts on behalf of individual investors</td>
<td>18</td>
<td>50.0</td>
</tr>
<tr>
<td>Holding long positions on December 2nd, 1974</td>
<td>24</td>
<td>66.7</td>
</tr>
<tr>
<td>Holding short positions on December 2nd, 1974</td>
<td>12</td>
<td>33.3</td>
</tr>
<tr>
<td>Realizing losses given prices on December 2nd, 1974</td>
<td>11</td>
<td>30.6</td>
</tr>
<tr>
<td>Realizing gains given prices on December 2nd, 1974</td>
<td>22</td>
<td>61.1</td>
</tr>
</tbody>
</table>

Panel B: Retail investors

<table>
<thead>
<tr>
<th>Number of investor sub-accounts with the CLAM</th>
<th>N. Obs.</th>
<th>% Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>683</td>
<td>100.0</td>
</tr>
<tr>
<td>Of which:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holding long positions on December 2nd, 1974</td>
<td>566</td>
<td>82.9</td>
</tr>
<tr>
<td>Holding short positions on December 2nd, 1974</td>
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<td>2.6</td>
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<tr>
<td>Realizing losses given prices on December 2nd, 1974</td>
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<td>93.1</td>
</tr>
<tr>
<td>Realizing gains given prices on December 2nd, 1974</td>
<td>37</td>
<td>5.4</td>
</tr>
</tbody>
</table>
Table 2 – Defaults by retail investors to Nataf

This table provides descriptive statistics on the default of retail investors via-à-vis Nataf. Panel A shows the distribution of exposures by retail investors holding positions via Nataf on December 2nd, 1974 (in tons of sugar), as well as as average prices at which these contracts were bought. We also report the month in which this level of sugar prices was reached. Panel B shows the percentage of retail investors with negative balance under several price scenarios. Panel C displays the distribution of gains and losses by these investors under the same price scenarios. Settlement prices of 7,454 FRF/ton and 6,217 FRF/ton correspond respectively to the price mandated by Article 22 of the market’s rulebook and to the price on December 2nd, 1974, when the market closed. The price of 5,917 FRF/ton is a settlement price that was discussed during the recovery and resolution phase. See Appendix B for details on the data.

**Panel A: Exposure and average price paid by retail investors**

<table>
<thead>
<tr>
<th>Exposure (in tons)</th>
<th>Min</th>
<th>10pc</th>
<th>25pc</th>
<th>50pc</th>
<th>Mean</th>
<th>75pc</th>
<th>90pc</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>403</td>
<td>200</td>
<td>450</td>
<td>18,850</td>
</tr>
<tr>
<td>Average buy price</td>
<td>2,084</td>
<td>4,879</td>
<td>5,525</td>
<td>6,201</td>
<td>6,080</td>
<td>6,784</td>
<td>7,275</td>
<td>8,005</td>
</tr>
</tbody>
</table>

**Panel B: Share of investors with negative balance**

<table>
<thead>
<tr>
<th>Settlement price</th>
<th>7,454 FRF/ton</th>
<th>6,217 FRF/ton</th>
<th>5,917 FRF/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of negative balances</td>
<td>0.043</td>
<td>0.496</td>
<td>0.582</td>
</tr>
</tbody>
</table>

**Panel C: Distribution of gains and losses (in Th. FRF)**

<table>
<thead>
<tr>
<th>Settlement price</th>
<th>Min</th>
<th>10pc</th>
<th>25pc</th>
<th>50pc</th>
<th>Mean</th>
<th>75pc</th>
<th>90pc</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,454 FRF/ton</td>
<td>-36.6</td>
<td>28.7</td>
<td>77.1</td>
<td>138.9</td>
<td>464.1</td>
<td>281.1</td>
<td>605.6</td>
<td>31,061.8</td>
</tr>
<tr>
<td>6,217 FRF/ton</td>
<td>-25,534.1</td>
<td>-152.9</td>
<td>-62.9</td>
<td>2.3</td>
<td>-44.1</td>
<td>71.7</td>
<td>206.6</td>
<td>15,996.0</td>
</tr>
<tr>
<td>5,917 FRF/ton</td>
<td>-31,189.1</td>
<td>-208.8</td>
<td>-106.7</td>
<td>-31.9</td>
<td>-157.1</td>
<td>41.4</td>
<td>128.0</td>
<td>12,666.0</td>
</tr>
</tbody>
</table>

36
Table 3 – Execution price of orders by Nataf on behalf of its clients

This table regresses the execution price of orders by Nataf on behalf of its clients on measures of exposures by these clients to the collapse in sugar prices (Equation 2). Panel A shows characteristics of the pool of investors sending buy and sell orders. Investors sending both types of orders are in both pools. We also compare their characteristics with those of the entire pool of Nataf clients. To do so, we report the average price at which existing positions have been bought, as well as the gains or losses on December 2nd, 1974. Panel B shows regression estimates for buy and sell orders. The first measure of exposure is the average execution price of pre-existing trades for each client (Columns 1, 2, 4, and 5). It captures how quickly a client’s balance turns negative when prices fall. The second measure of exposure is the size of an investor’s pre-existing position, expressed in number of contracts (Columns 3 and 6). We include a measure of the size of each trade as a control variable. D and MAT correspond respectively to trading day and to contract maturity fixed effects. The sample period includes 5 days of trading between November 22nd and November 28th, 1974. p-values are in parentheses. *, ** and *** denote respectively statistical significance at the 10%, 5% and 1% levels. See Appendix B for details on the data.

