US Crashes of 2008 and 1929 How did the French market react? An empirical study.

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Abstract

We compare the reaction of the Paris bourse to the US crashes during both the 2008 and the 1929 crises. We constitute a new dataset of daily French stock prices from February 1929 to March 1930 that we combine to the already existing daily series of the Dow Jones. We also use newspapers and minutes from the Banque de France and from the Paris Stock Exchange's brokers syndicate in order to confront quantitative data with historical narratives. We finally run contagion tests in both periods, using adjusted correlation coefficients to test for pure contagion. In 1929, the Paris stock market does not exhibit any reaction to the New-York crash. The recent crisis is totally different with a clear contagion of the US crash. This study highlights a significant difference between the two crises and provides strong evidence that the transmission of the Great Depression used other channels than stock markets.

JEL Classification: G150, G010, N12, N13
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1 Introduction

World has been affected by an economic and a financial crisis started in 2008 in the US. Stock markets all over the world followed New-York in his fall. Most of the economists quite agree that the only comparable crisis is the Great depression of the 1930s (Almunia and al., 2010). This major event of the 20th century also started in the US before spreading all over the planet. France is one of the most impacted countries by the Great Depression even if it is with a lag compared to the US; the French industrial production of 1937 is 28 % lower than the one observed in 1929 (Landes, 2000 p. 534).

The US stock market crash is usually seen as the starting point of the Great Depression. But the channel of the propagation of the crisis from US to the other parts of the world especially to France is still an open question. A propagation of the US crash in France could have happened in 1929 because the two markets were related without capital controls. The US crash Paris could have had an important echo in France since the Paris market was seen in the early thirties as the most important financial place of continental Europe (Jacques, 1932). Studying the international correlations among the major world equity markets over 150 years, Goetzmann and al (2001) show that the equity market correlation between Paris and New York during the interwar was at the his second highest history just after the recent period. The period we study in our empirical exercise stops in 1930, when controls on capital flows were not that important, allowing large international flows (see Obstfeld and Taylor 1997 and Mitchener and Wandschneider 2014). In fact, the main controls to capital flows appeared by 1931 and afterward, when the UK went out of the gold block and imposed controls on foreign exchanges.

The literature generally mentions that "the Great Depression was transmitted internationally through trade flows, capital flows and commodity prices." (Almunia and al., 2010). Especially for France, the devaluation of the Sterling in September 1931 is frequently observed as the starting point of the local version of the Great Depression (Sauvy, 1984). Thus, even implicitly, most of the existing literature excludes the stock market as a channel of transmission but without dedicated demonstration. This lack has become more problematic since the crisis of 2008 exhibits a very strong correlation among international stock markets.

In this paper, we investigate the short term reaction of the Paris Bourse in the six month after both the US crashes of October 1929 and Lehman failure in 2008. To measure the behavior of the French market in 1929 we build a new dataset of daily stock prices collected at the archives of the French bourse (conserved at the French Ministry of Finance). These daily prices provide a clear demonstration that the propagation of the Great Depression is not the result of a contagion of the stock market crash. Indeed, the French stock market remains stable during the US crash. This stability is demonstrated using four kinds of evidence: a descriptive measure of the stability of the French market during the US crash, the lack of any structural breaks in the French series in 1929, the stability of the volumes trades in Paris and few narratives of the practitioners of that time.

Thus, we lend support to the standard claim of channels different than stock market by providing strong evidences of the absence of any contagion (co-movement of asset prices beyond what is warranted by fundamentals) in 1929. To our best knowledge, it is the first study aiming at proving the absence of any contagion of the Wall Street crash to Europe, using data on a daily basis.

A second contribution is to characterize the relationship between the French and US markets using these high frequency data and compare it with the same indices in the recent period. There is no doubt that the US stock market leads the French one in the recent period but it is less clear in 1929. Despite the leading role of the US economy at that time, the two markets remain broadly independent. We do observe an influence of the US market on the French one but at a weak level as demonstrated by the very low correlation among the two markets.

Previous studies indicate important differences in the behavior of the two markets. The US market exhibits a very high volatility during the Great Depression contrasting to a stable level for the rest of the history (Schwert, 1997). In France, the maximum of the volatility is ten years later at the end of the World War II (Le Bris, 2012). Using our daily dataset, we investigate more deeply these differences and confirm the higher stability of the French market compared to the US in 1929. This stability is not affected by the US crash.

Our evidence joins claims made by Mauro and al. (2002 and 2006) in which they argue that the modern global financial system suffers from contagion whereas the historical financial system of the pre-world War I era was less prone to it. We show that it is still true during the interwar period, at least between US and France. The absence of contagion is consistent with the structural differences between the two markets.

The last contribution of this research is to identify a crucial difference between the episodes of 2008 and 1929. The behavior of the French market in 1929 contrasts strongly with what has been observed during the recent crisis with a general drop on international stock market after the Lehman default. On this crucial point, 2008 is thus different from 1929. Several studies offer narrative comparisons between the Great Depression and the Great Recession, as the recent crisis is sometimes named. They stressed the similarities between the two episodes. For example, Peicuti (2014) makes an interesting list of their analogies, highlighting some stylized facts to show the similarities between the periods 1921-1929 and 2001-2007. In particular, the rapid growth without contraction, the increase in global liquidity and the lack of inflation are common to both France and the US for those periods. Moreover, the international spillover effects are a strong common feature of both crises. Grossman and Meissner (2010) also compare the two international crises and try to draw lessons from them in terms of both trade and financial linkages, but without empirical tests. In the recent empirical literature, Mehl (2013) study the impact of global volatility shocks from 1885 to 2011 with monthly data. One of his results is that the two most severe global stock market volatility shocks are the late October 1929 stock market crash at the NYSE and the collapse of Lehman Brothers in 2008.

After describing the dataset in Section 2, Section 3 presents four types of evidences demonstrating the absence of any specific movement in the French stock market in 1929. Section 4 shows a clear contagion in 2008 but not in 1929. We test for the presence of contagion after the crash at the NYSE in both 1929 and 2008. In section 5, we implement VAR / VECM models in order to characterize the relationship between the French and the American stock price indexes. In both periods, the returns on the American index seem to have an influence over the French one. Section 6 concludes.

2 Data

Regarding French stock prices during the interwar period, only monthly data are available. The two most common sources are the stock price index of the League of Nations and the one of the *Statistique Générale de la France* (i.e. the National Institute for Statistics). Both of those indexes are un-weighted. More recently, Le Bris and Hautcoeur (2010) constructed a Blue Chips index of French stock prices weighted by market capitalization over 150 years, but the frequency is also monthly.

