

Short selling ban impact – a comparison of the French and the Dutch markets

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Abstract

During the Covid-crisis in 2020, French Regulators, with the aim of both limiting any form of procyclicality which could amplify the unidirectional nature of the market and maintaining investors' confidence, decided to ban increased net short positions on all equities admitted to trading on the platforms that they regulated. On the contrary, Dutch regulators, considering that it did not observe any market failure that required supervisory intervention, decided not to ban the practice of short selling.

These two markets share similar features, among which the same market operator (Euronext), with the same rules and fee structure, which makes it possible to have an appropriate counterfactual scenario to assess the effects of this measure. The AFM and AMF thus decided to conduct a joint study on the impact of the short selling ban through a comparison of the Dutch and French markets. This study resulted in the following conclusions.

Following the Marsh and Payne (2012) approach, we find that volatility decreased during the banned period for French stocks whereas we find no significant increase in returns. However, given the lack of explanatory power of the model for this variable and the conjunction of different national and supranational measures taken at that time, it remains difficult to drive strong conclusions from the results. In line with the decrease of volatility, trading volumes fell significantly due to the decrease in the number of trades rather than the size of the transactions executed. This came with a symmetric reduction of the aggressiveness both on the bid and on the offer side.

The effect of the ban on liquidity conditions is also mixed: whereas we did not observe a greater deterioration of prices at the best limits for French stocks during the ban compared to their pre ban level, trading costs increased significantly beyond these best limits due to the decrease of order book depth. This means that general liquidity conditions were poor at this time. Interestingly, the decrease in depth occurred on both sides of the market, suggesting that the withdrawal of short sellers was symmetric and in line with their usual risk-neutral position. A sectoral analysis shows that these effects were essentially most prevalent in sectors most affected by the crisis. For less affected sectors, impact on returns remained unchanged and the impact on volatility was mixed: either higher or lower depending on the sector. In any case, French stocks did not experience a decrease in their order book depth during the ban as prices paid remained unchanged or decreased compared to Dutch stocks.

Additionally, analyzing data from daily net short position (NSP) reporting, we find that the total short value decreased in both France and the Netherlands although there was no obligation to unwind positions during the ban. Furthermore, the short value on both markets is very concentrated: The observed decrease is driven by the five position holders with the largest short positions and occurred homogeneously across sectors. Finally, we did not find any evidence of a displacement effect (the positions holders shifting their positions) from the banned to the non-banned jurisdiction.

Introduction

During the recent COVID-19 pandemic crisis, stock markets around the world experienced both an extreme increase in volatility and an unprecedented drop in stock prices. The leading European stock market indices posted record declines ranging, depending on the jurisdiction, from -20% to -40% between 2 March and 15 March 2020. During this period there was a lot of pressure on regulators to intervene in the market to ‘stop speculation’ and even to close markets in their entirety. With the aim of both limiting any form of procyclicality which could amplify the unidirectional nature of the market and maintaining investors’ confidence, several regulators decided to ban short selling¹, based on the EU Regulation on short selling (SSR). Accordingly, regulators in France, Italy, Austria, Belgium, Greece and Spain banned increased net short positions² on all equities admitted to trading on the platforms that they regulated (provided that the most liquid market was located in the country in question).³ The remaining European regulators decided not to ban the practice of short selling. Among these regulators, the AFM considered that it did not observe any market failure that required supervisory intervention. Despite different dates of entry into force, the countries with a short selling ban arranged an orderly exit from the ban on 19 May 2020. Although ESMA considered that the measures taken by the national authorities in question were ‘appropriate and proportionate’, there proved not to be consensus about an European-wide ban.⁴

To provide regulators with more information for the monitoring of net short positions, the initial reporting threshold for net short positions (NSPs) in Europe was temporary lowered in Europe from 0.2% to 0.1%.⁵

The practice of short selling makes it possible to generate a profit from falling prices by selling borrowed equities, and repurchasing them at a later moment for a lower price to return the borrow. This practice therefore speculates on a fall in prices. While it is unanimously accepted that short selling contributes to the orderly functioning of markets by providing liquidity, periods of stress, notably in a very bearish market, always bring forward debate about the possible (negative) catalyst effect of the practice.