Panel A: Pool of investors

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>10pc</th>
<th>25pc</th>
<th>50pc</th>
<th>Mean</th>
<th>75pc</th>
<th>90pc</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average buy price (in FRF/ton)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All investors</td>
<td>2,084</td>
<td>4,879</td>
<td>5,525</td>
<td>6,201</td>
<td>6,080</td>
<td>6,784</td>
<td>7,275</td>
<td>8,005</td>
</tr>
<tr>
<td>Investors buying</td>
<td>2,084</td>
<td>3,894</td>
<td>4,776</td>
<td>5,749</td>
<td>5,526</td>
<td>6,517</td>
<td>6,813</td>
<td>7,743</td>
</tr>
<tr>
<td>Investors selling</td>
<td>3,784</td>
<td>3,976</td>
<td>4,775</td>
<td>5,634</td>
<td>5,591</td>
<td>6,228</td>
<td>7,298</td>
<td>7,572</td>
</tr>
<tr>
<td>Gain/loss (in Th. FRF)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All investors</td>
<td>-25,534.1</td>
<td>-152.9</td>
<td>-62.9</td>
<td>2.3</td>
<td>-44.1</td>
<td>71.7</td>
<td>206.6</td>
<td>15,996.0</td>
</tr>
<tr>
<td>Investors buying</td>
<td>-25,534.1</td>
<td>-170.7</td>
<td>-34.6</td>
<td>58.5</td>
<td>-73.7</td>
<td>238.4</td>
<td>562.0</td>
<td>15,996.0</td>
</tr>
<tr>
<td>Investors selling</td>
<td>-25,534.1</td>
<td>-74.9</td>
<td>11.7</td>
<td>67.2</td>
<td>-192.8</td>
<td>190.9</td>
<td>301.7</td>
<td>15,996.0</td>
</tr>
</tbody>
</table>

Panel B: Regression analysis

<table>
<thead>
<tr>
<th></th>
<th>Buy orders</th>
<th>Sell orders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average buy price of existing trades</td>
<td>-0.019** (0.014)</td>
<td>0.033 (0.115)</td>
</tr>
<tr>
<td>Size of existing position</td>
<td>-0.204*** (0.000)</td>
<td>0.238 (0.482)</td>
</tr>
<tr>
<td>Trade size control No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>N. Obs.</td>
<td>68</td>
<td>68</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.134</td>
<td>0.185</td>
</tr>
<tr>
<td>Fixed effects</td>
<td>D, MAT</td>
<td>D, MAT</td>
</tr>
</tbody>
</table>
This figure plots the price of sugar. Panel A plots the world sugar price in the spot market over the 1960-2016 period, at a monthly frequency, expressed in 2016 USD per ton. Data are obtained in nominal terms from the World Bank Global Economic Monitor Database, and converted to real terms using the US consumer price index obtained from the Saint-Louis Federal Reserve’s FRED database (series identifier: CPIAUCSL). Panel B plots the spot and nearest-term future sugar prices in Paris over the period from January 1973 to June 1975, at a daily frequency, in current FRF per ton. The dashed vertical line corresponds to December 2nd, 1974, when the default of Nataf was declared. See Appendix B for details on the data.
Figure 2 – Transactions registered by the CLAM, 1966-1977

This figure plots the volume of transactions in the Paris Commodity Exchange, registered at the CLAM. Data are at a monthly frequency over the 1966-1977 period. Panel A plots the number of transactions registered in the white sugar market after the introduction of the main future contract (“contract n°2”) in July 1966. The transaction volume is expressed in thousand tons of white sugar. Panel B plots the number of transactions registered in the cocoa and coffee markets, expressed in thousand tons. Trading on coffee futures started in December 1972. Starting in 1976, data correspond to transactions registered at the Banque Centrale de Compensation, the successor of the CLAM. In both panels, the dashed vertical line corresponds to December 2nd, 1974, when the default of Nataf was declared. See Appendix B for details on the data.
Figure 3 – Stock price of the CLAM

This figure plots the stock price of the CLAM at a daily frequency. Panel A plots the stock price over the period from February 1966 to December 1975. Blank spaces correspond to days on which there is no trading recorded and no available data on bids and asks. Panel B plots the CLAM’s stock price from January 1974 to May 1975. The shaded area corresponds to a period of strike in the Paris Stock Exchange, during which there are no quoted prices (28th March to 8th May 1974). The first vertical line (21st November 1974) corresponds to the highest sugar price and the second vertical line (2nd December 1974) corresponds to the failure of Nataf, which leads to the closure of the sugar futures market. See Appendix B for details on the data.
Figure 4 – Initial margin requirement in 1974