To build the French market daily prices of 1929, we collected daily spot[1] prices for forty individual stocks listed at the official list[2] of the Paris Bourse. Those stocks are the forty highest market capitalizations at the beginning of 1929 as identified by Le Bris and Hautcoeur (2010). Our dataset covers the period from February 1929 through the end of March 1930.

We reconstruct a blue chip weighted index we call HCAC 40 (H for Historical), for which the daily return is given by:

$$R_{HCAC_t} = \frac{\sum_{i=0}^{40} \text{number of share}_i \times \text{price of share}_{t+1}^i}{\sum_{i=0}^{40} \text{number of share}_i \times \text{price of share}_t^i} - 1$$

For each stock,[3] we collected the closing price every day. If a stock has no transaction price for a given day, we use the last transaction price in order not to keep the index away from fluctuations due to a lack of liquidity, and not due to a the mechanism of supply and demand.

This index allows us to interpret most of the movements of the French equity market since we know that the aggregated market capitalization of our forty firms

[1] The Paris Stock Exchange had already a term market and an option market but we only collected prices for the spot market.

[2] There was already an OTC market inside the Paris Bourse, but all the data we collected only concerns the official market.

[3] The complete list of stocks we used are reported in Appendix 1.

represents around 60% of the total market capitalization of the Paris Bourse at this time (Le Bris and Hautcoeur, 2010). A blue chips index does reflect the overall market (Annaert and al., 2011). The daily data of 2008 are from Euronext CAC 40. We checked whether our index could be biased since some companies might be more prone to international fluctuations than others. Typically, the banking sector could suffer more from exogenous shocks like the Great Crash of October 1929, while companies which have their business totally grounded in France (e.g. railroads) should be more isolated. For that matter, we made a sectorial analysis (reported in appendix 1) where we computed a banking index, that include all of the nine banks we have in our database, and a "French only" index that include railroads, utilities and coal mines firms. The Figure 8 presented in Appendix 1 shows that the trends seem to be similar between the two sub-indices and the main one. This claim is verified through a simple test on the means and the variances of the indice returns.[4]

For US data, we use the Dow Jones Industrial index. While the Dow Jones is an inaccurate index for measuring long-term stock performances, since it is weighted by stock prices, it can be useful in the analysis of short term movements. Additionally, it is the single source of daily data for the 1929 period. We also take the Dow Jones for the recent period in order to have the same measure in both periods.[5]

3 1929 in the French stock market: a peaceful period

We rely on four types of evidences to demonstrate that the French stock market is not affected by any specific phenomenon in 1929.

3.1 Descriptive analysis

It is well-known that the French market, like other international markets, closely followed the US into the crash after the failure of Lehman brothers (Figure 1). Despite few differences in the behaviours of the two markets prior months, we graphically identify that the two markets evolve closely after the Lehman failure.

The story is really different when we look at the 1929 case (Figure 2) since no shock occurred on the French stock market after the crash at the NYSE. It is quite surprising to observe that even the worst days in the NYSE seems free of any impact in the Paris market; 1929 October 28, the Dow Jones fell by 13.47% but our French index decreased by 0.60% and 2.99% the day after when the Dow Jones suffered another fall of 11.73%. After these two days, the loss is 23% in New-York and only 5% in Paris. The only sharp decrease that we can observe is in late November (red dashed circle), so over a month after the crash. This absence of any contagion of the US crash is really different from what was observed during the last financial crisis.

[4]Results are reported in Table ??, in Appendix 1.

[5]We checked if the results would be different by taking the S&P 500, but the correlations between this later and the Dow Jones is over 0.99 for the period.

Figure 1: Dow Jones and CAC Indices in 2008

Notes: base 2008M09=100.
Source: Dow-Jones, Federal Reserve of Saint Louis; CAC, calculation from authors

In Appendix 2 are reported the graphs of the returns on the indexes in both periods. We easily observe that the magnitude of the volatility of the French index in 1929 is a lot lower than the American one. It is quite different in 2008, where the magnitude of the volatility is very high for both indexes. Moreover, we can see volatility clusters in each graphs but the French index in 1929: the Historical CAC 40 does not exhibit any particular volatility structure, whereas modern financial series are featured by asymmetric volatility.

3.2 1929 in France does not exhibit any structural break

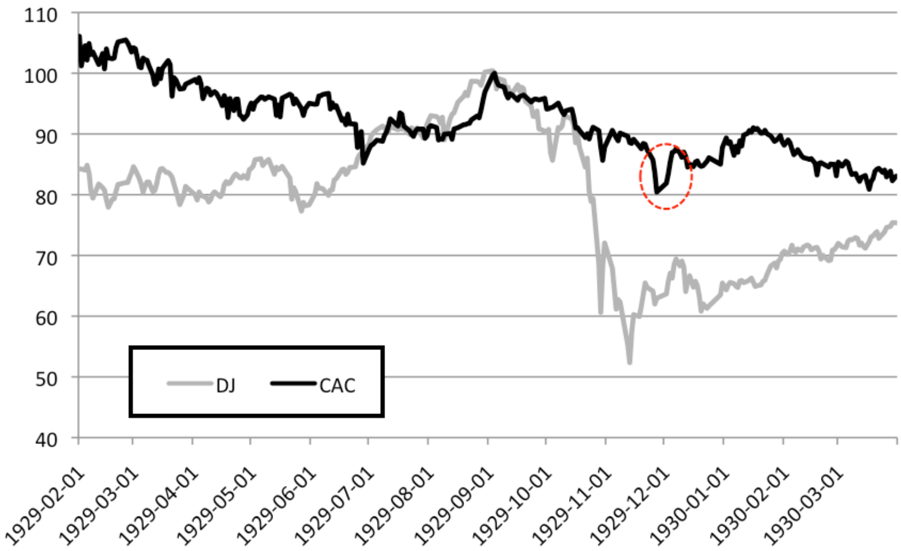
A more formalized test for the presence of a specific activity in 1929 in France is to compare the stability of the parameters when we model the stock returns. As in modern series, unit root tests[6] (not reported) lead us to use returns, rather than the series in level to get stationary series. A first glance at the data indicate that the volatility of the returns does not seem to have a particular structure: the high volatilities are not clearly followed by other high volatilities and it is the same for low volatilities. It seems then legitimate to use linear specifications.