Numerous voices opposed the implementation of this measure pointing to the academic research carried out on previous enacted bans (particularly following the 2008 crisis or during the European sovereign debt crises). This research concludes that there is a significant deterioration of liquidity and an increase in price inefficiency for the securities concerned.

Among the published work, Beber and Pagano (2013), who analyze daily data on 16,491 shares in 30 countries between January 2008 and June 2009, argue that imposing bans or regulatory constraints is detrimental for market liquidity particularly for small stocks with high volatility. Boehmer *et al.* (2013) examine the U.S. Securities and Exchange Commission’s decision to temporarily ban short sales on financial stocks in September 2008. They find that shorting activity drops by an average of 77% in affected large-cap stocks. Moreover, small-cap stocks were largely unaffected, but large-cap stocks subject to the ban suffered a severe degradation in market quality, as measured by quoted and effective spreads, price impacts, and realized spreads.

Another study by Marsh and Payne (2012) shows that in the UK markets, the result of the short selling ban on financial stocks reduced liquidity and efficiency as well as damaged the price discovery process and exacerbated the problems in UK financial stocks rather than stabilizing them.

¹ As provided for in Regulation (EU) No. 236/2012 of the European Parliament and of the Council of 14 March 2012 (SSR).

² These bans were mostly announced between 13th and 17th March 2020 and were extended several times over longer periods of time.

³ The ban also restricted the possibility of conducting transactions in certain derivatives included in the SSR when the underlying financial instruments were banned. This included certain index when the weight of the shares covered by the ban represented more than 50% of the basket of shares underlying the index.

⁴ Article 26 SSR.

⁵ The SSR provides that any individual or legal entity holding a net short position equal to or greater than 0.2% of the capital of a company whose shares are admitted to trading on a European market, provided that the main market for the equity in question is located in Europe, shall disclose this position to the competent authority within one trading day. The temporary lower net short position reporting threshold expired on 19th March 2021.

More recent studies have begun to analyse the impact of the bans on short selling for European stocks in March 2020. Siciliano and Ventoruzzo (2020) analyzed their impact on fourteen selected EU27 countries and the UK. Their results suggest that during the crisis, banned stocks had higher information asymmetry, lower liquidity, and lower abnormal returns compared with non-banned stocks.

Taking the same approach, ESMA (2021) finds that short selling bans are associated with a liquidity deterioration, measured by both significantly higher bid-ask spreads (+7.5% of bid-ask spreads for stocks in banned jurisdictions during the restriction compared to the control group) and Amihud illiquidity values (between +2.2% to 4.8%). However, the analysis of ESMA highlights that shares in banned countries exhibited a lower degree of volatility during the ban period and did not identify any statistically significant correlation with abnormal returns. This suggests that the bans did not harm nor sustain market prices over the enactment period.

Regarding previous literature it should be noted that, contrary to previous bans (e.g. in 2011 for stocks in the financial sector), this 2020 ban is unique: it did not target a sector or a restricted number of stocks, but the entire equity market. The fact that other jurisdictions with similar markets did not decide to apply the ban makes it possible to have an appropriate counterfactual scenario to assess the effects of this measure. This is what we are aiming to achieve through this analysis, comparing the Dutch and the French markets.

Although the French market is much larger than the Dutch market, both markets share similar features. One of these features is that they share the same market operator: Euronext. This means that both markets have both the same rules and fee structure.

Finally, whereas most of recent studies rely on commercial data that are, at best, available on daily basis, our analysis is based on data only available to the Autorité des Marchés Financiers (AMF) and the Autoriteit Financiële Markten (AFM). This data consists of intraday trades and quotes. This exclusive data allows us to exploit the full limit order book information.

This paper is divided into three parts. First, the paper looks at the evolution of the total short positions in both the Netherlands and France. Second, the paper investigates the impact of the ban in France on the French market quality using a set of known metrics. Third, the paper takes a closer look at the sectoral differences.