This figure plots the initial margin requirement set by the CLAM from November 1973 to early December 1974. Panel A plots the absolute level of initial margin required, expressed in FRF per ton of sugar. Panel B normalizes this margin requirement by the price of the nearest-term sugar future in the Paris market. In both panels, the dashed vertical line corresponds to December 2nd, 1974, when the default of Nataf was declared. See footnote 15 for a description of the unusual increase in margins in January 1974. Data on initial margin requirements are obtained from documents in the National Archives. See Appendix B for details on the data.
Figure 5 – Volatility and Value-at-Risk

This figure displays the volatility of sugar prices and the Value-at-Risk (VaR) of the CLAM. In Panel A, the left chart plots daily returns on the nearest-term sugar future contract in the Paris Commodity Exchange, between January 1974 and December 1974. The right chart plots the difference between the highest and the lowest future price at a daily frequency, normalized by the mid-price (i.e., the average between the highest and the lowest price). In Panel B, we plot the 98% VaR at a daily frequency, normalized by the CLAM’s initial margin requirement. In the left chart, the VaR is computed each day using sugar price data on the last 200 trading days. In the right chart, the VaR is computed using intraday data (4 observations per day), and converted to a daily VaR using the square-root-of-time rule. Value below one correspond to days in which the initial margin covers the CLAM against fluctuations in prices equal to its 98% VaR. In both panels, the dashed vertical line corresponds to December 2nd, 1974, when the default of Nataf was declared. See Appendix B for details on the data.

Panel A: Daily volatility of nearest-term sugar future prices

Panel B: Value-at-Risk / Initial margin requirement
Figure 6 – Build-up of Nataf’s position

This figure illustrates the build-up of Nataf’s long position in sugar futures. Panel A shows the open position in number of Nataf in tons of sugar, and Panel B the share of this position relative to the open position of the CCP. The open position of the CCP corresponds to the net volume of physical sugar or the monetary amount that would change hands if all positions were to be settled on a given day. Nataf’s position is approximated using data on initial margins required. We ensure that our approximation is equal to known values of the position as of end-September, end-October and end-November. See Appendix B for details on the data.
This figure depicts Nataf’s account at the CLAM in the three months preceding its default, from September 2nd to December 2nd, 1974. Panel A breaks down the assets used to meet initial and variation margins. Assets comprise bank guarantees (red line) and deposited capital, i.e., cash (difference between the blue and the red lines). These assets are used to pay for initial margins (yellow line) and variation margins (difference between the yellow and purple lines). Panel B plots the balance on Nataf’s account (in blue). The balance is defined as in Equation (1). The red line plots Nataf’s balance under the assumption that initial margins can be used to meet variation margins call. The vertical line corresponds to November 21st, when sugar prices reached their highest level. Data are obtained from the archives of the Paris Chamber of Commerce. See Appendix B for details.
Figure 8 – Equity value of the CLAM

This figure plots the market value of the CLAM’s equity, in million FRF, as a function of the settlement price for outstanding exposures on December 2nd, 1974. The calculation of the equity market value is based on the CLAM’s stock price on December 2nd, 1974. For any settlement price above 6,300 FRF (including the price mandated by Article 22 of the sugar market’s rulebook, i.e., 7,400 FRF), the balance on Nataf’s account is positive and it does not default. For a settlement based on the price prevailing on Dec. 2nd (6,200 FRF), the CLAM incurs a loss of 8.1 million FRF but does not defaults. For any settlement price below 5,920 FRF, the loss due to Nataf’s default is larger than the CLAM’s equity. In this region, the blue line plots total losses incurred by equity, while the orange line plots the equity value under limited liability. A second kink at 5,820 FRF corresponds to the default of additional registered brokers if prices fall below this threshold. The implementation of the second Varsano proposal (settlement at 5,700 FRF) does not allow the CLAM to absorb losses. See Appendix B for details on the data.
We assess counterfactual scenarios in which the CLAM would have declared Nataf in default on December 25th and started liquidating its position on December 26th. We assume that the CLAM sells positions for a fraction $k = \{50\%, 100\%, 125\\%\}$ of the trading volume on any given day, and at a price equal to the settlement price. In Panel A, we plot the residual size of Nataf’s position, in number of contracts. In Panel B, we plot the shortfall in its initial margin buffer, under the assumption that initial margins are used to cover shortfalls in variation margins. See Appendix B for details on the data.
Additional institutional description

This appendix provides additional institutional details on the Paris Commodity Exchange and on the CLAM. A more general description of the exchange can be found in Tardieu and Porteu de la Morandière (1974), Saclé and Goldschmidt (1974), Menu (1980) and Simon (1981). Figure A1 illustrates the structure of the CLAM.

Price fluctuation limits

The Paris Commodity Exchange featured price fluctuation limits, called “limit-up” and “limit-down”. In any given trading day, all transactions had to be executed within these price limits, defined with respect to the previous day’s settlement price. Until November 1974, limits up and down on sugar contracts were close to proportional to the level of settlement prices. For a price below or equal to 250 FRF, the limit was 25 FRF; within the {251 FRF, 450 FRF} bucket, it was 35 FRF; within the {451 FRF, 650 FRF} bucket, it was 55 FRF, and so on. Starting on November 8, 1974, the proportional limit was changed to a constant limit of 300 FRF per trading day. Since future prices on that day (for the nearest-term delivery) were 7,400 FRF per ton, the proportional limit was 745 FRF. Therefore, the change substantially narrowed price fluctuation limits. Similar limits still exist on most commodity future exchanges worldwide.