We use the Box and Jenkins (1970) methodology in order to specify the best ARMA process to model R_{CAC_t}. We end up estimating an autoregressive process at the order 1 (AR(1)):

$$R_{CAC_t} = \alpha_0 + \beta_1 R_{CAC_{t-1}} + \varepsilon_t \tag{1}$$

[6]ADF and Perron tests have been used to detect the trend for both series. Results show that they are all I(1).

Figure 2: Dow Jones and CAC Indices in 1929



Notes: base 1929M09=100.
Source: Dow-Jones, Federal Reserve of Saint Louis; CAC, calculation from authors

Variables	Coefficient	Std. Error	t-statistic	p-value
α_0	-0.0005	0.0006	-0.8051	0.42
β_1	-0.2299	0.0555	-4.1394	0.00***

Notes: $***$ denotes significance at the 1% confidence level.

Table 1: Results

The estimation output shows that the estimated β_t is significant. Moreover, after testing for the absence of autocorrelation and homoscedasticity[7] on the residuals, we find that ε_t follow a white noise. It is important to notice that we do not detect any ARCH effect, which is usually the case for equity returns (especially at a daily frequency).This feature allows us to test for the stability of the parameters. Indeed, since there are no issues on the residuals, we are able to apply a basic Chow test by estimating the model (1) in two sub-samples, before and after the crash at the NYSE in late October 1929.

F-statistic	Log likelihood ratio	Wald Statistics
2.63	5.29	5.26
(0.073)	(0.071)	(0.072)

Notes: Sample: 2/05/1929 - 2/31/1930. p-values are reported in parentheses.

Table 2: Chow Breakpoint Test: 10/28/1929

The p-value of the F-test (2,296) $= 0.0736 > 0.05$: the null hypothesis is rejected at the 5% confidence level. The parameters are stable before and after the crash.

[7]We used a Ljung-Box test based on the correlogram of the residuals to detect the presence of autocorrelation and an ARCH test for the homoscedasticity.

The crash in New-York is free of any effect on the nature of the stock price variations in Paris.

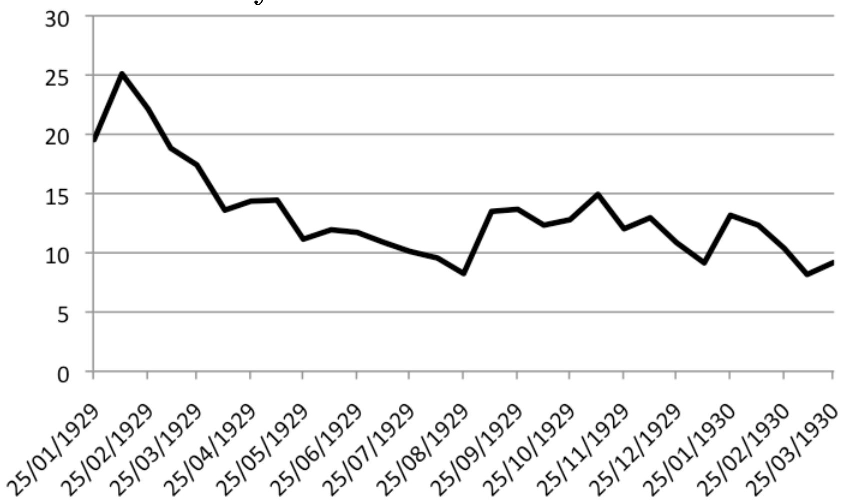
3.3 The volumes traded in the Paris bourse remain stable

A third evidence of the absence of any specific phenomenon in France in 1929 is the stability of the volumes exchanged. The increase of the quantity of stocks traded in NYSE during the crash is a common knowledge. Even in the absence of a violent price movement in France the US crash could have had consequences in the French market through specific movements leading to a rise of the volumes traded.

When researchers in history of finance study the Paris Bourse, a prominent weakness is the lack of data about the volume traded. We tried to solve this issue by collecting two series that we take as proxies for the volumes: the tax on financial transactions and the amount of compensations in between the brokers. However, both series have several limits that we discuss below.

The first one is a tax on financial transactions which is available on bi-monthly basis. The tax levies a fixed rate on the total volume traded at the Paris Bourse for securities listed on the official list, for both the spot and the term markets. Since we only have spot prices, there is an upward bias that is difficult to estimate if we want to link our prices with this volume proxy. We can suppose this bias constant overtime. Moreover, there is a frequency issue because our stock prices are daily and the tax is only available every two weeks. Figure 3 exhibits this series:

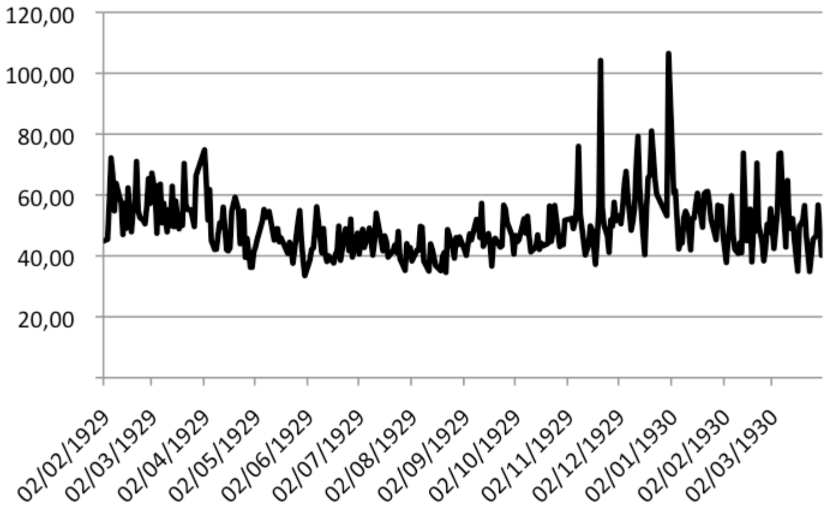
Figure 3: Bi-monthly amount of taxes raised in million Francs



Source: Authors.

Our second proxy for the volume traded is the daily amount of compensations between brokers operating on the official market. Here, the frequency is daily and moreover, it only concerns the spot market. Nevertheless, there is another potential bias, once again very hard to estimate. When a broker executes an order for a client, another broker has to compensate for the amount of the transaction, by an order of his own clients that goes on the opposite way. But if a broker has already two clients giving him opposite orders, he can compensate by himself and then doesn't have to ask a colleague. In this case, the compensation is not reported in the brokers company's balance sheet.[8] This also constitutes a downward bias but we can also suppose it constant over time. Figure 4 illustrates this series:

Figure 4: Daily compensation in million Francs



Notes: Source: Authors.