1 Descriptive analysis of short positions

The data we used consists of both public NSPs (NSPs above the 0.5% disclosure threshold) and non-public NSPs (NSPs in the threshold 0.1-0.49%). These positions are disclosed daily by position holders to the AMF and AFM. In order to have the more accurate picture of NSPs, we considered the period where the notification threshold for disclosing net short positions was temporarily lowered from 0.2% to 0.1% ranging from the 16th of March 2020 to the 12th of June 2020. The sample of positions used for the analysis contained 233 French and 73 Dutch companies. 285 different position holders are present in the data from the French market, and 214 from the Dutch market.

Figure 1 - Total net short value in France and the Netherlands

Figure 1A shows the total net short value in both France and the Netherlands. The left y-axis displays the daily total net-short value for each country, which is computed by aggregating the value of all the individual outstanding NSPs (with a threshold of 0.1%) in the respective national markets. The value of a given position is calculated by multiplying the shorted fraction of the outstanding float with the end-of-day market cap of the company. The right y-axis shows the normalized national index as compared to first day in the series (i.e. index day n/ index day one). Since we calculate value using the end-of-day market cap of the shorted company, the total net-short value of the French market can increase during the ban because of increasing stock prices. Later figures control for these fluctuations by using a constant market-cap for each company. The figure does not consider the total size of the Dutch and French markets.

Figure 1B shows the normalized total net short position value for both countries. The y-axis displays the normalized total net-short value as compared to the first value in the series (i.e. value day N/ value Day 1). The value of each position is calculated by multiplying the fraction of the company's float that is shorted by the average market cap of the company over the whole period. This is to ensure that any fluctuations in the graph are because of the changes in the underlying positions as opposed to changes in the stock price.

Figure 1A – Total net short value

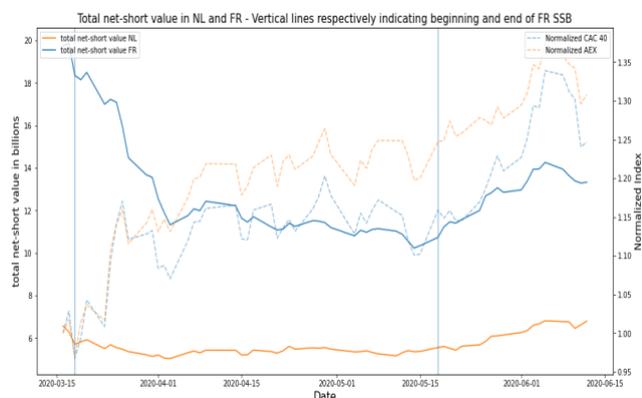
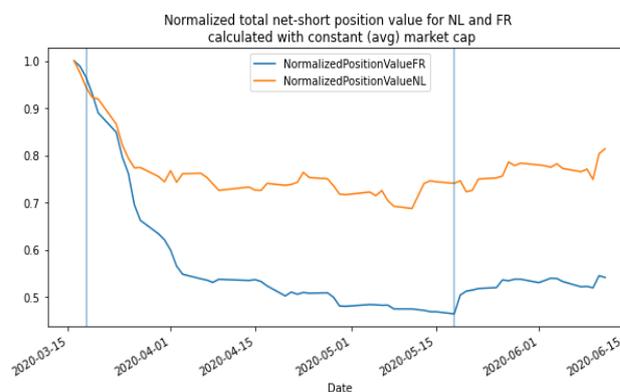


Figure 1B-Normalized total net short value



Although there was no obligation to unwind short positions during the ban on short selling in France, we see a big reduction of total net short value in France (from 18.3 billion euro at the start, to 10.7 billion euro at the end of the ban) compared to the Netherlands (from 5.7 billion euro to 5.5 billion euro). End of March 2020, the total market capitalization was equal to 3,300 billion euro on the French market and 850 billion euro on the Dutch market. This equals to approximately 0.76% of the Dutch, 0.59% of the French market.

Figure 2 – Individual NSP in France and the Netherlands

Figure 2A shows the distribution of individual NSP sizes in both France and the Netherlands at the beginning, the middle, the end of the ban and the end of sample period. The y-axis displays the NSP value in millions at the given percentile. The figure shows the position value at the specified percentile (e.g. a position at the 99th percentile on 2020-03-16 in the Netherlands has a value of 184 million).