Membership requirements

The CLAM did not have membership requirements that it could directly control. However, there were indirect membership requirements, since clearing members (with few exceptions) had to be registered brokers. Becoming a registered broker required demonstrating sufficient financial strength. The precise nature of the requirements was managed by the professional association of registered commodity brokers (Compagnie des commissionnaires agréés). Among other requirements, registered brokers needed to show sufficient financial strength, with an equity of at least 1 million FRF. This requirement has been raised several times in the years preceding the sugar crisis.
Default fund

The CLAM did not have its own default fund. Separately, the professional association of registered commodity brokers managed a fund aimed at protecting individual investors against the default of their broker (Caisse Mutuelle de Garantie). Indeed, brokers did not post margin to their clients. The minimum amount held within this fund was 5 million FRF, and its maximum amount was 50 million FRF. An above limit is in place to ensure that surviving members do not assume unlimited liabilities for the default of other members. When the fund is replenished, contributions are proportional to the turnover of each member over the past 12 months.

Clearing fees

To register a transaction, the CLAM charges a fee per ton of sugar. Clearing fees do not depend on the level of sugar prices. In addition to clearing fees, a tax is also levied on each trade, equal to 1/10,000 of the notional value of each transaction.

Bank guarantees

The use of bank guarantees to cover margin payments was widespread. In a typical arrangement, a registered broker brings to the CLAM a letter of credit by which a bank commits to meet the broker’s payments upon demand, for a certain period of time and up to a limit. When bank guarantees are used, the CLAM earns interest on the amount drawn. The CLAM can decide to refuse certain bank guarantees. For example, in the third quarter of 1974, it put a cap on the guarantees that could be provided by one bank (Banque Vernes et Commerciale de Paris), which had issued letters of credit for an amount greater than its equity. Based on data covering all brokers after the closure of the market, we find that 28 out of 35 brokers were pledging bank guarantees to the CLAM, for a total amount of 384 million FRF. In contrast, the use of securities to meet variation margin calls was extremely limited. Only one broker was posting securities to the CLAM, for an amount of 350,000 FRF.
Position limits

The CLAM did not enforce limits on the position that each registered broker could take. Throughout the history of the exchange, it was often the case that a few registered brokers concentrated a large share of the open position. To understand how such exposures are built, it should be reminded that, to an overwhelming extent, registered brokers do not trade on their own account, but on behalf of clients, for which they execute orders. A broker increases its share of the open position not by building up its own exposure, but by attracting more trading orders from investors. While Nataf attracted a large number of orders, there is no evidence that its commercial practices were different from that of other brokers.\textsuperscript{30} Due to their role of intermediaries for the execution of orders, registered brokers have balance sheets that resemble that of a CCP, with almost-matched books, and with a net open position usually equal to zero or small. Also note that the share of the open position of a registered broker within the open position of the clearinghouse varies not only because a clearing member increases trading, but also because other members close positions or reduce trading. This factor partly explains the growth of Nataf’s position.

Board

Even though the CLAM is a private corporation, its board of directors did not primarily represent its equity holders. This is a consequence of the fact that the CLAM had a monopoly status and operated as a public utility for the Paris Commodity Exchange. According to its statutes, its board is composed of 12 members, which should receive the approval of the Department of Commerce. These members comprised four registered brokers, five representatives of commodity professionals, and three representatives a large banking groups. A representative of the Department of Commerce attended all board meetings.

\textsuperscript{30}In subsequent judicial cases opposing investors to brokers about fraudulent practices or false advertising, Nataf is under-represented relative to other brokers.
Exchange governance and supervision

The governance and surveillance of the Paris Commodity Exchange are decentralized. A technical committee (comité technique), comprising both registered brokers and representatives of other market participants, ensures that transactions take place according to the market’s rule book. Furthermore, the Paris Chamber of Commerce is in charge of the overall surveillance of operations. The government’s involvement, through the Department of Commerce, is limited to one representative seating in several committees of the exchange.

Figure A1 – Schematic representation of the CLAM

This figure provides a schematic representation of the clearing process in the Paris Commodity Exchange. Sellers and buyers of sugar futures are represented respectively in green and pink. Based on the most common exposures observed in the data, sugar professionals are sellers and retail investors are buyers. Each broker or professional participant holds a deposit account on the balance sheet of the CLAM, represented by a square. This account is used to pay initial and variation margins. Retail investors, or clients, trade through a registered broker. They may either pay margin through the main broker account (Clients 2, 3 and 4) or hold a separate sub-account in their name in the books of the CLAM (Client 1). Sub-accounts are opened at the demand of brokers and managed by them.
B Data sources

We provide a detailed description of the archive sources used. For quantitative data, we give additional details on the variables observed.

- **National Archives** (*Archives nationales*), located in Pierrefitte-Sur-Seine. We searched through the archives of the Department of Commerce, in particular boxes 19910031/1 to 19910031/23 (*Commerce et Artisanat ; Direction du commerce intérieur ; Sous-direction activités commerciales; Marchés à terme de marchandises, 1939-1989*).