We can see that the volumes are pretty stable except for the end of the year 1929 where some pics appear in November and December, so few weeks after the crash at the NYSE. This seems to indicate some sort of lagged impact on the Paris Stock Exchange, but it contrasts with our descriptive data on prices.

3.4 Narratives of practitioners

In this subsection, we look in financial newspapers and in the archives of both the minutes of the *Banque de France*, and the *Compagnie des agents de change*. We also looked at some research papers published by French economists at the time. The aim is to check if the story told by the contemporaries fits with our three quantitative evidences previously exposed.

Jean Dessirier (1930), a famous French analyst of the stock exchange, noticed that French asset prices did not follow the downturn of US equity prices. He insists on the French monetary situation, featured by "the maintenance of an easy monetary situation, despite the international tension". He tries to explain that the French stock market hung on because of the nature of French investors comparing to the American ones, much more prone to speculation.

[8]Until 1987, a brokers company called *Compagnie des Agents de Change* had the monopoly on all the transactions at the Paris Bourse, but the institution had to remain accountable by the State.

The French monetary situation of the late 1920's and the early 1930's has been much studied in the literature about the Great Depression and it links with the Gold Standard.[9] This situation is featured by an increasing amount of gold reserves during the period 1927-1932, while the authorities kept the monetary base stable by increasing the cover ratio.We looked at the bi-weekly reports of the board of governors of the *Banque de France* over the period and found some interesting statements. Indeed, Emile Moreau explicitly warns off against the monetary circulation movements in early 1930[10] and especially in terms of gold inflows coming from abroad. In May 1930, he even plans on decreasing the discount rate after the Bank of England decreased its own, in order not to see more gold inflowing. This suggests that the very first goal of the authorities at this time was to keep the prices stable.

We also looked at the bi-monthly minutes of the Compagnie des Agents de Change. The only time they mentioned a bear market is on December the 5^{th}. However, they do not explain the reasons of this downturn. They only focus on the announcement made by the new government that the fiscal surplus will be invested in the economy and therefore that there are no reasons to be pessimistic.

Finally, we went through financial newspapers in order to find some citations that would explain the pics observable on Figure 4, as well as the decrease in the prices depicted on Figure 2 (dashed circle). We can read in *Le temps* of November the 18^{th} that "rumours on failures in Germany did participate, to a certain extent, in the fall of the prices" and that "Before going back to business, the Paris' Bourse is waiting to know the evolution of Wall Street". These quotes suggest that what happens in other financial places seems to influence the behaviour of investors in Paris at that time. However, and more interestingly, the editions of November 21^{st}, 22^{nd}, 26^{th} and 27^{th} all present the same explanation for the slump of late November: a wave of sale orders coming from foreign accounts, 'in particular from Germany and Eastern European countries". However, they point out that those sales are quite well absorbed by French investors, which is confirmed by our data because the prices do not fall very sharply and for a short period. Finally, on December the 3^{st} (the second pic on 4), this day is a "liquidation day" (i.e. the day when every term and option contracts are either reported or concluded), which explains partially the increase in the volume. However, it is also mentioned that the monetary situation is playing a large part in the good behaviour of the stock exchange: "The widecomfort of the monetary situation appears, regarding the stock market,at the same time than the excellent position of the stock exchange".

The study of those historical sources seems to confirm the descriptive analysis of our data. In the next section, we make of comparison of the econometrical findings of the study of the relationship between the returns on the Dow Jones the ones of the CAC 40 in both periods.

[9] We can cite, among others, Hamilton (1987), Bernanke and James (1991), Eichengreen and Temin (1996), Irwin (2012).

[10] See bi-weekly minutes of the *Banque de France* from 1930/01/02; 1930/01/23; 1930/01/30; 1930/02/20; 1930/03/20.

4 The presence of contagion in 2008 but not in 1929

Since we didn't detect any specific movement in the French stock market in 1929, we should reject a contagion from New-York to Paris. Based on the Forbes and Rigobon (2000, 2002) methodology, we adjust correlation coefficients from the heteroscedasticity bias that occurs during crisis periods. Indeed, volatility increases after shocks on stock markets and the two authors show that the usual correlation coefficients are then biased by construction.

Such a methodology has been used in Bordo and Murshid (2000) to test for contagion for several historical international financial crises, including the interwar period. However, they use weekly foreign government bond prices traded at the NYSE for several countries, while we focus on only two countries and use stock prices traded in each country's stock exchange.

For our two series of stock index returns R_{DJ_t} and R_{CAC_t}, the Pearson correlation coefficient is given by:

$$\rho_{R_{DJ_t},R_{CAC_t}} = \frac{\mathrm{Cov}(R_{DJ_t}, R_{CAC_t})}{\sigma_{R_{DJ_t}} \times \sigma_{R_{CAC_t}}}$$

Looking at this equation, we notice that a raise in the volatility of the stock market where the crisis occurred, causes a mechanic raise of ρ because the variance of the returns is going to increase in this market after the shock. Therefore, Forbes and Rigobon (2002) propose to calculate an adjusted correlation coefficient given by:

$$\rho_i^* = \frac{\rho}{\sqrt{1 + \delta[1 - \rho^2]}}$$

with

$$\delta = \frac{V_{RDJ}^c}{V_{RDJ}^t} - 1$$

and c and t respectively represents periods of crisis and tranquility.[11] . δ corresponds to the relative increase in the variance after the shock in the country where the crisis occurs.

In order to test the variation in the adjusted correlation coefficient is significant or not between the two sub-periods, we use a Student test with the hypothesis below:

$$\begin{cases} H_0 : \rho_1^* = \rho_2^* \\ H_1 : \rho_1^* > \rho_2^* \end{cases}$$

with ρ_1^* the adjusted coefficient during the crisis period and in the calm period.

The t-stat is given by:

[11]The crisis period starts in october for 1929 and in septbember 2008 for the recent period.

$$t = (\rho_1^* - \rho_2^*)\sqrt{\frac{n_1 + n_2 - 4}{1 - (\rho_1^* - \rho_2^*)}}$$

Table 3 reports the calculation for the two sub-periods. Clearly, the test rejects

	1929		2008	
	pre-crisis	post-crisis	pre-crisis	post-crisis
ρ	0.0003	0.15	-0.0379	0.1798
$\sigma_{R_{DJ}}$	0.0133	0.0324	0.0131	0.025
$V_{R_{DJ}}$	0.0002	0.001	0.0002	0.0006
δ	4.935		2.642	
ρ_i^*	0.0001	0.0622	-0.0199	0.0953
t-stat	-1.037		-2.68	

Table 3: Adjusted Correlation Coefficients

the null hypothesis in 2008 ($|-2.68|>1.96$) but not in 1929 ($|-1.037|<1.96$). This result confirms our precedent evidences that there was no impact of the NYSE crash at the Paris Stock Exchange. However, this contrasts with the fact that in our VAR (1) specification, the returns of the Dow Jones should have an influence over the Historical CAC 40 in 1929 as will be explained below.