Figure 2A shows that NSPs disclosed in both the French and Dutch markets have a heavy tail, meaning that the largest NSPs deviate far from the median. To illustrate: the 50th percentile (i.e. the median NSP at that moment) on 16 March is 4.8 million euros in France and 4.5 million euros in the Netherlands. The 99th percentile, however, contains NSPs of 282 million and 181 million in France and the Netherlands respectively.

Figure 2B shows the net short value held by a percentile group of position holders. Compared to figure 2A, which displays the percentiles in terms of the underlying NSPs, figure 2B displays the distribution in terms of position holders by their accumulated NSPs in the market on the given data. The y-axis displays the percentage of the total net-short exposure in France and the Netherlands of the given group of position-holders. The x-axis shows the percentile bin/group. The position-holders are grouped by percentile, groups of 5%. This means that there are 20 groups. The top group (i.e., 95% percentile) contains the biggest position-holders in terms of total exposure value, and the bottom group the lowest.

Figure 2A - Distribution of individual NSPs

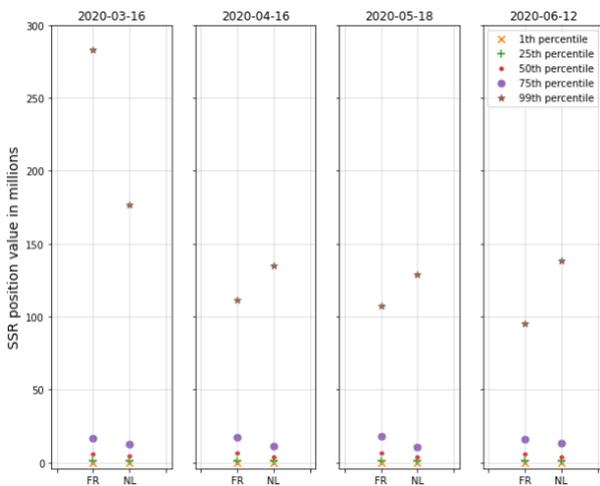


Figure 2B - Total net short exposure value (NL+FR) distribution by percentile group of position holders

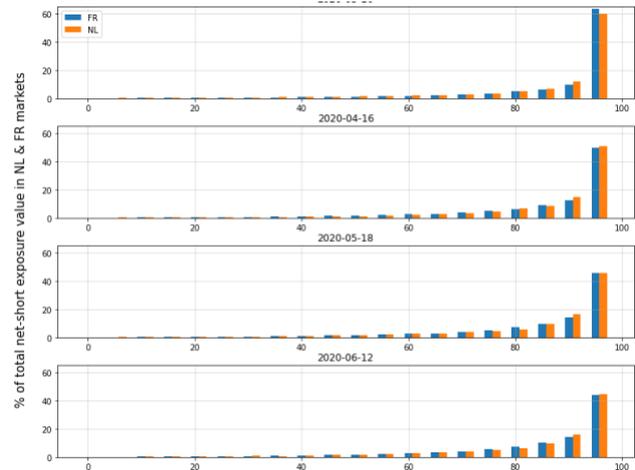


Figure 2A and 2B show that from the beginning to the middle of the ban most of the total net short value was held by the top 5% position holders. Over time during the ban, however, this concentration decreased. This indicates that these top position holders decreased their NSPs (which is shown in figure 2B). Furthermore, it is noteworthy that the distributions of the different countries are similar.

Figure 3 – Sectoral distribution of Top 20 position holders in France and in the Netherlands

For the figures on the left the y-axis display the total net-short value of the twenty largest position holders in millions, segmented by industry. This top twenty was selected by looking at the total net-short value (French and Dutch markets together) of each position-holder at the beginning of the ban. The underlying position-holders are thus held constant for figure. The figures on the right display the relative total position size per sector over time by showing it as a percentage of the total on the y-axis.