  - **Data collected 1**: These boxes contain a large quantity of non-quantitative information about the Paris Commodity Exchange and the 1974 sugar crisis. We collect a large number of policy briefs, reports and preparatory notes from meetings involving officials at the Department of Commerce. We use them to reconstruct the history of the sugar crisis.

  - **Data collected 2**: Regarding the CLAM, we find the history of margin calls starting in the Fall 1973. We also find detailed accounts of exposures on the day the market closed. This includes broker-level information on long and short positions via-à-vis the CLAM (in notional terms), the market value of these positions, the funds deposited at the CLAM for the payment of margins, and the bank guarantees used to pay margins. Furthermore, at the investor level (i.e., for different clients of a given broker), we know the detail of long and short positions in notional terms.

  - **Data collected 3**: Regarding Nataf, we find the detail of all transactions registered in the last five days of operations. The records include the name of the counterparty, the maturity and the price. We also find a hand-written ledger with the market value of the position of Nataf’s clients on December 2nd, 1974. Based on family names, we match these data with the transaction data.
Data collected 4: Finally, we collect a large number of documents from the judicial procedures engaged in December 1974 by retail investors realizing losses. These documents contain testimonies by retail investors and are useful to understand why these investors entered the market and why they failed or margin calls.

• Archives of the Paris Chamber of Commerce (Chambre de Commerce et d'Industrie de Paris), located in Paris. We searched through boxes in the series numbered 135-W.

Data collected 1: We also find significant non-quantitative information about the Paris Commodity Exchange and the 1974 sugar crisis. In particular, there are a large number of supervisory reports that help understand how the CLAM and registered brokers were monitored.

Data collected 2: Regarding Nataf, we find details on its account at the CLAM in the last three months of operations, at a daily frequency. This includes a breakdown of its position between initial and variation margins called, funds deposited in cash, and bank guarantees used as collateral.

• Archives of the French Ministry of Finance (Centre des Archives Economiques et Financières), located in Savigny-le-Temple. We searched through boxes numbered 1A-0000371/1 and 2, and 1A-0000204/1.

Data collected 1: We find only a few supervisory notes related to the sugar crisis.

Data collected 2: From the complete collection of the Cours authentique et officiel (the daily newspaper published by the professional association managing the Paris Stock Exchange, or Compagnie des agents de change), we hand-collect daily stock market data from February 1966 to December 1975. For the CLAM, this includes the stock price, dividend payments, and the number of shares outstanding. We consistently use the ex-dividend stock price. When
there are no transactions on a given day, we instead use bids or asks (8% of observations). A stock price for the CLAM is available before 1966. However, the main white sugar future contract (so-called “contract n°2”) did not trade before July 1966. We also collect daily data on stock market indices for the overall market and for the financial sector, over the 1972-1975 period.

- **Archives of the Bank of France** (*Banque de France*), located in Paris. We searched through references numbered SLIP199123 box 68 and SLIP0199113 box 46.

  - **Data collected 1**: We find supervisory reports produced by the Bank of France about the CLAM. This includes a detailed report by J. Le Poupon (*Commission de Contrôle des Banques*, 22 April 1975), and a number of other notes.

  - **Data collected 2**: We also collect detailed balance sheet data for the CLAM, at a quarterly frequency. We also consult a number of annual reports by the CLAM.


  - **Data collected 1**: We collect the complete collection of daily reports on sugar trading in the Paris Commodity Exchange, as produced by the professional association of registered commodity brokers (*Cours constatés officiellement par la Compagnie des courtiers de marchandises assermentés au Tribunal de Paris*) for years 1973, 1974 and 1975. For every trading day, the report contains the spot price, future prices at all maturities and at several points during the day (opening, 12:30, 3:15pm or 3:30pm, and closure), settlement prices (used for variation margin calls), high and low prices for the day, the trading volume as well as open positions for the CLAM by maturity. Actual transactions can be distinguished from bids and asks. Future prices are collected only for the shortest-term contract.
– *Data collected 2*: We consult the complete collection of the daily economic newspaper *Les Echos*. We hand-collect daily data on spot and future sugar prices (for the shortest-term contract) in the London and New York commodity markets for years 1973, 1974 and 1975. Furthermore, in the same newspaper, we consult a daily chronicle on commodities, where the sugar crisis is often discussed.
C The 1974 sugar shortage in newspapers

This appendix illustrates the worldwide shortage of physical sugar in 1974 by reproducing an article published in the New York Times on November 6, 1974 (Figure A2). This article discusses the shortage in the UK. Similar newspaper articles were extremely common throughout the second semester of 1974 in the US, the UK, France and other countries. Among other statements, one can read

“An acute shortage of sugar has spread through Britain, prompting panic buying in some areas and widespread hoarding. Prices of sugar around the world have more than doubled in the last few months, but with the increasing problem here, travelers have been discovered “smuggling” packets into the country, hiding sweetener in their clothing — even though it is not contraband.”