5 French and US markets are much more integrated in 2008 than in 1929

As a general explanation of the difference in the reaction of the French market to the US crashes of 1929 and 2008, we assess the relationship between the two markets in both periods. This measure of the nature of the relationship remain open the question of the fundamental causes. We use VAR/VECM specifications in order to characterize the relationship between R_{CAC_t} and R_{DJ_t}. Such model has been firstly used for lower frequency (i.e. monthly or yearly) macroeconomic time series, starting with Sims (1980). However, studies such as Masih and Masih (1997) use this methodology on daily financial time series to analyse the impact of the 1987 crash on the co-movements among different markets. Chien-Chung Nieh and Cheng-Few Lee (2001) also use it to characterize the relationship between stock prices and exchange rates among the G7 countries at a daily frequency.

In this paper, we apply those models to see if there are differences in the relationship between the returns in both periods.

5.1 The co-movements between American and French stock returns in 2008

The first step is to run a cointegration test in order to find out if there is a common trend in the two series. We run the "trace" test of Johansen (1991). Annexe 2 reports the results of the test and enables us to conclude in favour of a cointegration relationship between R_{CAC_t} and R_{DJ_t}. In other words, one can conclude that there exists a long term relationship between the two returns.

This first result leads us to the existence of a Vector Error Correction Model (VECM) to model the dynamics of the relationship between the indexes. In fact, such a model allows us to look for both the long term relationship, which take into account the cointegration, and the short term relationship between the variables. The results of the estimation are reported in Annexe 3, Table 10. We normalized the French index (LCAC in the table), assuming it is our endogenous variable. The estimated cointegration relationship is given by:[12]

$$LCAC_{t-1} = -2.65 + \underset{(20.87)}{1.18}\, LDJ_{t-1} + z_{t-1}$$

With z_{t-1} the lagged residuals.

Results for the short term relationship are also interesting:

$$R_{CAC_t} = \underset{(-1.06)}{-0.0005} - \underset{(-11.37)}{0.45}\, R_{CAC_{t-1}} + \underset{(24.63)}{0.82}\, R_{DJ_{t-1}} + \underset{(8.01)}{0.35} R_{DJ_{t-2}} - \underset{(-3.10)}{0.04}\, z_{t-1}$$

The error correction term z_{t-1} is negative and significant. But if we reverse the equation and we take LDJ_t as endogenous, the error correction term becomes non-significant (See Table 10). This result means that there is one restoring force towards the long term equation: the two series co-move in the long term and if there is a deviation from the mean, it is $LCAC_t$ that will adjust. LDJ_t is the driving force in this long term relationship. R_{CAC_t} depends significantly on his value lagged once and on the lagged values of R_{DJ_t} . Once again, if we take R_{DJ_t} as the endogenous variable, we can see that it only depends on his own lagged values but that R_{DJ_t} has no influence over R_{DJ_t} in the short term.

Those results are consistent with what we expected: the US market is the leader and the French market follows during that period.

5.2 The co-movements in 1929

We run the same cointegration test on our 1929 sample,[13] leading us to rely on a VectorAutoRegressive (VAR) model as we fail to reject the presence of a long-run relationship. First we test for Ganger causality between R_{CAC_t} and R_{DJ_t} in order to choose the endogenous variable. We ran several tests for each number of lags up to 6. Results are reported in Appendix 3. We can see that for any lag from 1 to 6, the null hypothesis of R_{DJ_t} not causing R_{CAC_t} is rejected, while the opposite is only verified when we take one lag. This suggests we should take R_{CAC_t} as endogenous.

[12] t-stats are reported in parentheses. All results are available in the Appendix 3, Table 10.

[13] Results are reported in Appendix 3, Table 11.

Following Engle and Granger's methodology (1987), we estimate VAR with p lags, chosen as to minimize the information criteria, hence $p = 3$. Finally, we estimate:[14]

$$R_{CAC_t} = a_0 + b_1 R_{CAC_{t-1}} + b_2 R_{CAC_{t-2}} + b_3 R_{CAC_{t-3}} + c_1 R_{DJ_{t-1}} + c_2 R_{DJ_{t-2}} + c_3 R_{DJ_{t-2}} + \varepsilon_t \tag{2}$$

Table 4: Estimation Results of (2)

Variable	Coefficient	Std. Error	t-statistic
a_0	-0.0006	0.0007	-0.85
$\mathbf{b_1}$	$\mathbf{-0.22}$	**0.06**	$\mathbf{-3.87}$
b_2	-0.01	0.06	-0.24
b_3	-0.07	0.06	-1.34
$\mathbf{c_1}$	**0.18**	**0.03**	**5.39**
c_2	-0.007	0.03	-0.21
c_3	0.01	0.03	0.31

As one can note in Table 4, the only significant coefficients are associated with $R_{CAC_{t-1}}$ and $R_{DJ_{t-1}}$. This means that the only useful information helping predicting the returns of R_{CAC_t} is contained in of $R_{CAC_{t-1}}$ and $R_{DJ_{t-1}}$. In this case, we estimate a second VAR(p) with p = 1. The new relationship we estimate is given by:

$$R_{CAC_t} = a_0 + b_1 R_{CAC_{t-1}} + c_1 R_{DJ_{t-1}} + \varepsilon_t \tag{3}$$

Table 5: Estimation Results of (3)

Variable	Coefficient	Std. Error	t-statistic
a_0	-0.005	0.007	-0.76
b_1	$\mathbf{-0.25}$	**0.05**	$\mathbf{-4.82}$
c_1	**0.18**	**0.03**	**5.82**

Nonetheless, for p = 1, the results of the Granger causality test show that there are feedback effects, meaning that we can use both variables as endogenous. The estimation output of the VAR(1) (reported in Annexe 2) gives us the same estimation with R_{DJ_t} as the endogenous variable:

$$R_{DJ_t} = a_0 + b_1 R_{CAC_{t-1}} + c_1 R_{DJ_{t-1}} + \varepsilon_t \tag{4}$$

For both equations, the coefficients of the lagged values of the indexes are significant at the 10% confidence level. Consequently, it is hard to determine which market leads the other, compared to 2008.