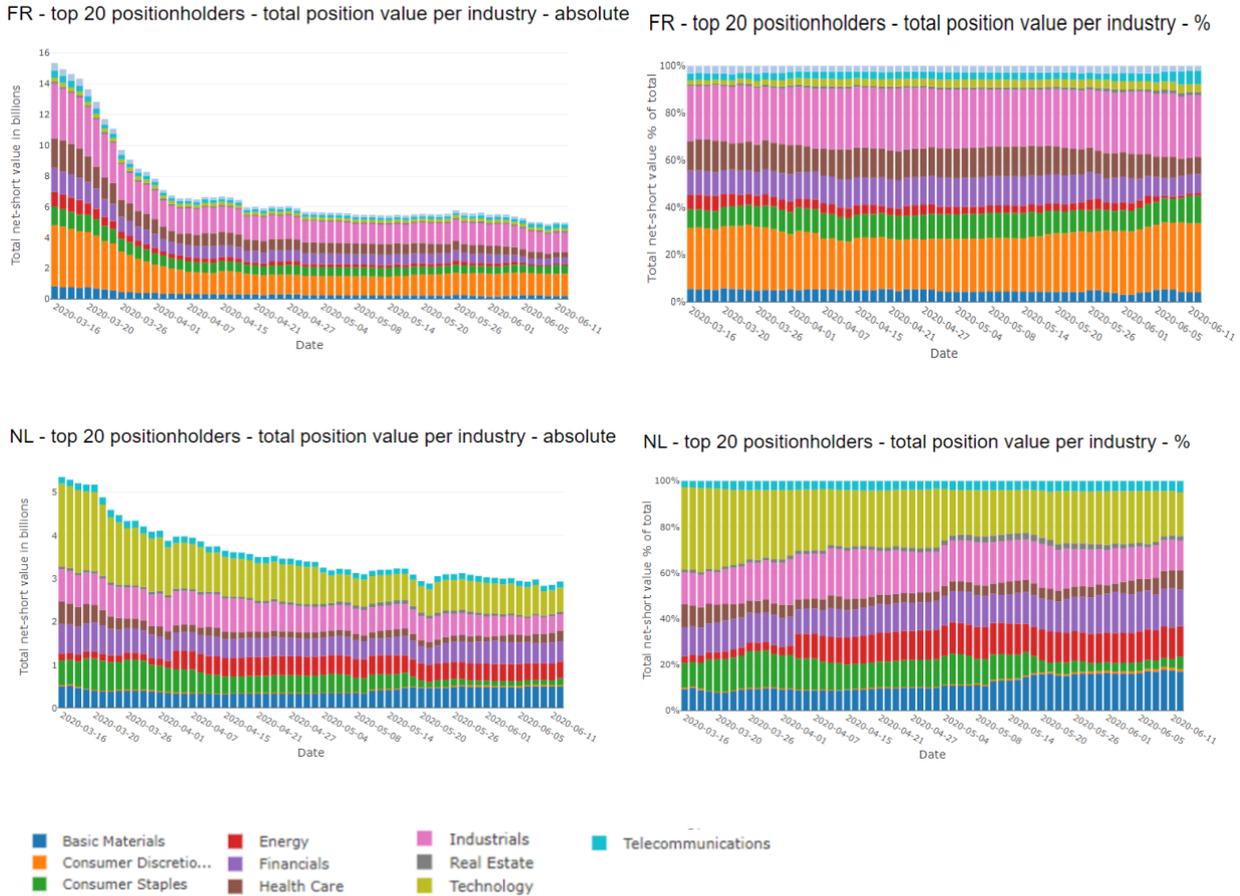


Figure 2A and 2B demonstrate that most of the short value in the market is attributed to a handful of position holders. In figures 3, we have plotted the total short position value for the top 20 position holders in both France and the Netherlands. We have made a sectorial division to illustrate the way short positions are reduced. The twenty position holders equal approximately 7.5% of the total number of position holders and 78% of the total value on the French market, and 9.5% of the total number of position holders and 82% of the total value on the Dutch market.