“The shortage has spread to breakfast cereals. Sugar-coated varieties are in great demand, “but you can’t find them any more,” said one housewife here. [...] At the same time, a delegation of housewives was granted permission to inspect the Tesco warehouses to determine whether the company was stockpiling sugar while awaiting higher prices. The group said tonight that no evidence of stockpiling had been found.”

Furthermore, one can read on the picture, taken in a London supermarket, “Please limit your total purchases to 2lb of ANY sugar.”
Appendix – For Online Publication

Figure A2 – New York Times article on the 1974 sugar shortage

Union-Induced Delivery Ban Adds to Ills

BY TERRY ROBARDS

LONDON, Nov. 5—An acute shortage of sugar has spread through Britain, prompting panic buying in some areas and widespread hoarding. Prices of sugar around the world have more than doubled in the last few months, but with the increasing problem here, sugar prices have also soared. Smuggling "sweetness" packets into the country is costing sweet teeth in their clothing — even though it is not contraband.

The shortage here is partly related to an ongoing debate over sugar supplies in the European Economic Community and is being viewed by some consumers here as further evidence that Britain is not benefiting from membership in the Common Market.

Shoppers paid about 12 cents a pound in supermarkets three months ago, but now find prices as high as 32 cents a pound and the shelves often bare. Price increases occur almost daily and many stores are holding sugar supplies in reserve for regular customers.

The shortage has spread to breakfast cereals. Sugar-coated varieties are in great demand, but you can't find them any more," said one housewife here.

Sir John Cohen, chairman of the big Tesco Stores, Ltd., the largest supermarket chain, called today for the Government to consider making rationing a way to conserve existing supplies. He said he had been in touch with Shirley Williams, Secretary for Prices and Consumer Protection, consisting mostly of house imports from the Common Market and a subsequent loss of jobs in the refining industry here.

The scarcity had been blamed on Monday when Tate & Lyle, Britain's largest sugar refiner, announced a sugar shortage. The group said tonight that no evidence of stockpiling had been found.

The National Consumer Protection Council, an action group what fear will be rising prices, has a long list of those who are now trying to guarantee their stocks of sugar.

Sugar Shortage Is Acute in Britain as Prices Soar

Continued From Page 55

Continued From Page 55

the General and Municipal Workers Union that imposed the blockade, said its purpose was to "stiffen the resolution" of Prevention. Mr. B. B. D. Federation, called the blockade "the most irresponsible act that one can imagine in the present situation."

Both the trade and the public have been bedeviled with the sugar situation for months," he added. "We have managed to keep going through a difficult period, but it leaves me speechless that anyone can further exacerbate the situation."

A spokesman for Tate & Lyle said damage to food and they were extremely short due to the soft drink companies from the worldwide increase in demand for sugar could be serious and a relatively inelastic supply indeed.

Market should not be substituted for the raw sugar importers on which the refinery workers depend for their jobs, not unusual. Leonard Reeves-Smith, chief executive officer of the British Food and Drink Federation, said that "Our action is in the nature of an ultimatum to the company. We have told them we are prepared to produce and pack the sugar, but they must put it into stock and not deliver it. The company has been told that if they start delivering, apart from special cases like hospitals, then further action will take place."

The delivery stoppage has occurred at a critical moment when sugar supplies already were extremely short due to the soft drink companies from the worldwide increase in demand for sugar could be serious and a relatively inelastic supply indeed.
Table A1 – Timeline of events during the 1974 sugar crisis

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 Nov. 1974</td>
<td>Sugar prices hit their highest level, 8,150 FRF/ton.</td>
</tr>
<tr>
<td>2 Dec. 1974</td>
<td>A broker holding 56.8% of the (long) open position, Maurice Nataf, is declared in default. Other brokers are close to default.</td>
</tr>
<tr>
<td>3 Dec. 1974</td>
<td>The quotation of future prices is suspended by the minister of commerce, with the support of the CLAM and of the professional association of registered brokers. They invoke Article 22 of the sugar market’s rule book. According to this article, if quotations are suspended due to exceptional circumstances, existing trades must be cleared based on the average settlement price prevailing over the past 20 trading days. The market’s technical committee opposes the suspension of trading.</td>
</tr>
<tr>
<td>5 Dec. 1974</td>
<td>The market re-opens. The CLAM announces on Dec. 6th that it will not register new trades before a settlement price for existing positions is fixed by the technical committee.</td>
</tr>
<tr>
<td>11 Dec. 1974</td>
<td>The Paris Commercial Court (Tribunal de commerce) validates the suspension of trading and the settlement of existing positions based on Article 22. The average price over the past 20 trading days (7,459 FRF for the March 1975 maturity) is higher than the settlement price prevailing on Dec 2nd (6,217 FRF). This decision favors investors with long positions against hedgers (short positions). Based on this settlement price, both Nataf and the CLAM would not default. Therefore, both defend the implementation of Article 22. After the decision of the Paris Commercial Court, the CLAM immediately liquidates open positions based on Article 22, and call margins from sellers. The sellers refuse to pay. Several sugar professionals appeal the decision on the next day.</td>
</tr>
<tr>
<td>4 Feb. 1975</td>
<td>The Paris Court of Appeal invalidates the earlier decision by the Paris Commercial Court. The settlement price must be based on actual market prices, not computed on the basis of Article 22. This ruling favors hedgers (short positions) against retail investors (long positions). A settlement of contracts based on market prices would induce the CLAM to default, due to losses on its exposure to Nataf and possibly to the default of other brokers.</td>
</tr>
<tr>
<td>20 Jun. 1975</td>
<td>The decision of the minister of commerce to suspend trading on Dec. 3 is invalidated by the Council of State (Conseil d’Etat), further threatening the CLAM. By that date, sugar prices have been further falling to 1,450 FRF/ton. After this decision, it becomes clear that no recovery can take place, and that the CLAM needs to go through a resolution procedure.</td>
</tr>
<tr>
<td>22 Jun. 1975</td>
<td>The French government dismisses the board of the CLAM and appoints an administrator. The liquidation of the CLAM starts.</td>
</tr>
<tr>
<td>7 Nov. 1975</td>
<td>An agreement to share losses among all parties and settle contracts is proposed and signed by all parties on Dec. 19.</td>
</tr>
<tr>
<td>26 Jan. 1976</td>
<td>The sugar market re-opens with a new clearinghouse.</td>
</tr>
</tbody>
</table>
Table A2 – Exposure of brokers with long positions