However, we observed in this section that the two markets seem to be much less integrated in 1929 compared to 2008. This is interesting in the sense that the

[14]The complete estimation output is reported in Appendix 3.

Table 6: Estimation Results of (4)

Variable	Coefficient	Std. Error	t-statistic
a_0	-0.0004	0.001	-0.35
b_1	$\mathbf{-0.26}$	**0.09**	$\mathbf{-2.72}$
c_1	**0.11**	**0.57**	**1.86**

indexes we studied do not have cross-listed securities, so the presence of contagion in 2008 in addition with the cointegration relationship between the indexes on the same period is consistent with the presence of herd behaviour between investors all over the planet. It seems like it was very different in 1929.

6 Conclusion

This study provides three findings. First, we show that 1929 and 2008 crisis are different in one crucial point which is the international propagation of the US crash. Despite freedom of capital flows and the traditional relations between France and US, there is no crash or event specific movement at the Paris bourse in 1929. Financial globalization does not imply to support international propagation of stock market crisis as recently observed. Second, the French market exhibited a lower volatility at this time even before the crash. Third, this absence of any contagion of the US crash in 1929 confirms that other channels than stock markets explain the spread of the Great Depression from the US to the rest of the world. This absence of contagion of the US crash in 1929 is consistent with the weak relationship between the two markets we observe at this time.

The independence of the two stock markets at the end of the 1920s calls for the search of fundamental explanations. Several explanations can be listed. The stability of the French stock market in 1929 could be the result of the monetary situation. After the excessive devaluation of the Franc in 1928, France accumulated gold thanks to commercial surplus. These important gold reserves in France could motivate investors to remain invested in French stocks. In addition, we can highlight an important difference between France and the U.S. in terms of money markets. In fact, U.S. companies refinanced themselves with short term credit on the money market via commercial paper. There is no such market in France, but a national "discount system"[15] which might have isolated French companies from international fluctuations on the money market.

It could also be the effect of the nature of the components of the French stock market. Trade openness in advanced economies –defined as the sum of exports and imports scaled by GDP– was twice higher in 2009 than in 1929 (i.e. 80% vs. 40%), to take just one metric (Melh, 2013).

Finally, the difference between the financial market integration in both periods em-

[15] See on this point: Baubeau P. (2004), "Les 'Cathédrales de papier'ou la foi dans le crédit. Naissance et subversion du système de l'escompte en France, fin XVIII, premier XXe siècle," PhD dissertation, Université Paris Ouest Nanterre-la Défense

phasized in the paper could be completed by an analysis in terms of interest rate parity.

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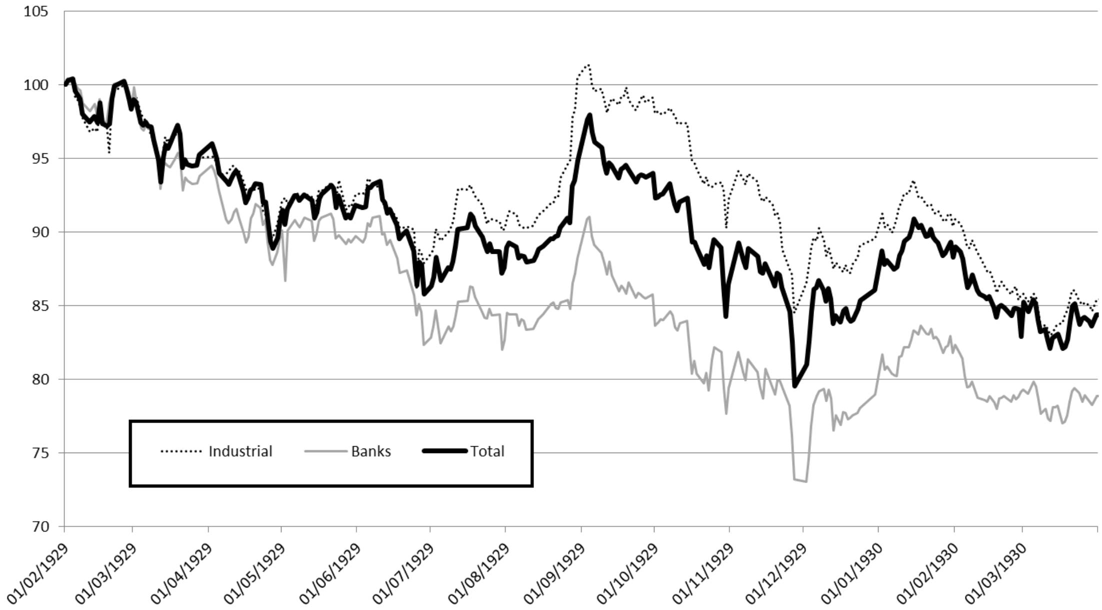
Appendix 1