We can see that, on the French market, the most shorted sectors are ‘Consumer discretionary’, ‘Industrials’ and ‘Financials’ which are among the most affected sectors during this crisis (see section 3). On the contrary, in the Netherlands short sellers have heavily targeted ‘Technology’ and not ‘Consumer discretionary’ companies. They however also short ‘Industrials’ and ‘Financials’ as in France.

Reduction in NSPs after the ban inception occurred homogeneously across sectors. For the French market, the sectorial ratio for the top 20 position holders approximately stays the same. Although this does not appear to be true for the Dutch market upon first sight, this difference with the French market proved to be caused by both the Dutch market being smaller, and the prevalence of stocks with a very high market cap in these respective sectors.

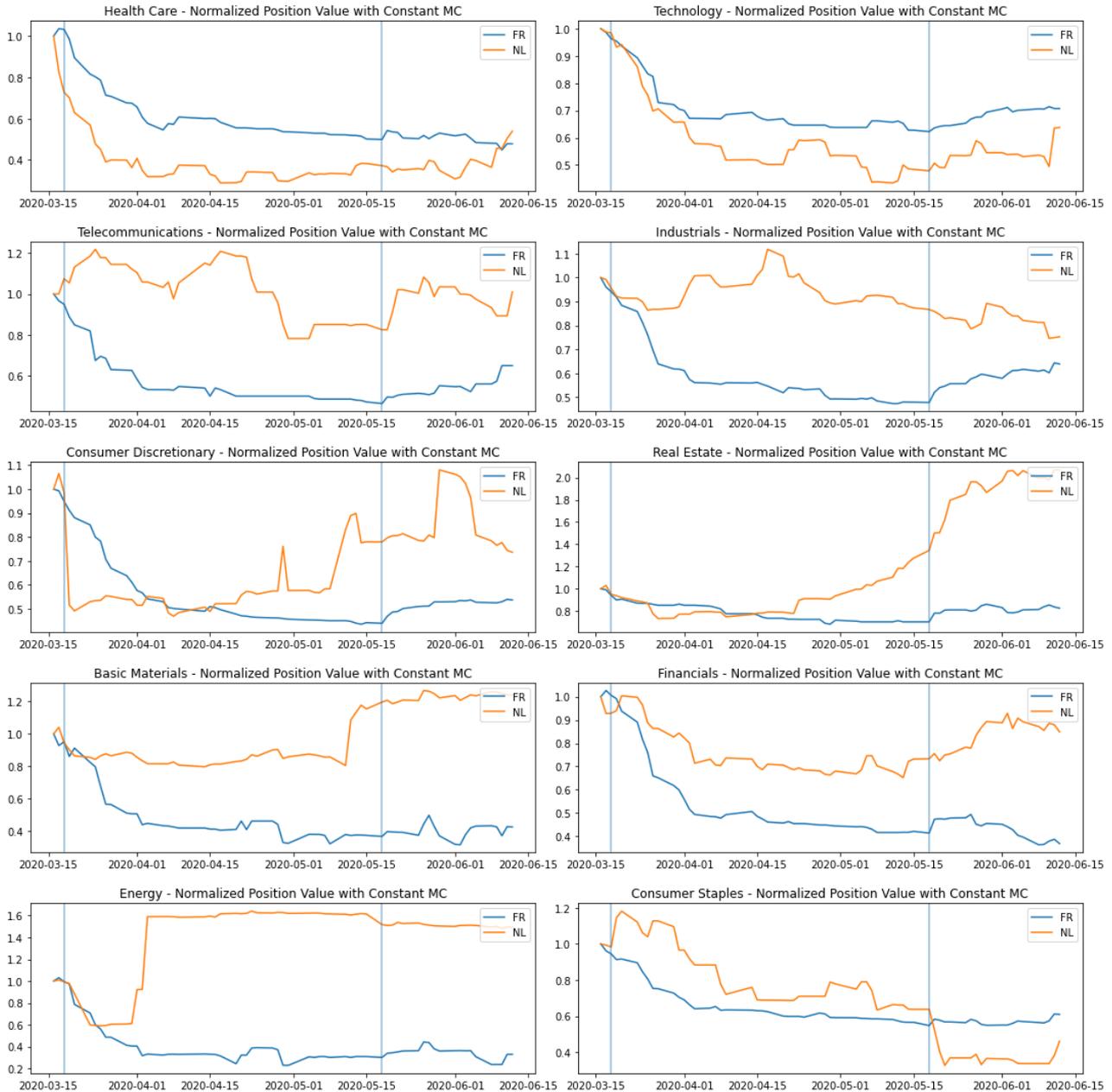
Based on this analysis, we conclude that most of the shorted value in the market can be contributed to a handful of position holders who do not short individual stocks, but rather short entire markets.