This table shows the balance of all brokers with a long position on their account at the CLAM, based on exposures on December 2nd, 1974. The balance is computed as in Equation (1), to which initial margins are added, to reflect the fact that they can cover shortfalls in variation margins. The balance is computed for two settlement prices, 6,217 FRF (the limit down price on December 2nd) and 5,700 FRF. A red color indicates a negative balance. See Appendix B for details on the data.

<table>
<thead>
<tr>
<th>Broker</th>
<th>Balance if settlement at 6,217 FRF</th>
<th>Balance if settlement at 5,700 FRF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Debtor</td>
<td>Creditor</td>
</tr>
<tr>
<td>Marcel Gelman</td>
<td>199,196</td>
<td></td>
</tr>
<tr>
<td>Pierre-Elie Borione</td>
<td>2,143,304</td>
<td></td>
</tr>
<tr>
<td>Maison Bauche</td>
<td>10,169</td>
<td></td>
</tr>
<tr>
<td>Claude Huet</td>
<td>261,389</td>
<td></td>
</tr>
<tr>
<td>André Hurtebize</td>
<td>259,925</td>
<td></td>
</tr>
<tr>
<td>Maurice Nataf</td>
<td>10,631,271</td>
<td></td>
</tr>
<tr>
<td>Compagnie Francaise du Sucre</td>
<td>24,410</td>
<td></td>
</tr>
<tr>
<td>COPRODAG</td>
<td>740,228</td>
<td></td>
</tr>
<tr>
<td>Jean-Georges Wiart</td>
<td>1,985,690</td>
<td></td>
</tr>
<tr>
<td>Société Debman</td>
<td>477</td>
<td></td>
</tr>
<tr>
<td>CICOMAP</td>
<td>168,176</td>
<td></td>
</tr>
<tr>
<td>GENECO</td>
<td>107,852</td>
<td></td>
</tr>
<tr>
<td>Node Langlois</td>
<td>1,349,044</td>
<td></td>
</tr>
<tr>
<td>Georges Maurer</td>
<td>4,244,389</td>
<td></td>
</tr>
<tr>
<td>Maiseries de la Méditerranée</td>
<td>87,999</td>
<td></td>
</tr>
<tr>
<td>Goldschmidt International</td>
<td>2,682,969</td>
<td></td>
</tr>
<tr>
<td>Bache Commodities</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Compagnie de Commerce International</td>
<td>29,918</td>
<td></td>
</tr>
<tr>
<td>SELAREC</td>
<td>1992</td>
<td></td>
</tr>
</tbody>
</table>
Table A3 – Ownership structure of the CLAM

This table provides details on the ownership structure of the CLAM, as of end-January 1975. The main source is a confidential report commissioned by the Bank of France after the closure of the sugar market. See Appendix B for details on the data.

<table>
<thead>
<tr>
<th>Type of shares</th>
<th>Registered shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of shares</td>
<td>120,000</td>
</tr>
<tr>
<td>Number of shareholders</td>
<td>669</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assurances Générales de France (AGF)</th>
<th>Number of shares</th>
<th>% of total shares</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AGF Vie</strong></td>
<td>54,001</td>
<td>45.00</td>
</tr>
<tr>
<td><strong>Banque Générale du Phénix</strong></td>
<td>12,000</td>
<td>10.00</td>
</tr>
<tr>
<td><strong>La Métropole</strong></td>
<td>3,827</td>
<td>3.19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Union des Assurances de Paris</th>
<th>Number of shares</th>
<th>% of total shares</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Union Capitalisation</strong></td>
<td>2,500</td>
<td>2.08</td>
</tr>
<tr>
<td><strong>Le Continent Incendie</strong></td>
<td>184</td>
<td>0.15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Banks</th>
<th>Number of shares</th>
<th>% of total shares</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paribas</strong></td>
<td>2,518</td>
<td>2.10</td>
</tr>
<tr>
<td><strong>Société Générale</strong></td>
<td>3,116</td>
<td>2.60</td>
</tr>
<tr>
<td><strong>Crédit Lyonnais</strong></td>
<td>3,054</td>
<td>2.55</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Board members</th>
<th>Number of shares</th>
<th>% of total shares</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gérard Bauche (CEO)</strong></td>
<td>1,200</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Henri Cayre</strong></td>
<td>1,281</td>
<td>1.07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sugar professionals</th>
<th>Number of shares</th>
<th>% of total shares</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beghin-Say</strong></td>
<td>1,874</td>
<td>1.56</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Individual shareholders</th>
<th>Number of shares</th>
<th>% of total shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 individuals owning &gt; 1% each</td>
<td>7,827</td>
<td>6.52</td>
</tr>
<tr>
<td>Other shareholders</td>
<td>26,618</td>
<td>22.18</td>
</tr>
</tbody>
</table>
Table A4 – Allocation of losses and resolution of the CLAM