Table 7: Index Composition

Security	Share in the index	Number of shares	Price on January 4^{th} 1929	Market capitalization
Canal maritime de Suez	17,87%	446 796	24 600	10 991 181 600
Banque de France	6,97%	182 500	23 500	4 288 750 000
Saint Gobain	5,44%	410 000	8 160	3 345 600 000
Crédit Foncier de France	4,88%	600 000	5 000	3 000 000 000
Brasseries Argentine Quilmès	3,53%	240 000	9 040	2 169 600 000
Mines de Lens SC	3,37%	2 050 000	1 010	2 070 500 000
Banque de Paris et des Pays-Bas	3,34%	400 000	5 140	2 056 000 000
Crédit Lyonnais	3,32%	500 000	4 090	2 045 000 000
Banque de l'Indo-Chine	3,24%	144 000	13 850	1 994 400 000
Société Générale	3,06%	1 000 000	1 880	1 880 000 000
Produits chimiques d'Alais et Camargue	2,71%	400 000	4 170	1 668 000 000
Mines de Courrières	2,48%	1 080 000	1 411	1 523 880 000
Nord (Chemins de fer)	1,96%	525 000	2 300	1 207 500 000
Mines de Marles	1,96%	1 040 000	1 160	1 206 400 000
Comptoir Nationale d'Escompte	1,91%	500 000	2 355	1 177 500 000
Paris Lyon Méditérannée	1,90%	800 000	1 460	1 168 000 000
Mines d'Anzin	1,77%	400 600	2 725	1 091 635 000
Etb Kuhlmann	1,63%	720 000	1 395	1 004 400 000
Banque de l'Union Parisienne	1,56%	300 000	3 190	957 000 000
Banque de l'Algérie	1,47%	50 000	18 050	902 500 000
Raffinerie Say	1,46%	368 156	2 440	898 300 640
Mines d'Aniche	1,41%	320 000	2 715	868 800 000
Sarre et Moselle	1,41%	400 000	2 170	868 000 000
Houilles de Blanzy	1,40%	600 000	1 435	861 000 000
Banque Nationale de Crédit	1,39%	500 000	1 705	852 500 000
Cie Parisienne de distribution d'électricité	1,39%	400 000	2 130	852 000 000
Sté Lyonnaise des Eaux et d'Eclairage AJ	1,38%	250 000	3 390	847 500 000
Mines de Vicoigne et Noeux SC	1,35%	600 000	1 380	828 000 000
Charbonnages du Tonkin	1,33%	64 000	12 800	819 200 000
Union d'électricité	1,31%	800 000	1 008	806 400 000
Air Liquide	1,30%	600 000	1 335	801 000 000
Penarroya	1,28%	585 000	1 345	786 825 000
Orléans (Chemins de fer)	1,22%	600 000	1 255	753 000 000
Cie de Béthune	1,19%	85 000	8 600	731 000 000
Forges et Aciéries du Nord et de l'Est	1,18%	440 000	1 655	728 200 000
Citroën	1,14%	400 000	1 760	704 000 000
Mines de Dourges SC	1,14%	285 000	2 460	701 100 000
Est-Lumière	1,13%	675 000	1 026	692 550 000
Ouest Parisien	1,12%	840 000	820	688 800 000
Est (Chemins de fer)	1,10%	584 000	1 160	677 440 000
Total	100%			61 513 462 24

Notes: In francs. Source: Authors.

Figure 5: Sub-indices in 1929



Notes: base 1929M02=100. Source: calculation from authors

Table 8: Sub-Indices (Industrial, Banks) vs. Total (HCAC 40) index

	Mean	**Variance**
Variable	t-test	F-test
Industrial	-0.149	1.364
	(0.88)	(0.007)
Banks	0.260	1.219
	(0.79)	(0.08)

Notes: Tests were applied on stationary data. ^{a} denotes rejection of the null of equality in mean (or variance). p -values are reported in parentheses.

Appendix 2

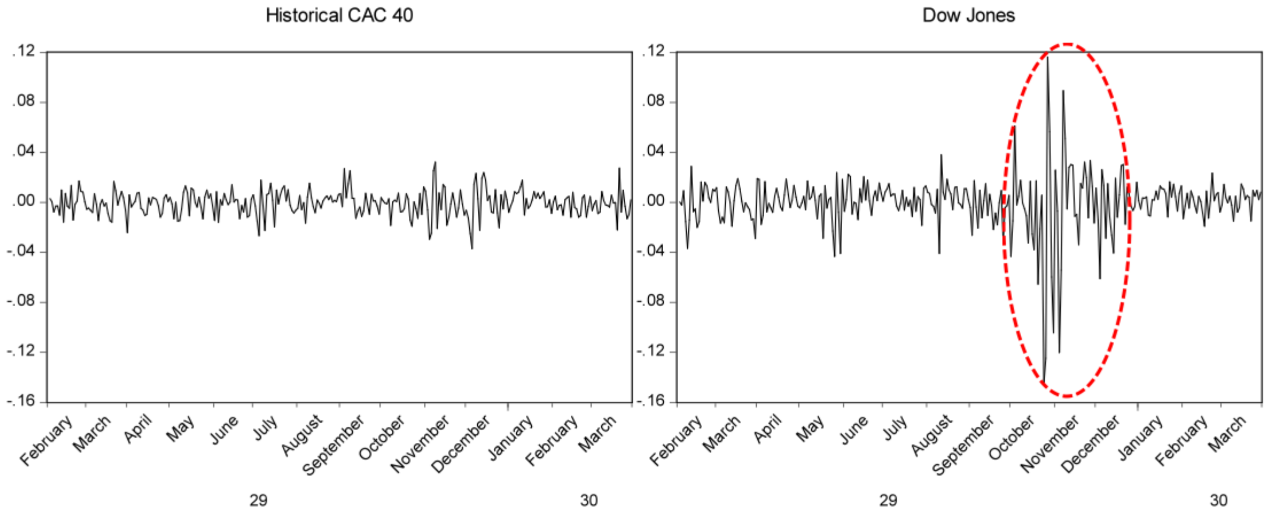


Figure 6: Stock returns volatility in 1929

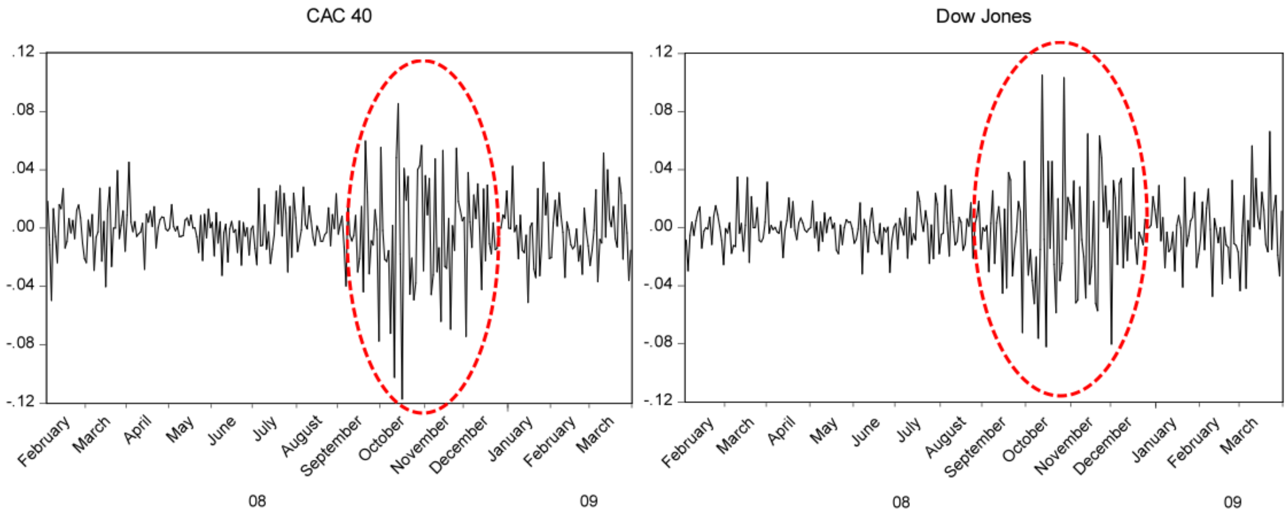


Figure 7: Stock returns volatility in 2008

Appendix 3

• <u>The Great Recession</u>

Both series in levels seem to have a downward trend. Regarding the unit root tests, there are both I(1), we can then suppose there is a constant term in the error correction model.