To assess whether the ban led to a displacement effect (i.e., the position holders shift their short exposure from the banned to the non-banned jurisdiction), we have made a sectorial division for both the French and the Dutch market and plotted the total net short value in Figure 4.

The only possible evidence for a potential displacement effect is observed in the Energy sector. This however was quickly invalidated after looking at the underlying data: the increase proved to be caused by a singular NSP in Royal Dutch Shell, a stock with a large market cap. Similarly, the fluctuations observed on the 'Consumer discretionary' are driven by one position held on one firm and is linked to the firm's own performances. As we did not see a mirrored action on the French market, we do not find this proof for the existence of a displacement effect. This has been confirmed by individual short seller behavior analysis: we did not find any proof of a short seller cutting its NSP on the French market to open it on the Dutch market. On the contrary, short sellers tend to close their positions on both markets when they decided to do so. Although this could be due to the ban, it could also reflect profit-taking behavior as prices started to recover after 18 March.

Figure 4 – Total net short value evolution by sector in France and the Netherlands

The value of a given position is calculated by multiplying the shorted fraction of the outstanding float with the end-of-day market cap of the company. Figure 4 shows the normalized total net-short value per country based on a constant market cap (average over the entire series for the given company), base100 = 16/03/2020.



2 Impact of the ban on prices and market quality

2.1 Data

Our analysis is based on data, received both by the AMF and by the AFM as regulators, which consists of intraday trades and quotes. This data allows us to consider the full limit order book for stocks traded on the French and the Dutch market spanning from 2 January 2020 to 15 June 2020. We consider all stocks traded on Euronext Amsterdam (123) which were not subject to the ban and CAC All-Tradable stocks (293) traded on Euronext Paris during the sample period which were subject to the ban.

In our analysis, we follow the Marsh and Payne (2012) approach. We consider all trades that occurred on Euronext trading platform for both markets and take snapshots of their order books at one minute intervals to build daily time-weighted averages, when considering orders analysis.

In order to measure short selling ban's impact, we consider various dimensions of market quality:

- *Returns*: daily returns, measured in basis points.
- *Volatility*: rolling standard errors of returns based on the previous five days.
- *Volume*: daily number of shares traded divided by the mean number of shares traded in the first 25 days of the sample.⁶
- *Trades*: daily number of transactions divided by the mean number of transactions over the first 25 days of the sample.
- *Trade Size*: mean number of shares traded per transaction divided by the mean number of shares traded per transaction over the first 25 days of the sample.
- *Aggressiveness*: daily number of shares aggressively bought (sold) divided by the mean number of shares aggressively bought (sold) over the first 25 days of the sample. Aggressive orders are defined as orders that immediately consume liquidity.
- *Quoted Spread*: Bid-ask spread, based on intra-day data and measured in basis points.
- *BSlip*: slippage measure on the buy side of the book (i.e. the cost of consuming liquidity with a market sell order of a given size) where Slippage is defined as the difference, in basis points, between the mid-price and the volume-weighted average price (VWAP) of a trade of given size. Various size levels are examined, ranging from one hundredth of one percent of average daily volume (ADV) to one percent of ADV. ADV data are taken From ESMA transparency data.
- *OSlip*: same slippage measure on the offer side of the book (i.e. the cost of consuming liquidity with a market buy order of a given size).

All penny stocks were excluded from the analysis and we winsorize all data by eliminating the observation consisting of the top 1 percent for all variables.