This table provides details on the allocation of losses during the resolution of the CLAM. Sources: Simon (1981) and archive documents. See Appendix B for details on the archive sources.

<table>
<thead>
<tr>
<th>Party</th>
<th>Allocation of losses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLAM</strong></td>
<td>Contributed the entire value of its assets (15 million FRF in liquid assets, 35 million FRF in real estate, 100 million FRF in debt claims).</td>
</tr>
<tr>
<td>Buyers of sugar futures</td>
<td>Exposures are cleared based on the settlement price of Dec. 2nd (6,217 FRF for the nearest-term future) plus 100 FRF.</td>
</tr>
<tr>
<td>Sellers of sugar futures</td>
<td>Exposures are cleared based on the settlement price of Dec. 2nd (6,217 FRF for the nearest-term future) minus 200 FRF.</td>
</tr>
<tr>
<td>Nataf clients</td>
<td>Obtain 35% of 6,017 FRF.</td>
</tr>
<tr>
<td>International Commodities Clearing House</td>
<td>Exposures are cleared based on the settlement price of Dec. 2nd (6,217 FRF for the nearest-term future) minus 200 FRF.</td>
</tr>
<tr>
<td>Blockholders (AGF and banks)</td>
<td>Sell their shares for 1 FRF per share to a subsidiary of Crédit Lyonnais (called SINFIC), and contribute to the creation of the successor CCP.</td>
</tr>
<tr>
<td>Minority shareholders</td>
<td>Sell their shares to SINFIC for 100 FRF per share.</td>
</tr>
<tr>
<td>Professional association of sugar producers</td>
<td>Contributes 7.5 million FRF.</td>
</tr>
<tr>
<td>Professional association of sugar beet producers</td>
<td>Contributes 7.5 million FRF.</td>
</tr>
<tr>
<td>Professional association of registered brokers</td>
<td>Contribute 23 million FRF, plus 5 million FRF in the name of the professional association of introducing brokers.</td>
</tr>
</tbody>
</table>
Figure A3 – Sugar future prices in Paris, London and New York

This figure plots the daily price of the nearest-term sugar future contract in the Paris, London and New York markets. Data are at a daily frequency over the period from January 1973 to June 1975, in current FRF per ton. Data in the London market are in pounds per long ton, and data in New York in cents per pounds. Both series are converted to current FRF using data on exchange rates from the Saint-Louis Federal Reserve’s FRED database (series identifiers: EXFRUS for the FRF/USD exchange rate and EXUSUK for the USD/GBP exchange rate). Prices in Paris are for contracts on white sugar, while prices in London and New York are for contracts on brown sugar. The dashed vertical line corresponds to December 2nd, 1974, when the default of Nataf was declared. See Appendix B for details on the data.
Figure A4 – Open position of the CLAM

This figure plots the open position of the CLAM on sugar futures, at a monthly frequency, from July 1966 to December 1974. The open position corresponds to the net volume of physical sugar or the monetary amount that would change hands if all positions were to be settled on a given day. It captures the exposure of the CLAM, after netting long and short positions for each clearing member. In Panel A, the open position is expressed both in thousand tons (dotted line) and in million FRF (solid line). The exposure in FRF on a given day is obtained by multiplying the exposure in tons by the price of a ton of sugar on that day. In Panel B, we plot the ratio of the open position of the CLAM in FRF, normalized by the market capitalization of the CLAM. See Appendix B for details on the data.

Panel A: Open position of the CLAM

Panel B: Open position of the CLAM over market capitalization
Figure A5 – Stock market indices

This figure plots two stock market indices at a daily frequency from January 1974 to Mai 1975. The first index (solid line) is a composite index, covering stocks from all sectors; the second index (dotted line) is an index covering only stocks from the financial sector. These indices were computed daily by the professional association managing the Paris Stock Exchange (Compagnie des agents de change). The shaded area corresponds to a period of strike in the Paris Stock Exchange, during which there was no quoted prices (28th March to 8th May 1974). The first vertical line corresponds to the highest sugar price (21st November 1974) and the second vertical line corresponds to the failure of Nataf (2nd December 1974), which leads to the closure of the sugar futures market. See Appendix B for details on the data.