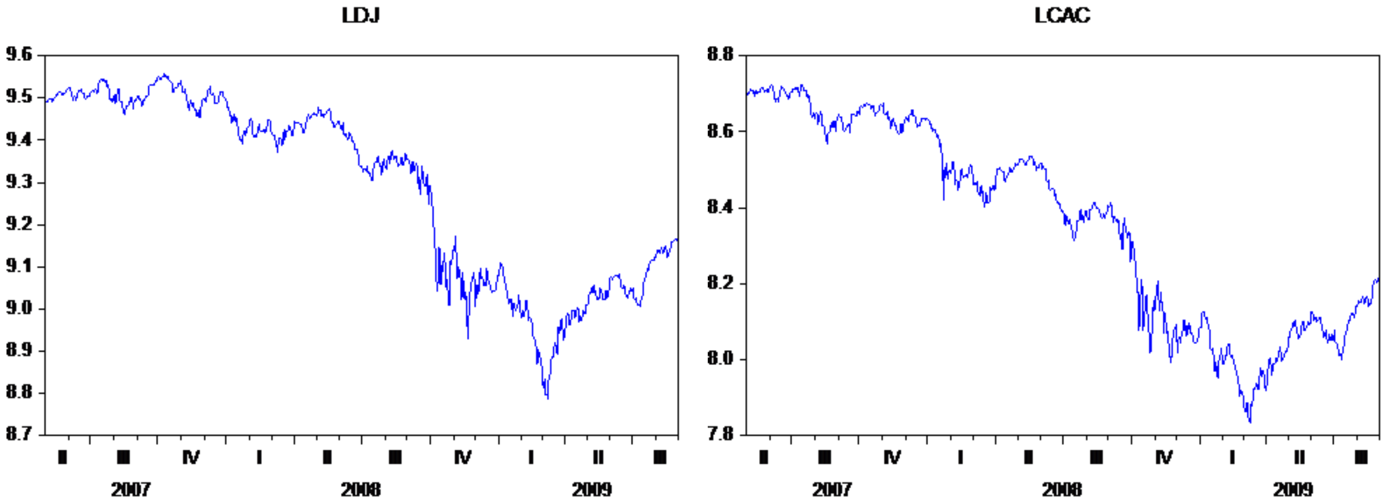


Figure 8: The co-movements between American and French stock returns in 2008

Table 9: Trace test results

Hypothesized Number of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	p-value
None	0.032	**20.738**	**15.494**	0.007
At most one	0.001	**1.077**	**3.841**	0.299

Sample: 5/04/2007 - 8/31/2009

$20.7 > 15.5 \rightarrow$ We reject the null hypothesis of no cointegration relationship.
$1.07 < 3.8 \rightarrow$ We accept the null hypothesis that there is at most one long-run relationship between the two variables.

Table 10: Vector Error Correction Estimates

Cointegrating Equation	z_{t-1}	
$LCAC_{t-1}$	1	
LDJ_{t-1}	-1.185	
	(0.056)	
Intercept	2.649	
Error Correction	$\Delta LCAC$	ΔLDJ
z_{t-1}	-0.041	0.004
	(0.013)	(0.018)
$\Delta LCAC_{t-1}$	-0.456	-0.044
	(0.040)	(0.055)
$\Delta LCAC_{t-2}$	-0.030	-0.025
	(0.027)	(0.038)
ΔLDJ_{t-1}	0.827	-0.159
	(0.033)	(0.046)
ΔLDJ_{t-2}	0.355	-0.092
	(0.044)	(0.061)
Intercept	-0.0005	-0.0007
	(0.0005)	(0.0007)
Sample 5/7/2007 - 8/31/2009 (606 observations)		
R-squared	0.58	0.04
F-stat	170.60	5.11
AIC	-5.77	-5.13

Notes: standard errors are reported in brackets.

- The Great Depression

Table 11: Trace test results

Hypothesized Number of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	p-value
None	0.015	**7.169**	**15.497**	0.558
At most one	0.008	2.541	3.841	0.111

Sample: 2/05/1929 - 3/31/1930

27.17 < 15.5 → We accept the null hypothesis at the 5% confidence level, thus there is no cointegration.

Table 12: Pairwise Granger causality test

Number of lags	$p = 1$	$p = 2$	$p = 3$	$p = 4$	$p = 5$	$p = 6$
$R_{DJ} \to R_{CAC}$	< 0.01	0.481	0.264	0.377	0.374	0.451
$R_{CAC} \to R_{DJ}$	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Notes: the probabilities of incorrectly rejecting the null of no causality are reported above.

Table 13: VAR(3) Estimates

	ΔLDJ	$\Delta LHCAC$
ΔLDJ_{t-1}	0.215	0.184
	(0.056)	(0.034)
ΔLDJ_{t-2}	-0.352	-0.007
	(0.056)	(0.034)
ΔLDJ_{t-3}	0.265	0.011
	(0.058)	(0.035)
$\Delta LHCAC_{t-1}$	-0.131	-0.227
	(0.097)	(0.058)
$\Delta LHCAC_{t-2}$	-0.129	-0.014
	(0.099)	(0.059)
$\Delta LHCAC_{t-3}$	0.071	-0.074
	(0.092)	(0.055)
Intercept	-0.0004	-0.0006
	(0.0001)	(0.0007)
Sample 2/07/1929 - 3/31/1930 (298 obs.)		
R-squared	0.19	0.14
F-stat	12.11	8.21
AIC	-4.83	-5.84

Notes: standard errors are reported in brackets.

Table 14: VAR(1) Estimates

	ΔLDJ	$\Delta LHCAC$
ΔLDJ_{t-1}	0.106	0.184
	(0.057)	(0.032)
$\Delta LHCAC_{t-1}$	-0.259	–0.255
	(0.095)	(0.052)
Intercept	-0.0004	-0.0005
	(0.001)	(0.0007)
Sample 2/05/1929 - 3/31/1930 (300 obs.)		
R-squared	0.03	0.15
F-stat	5.04	26.48
AIC	-4.67	-5.82

Notes: standard errors are reported in brackets.