As shown in the graphical annex, the sample contains four noticeably different sub-periods:

- From 1 January to 14 February for which market conditions are normal. Hence, this period is our reference period against which we will perform our comparative analysis (the benchmark period).
- From 17 February to 16 March, where market conditions are deteriorating significantly. We refer to this period as the pre-ban period.
- From 17 March to 18 May where increase in net short position is prohibited in France (the ban period).⁷

⁶ As in Marsh and Payne (2012), the 25 first days of the sample are used to normalize the measure relative to normal market conditions. Moreover, we consider all-transaction related data in number of shares traded rather than in euro value to avoid the effect of the price level change during the period studied.

⁷ Though the ban was only applied to an initial list of 92 stocks on 17 March, it has rapidly been extended to all stocks admitted to trading on a French trading venue on 18 March. Including or not 17 March in the ban period does not alter the results.

- From 19 May to 15 June when short selling ban is lifted (the post-ban period).

Distinguishing the evolution of the chosen metrics during these four sub periods, and not only opposing the ban period behavior to the rest of the sample, allows us to reflect more accurately the impact of the ban. As stated before, during the pre-ban period, market conditions deteriorated and were key to regulators' decision to ban short selling. Hence, they differ from normal market conditions of the beginning of the period or from the post-ban period when the ban was lifted but where conditions did not necessarily return to 'normal'.

2.2 Methodology

We use a difference-in-difference regression to model the behavior of the various indicators through our sample

$$MQ_{it} = \alpha_t + \beta_1 Banned_{it} + \beta_2 PreSSB_{it} + \beta_3 PreSSB_{it} \times Banned_{it} + \beta_4 SSB_{it} + \beta_5 SSB_{it} \times Banned_{it} + \beta_6 PostSSB_{it} + \beta_7 PostSSB_{it} \times Banned_{it} + \beta_8 X_{it} + \varepsilon_{it}$$

where

MQ_{it} refers to the market quality metric considered – returns, volatility, volumes traded, trades, trade size. Buys, Sells, spread bid ask, slippage.

$Banned_{it}$ is an indicator that equals one for French stocks (group of banned stocks)

$PreSSB_{it}$ is an indicator that equals one before the short selling ban (SSB) is active.

SSB_{it} is an indicator that equals one for when the SSB is active.

$PostSSB_{it}$ is an indicator that equals one after the SSB is lifted.

The coefficients which capture the difference in behavior between the control and the banned stocks during each period are β_3 , β_5 and β_7 respectively. If these coefficients are significantly⁸ different from zero, it reveals a difference in behavior of banned and control group stocks for a particular period. The “benchmark period” is the reference term in our estimation, which means that the coefficients capture the difference observed between the considered period and the benchmark period i.e. the evolution of the metric compared to normal market conditions.

We add variables to the right-hand side to control for other factors that are known to affect market liquidity (X_{it})

- Log market capitalization and price level. The average market capitalization of each stock is calculated over the second half of 2019.
- Ratio which is equal to the proportion of shares short sell on 16/03 (when required daily disclosure of all net short positions in excess of 0,1% of the ordinary share capital of the relevant companies became applicable).⁹
- Volatility measured as the rolling standard deviation of returns based on the previous five trading days, where appropriate.

We run an OLS estimation of the model for each dependent variable with fixed effect and robust standard errors double clustered both firm- and date-level to mitigate potential serial correlation and cross-correlation concerns.

In the regression we matched each French stock subject to the ban with its most similar Dutch stock according to market capitalization, industry sector and liquidity status. More specifically, we considered the average market capitalization of each stock over the second half of 2019, the industry sector as defined by Euronext and the liquidity status using the liquidity assessment from ESMA transparency calculations. We use Coarsened

⁸ Throughout this document, the term “significant” refers to the concept of statistical significance, i.e. when the estimated coefficient is significant at an error level of 5% or less.

⁹ This variable appeared however to have non-significant effects for all regression and is thus not reported in the analysis.

Exact Matching technique to obtain a sample of 192 stocks with equal number of stocks subject to ban and not. Table 1 provides the dataset structure and describes the composition of our two different samples.

Table 1- Descriptive statistics for the matched sample

Number of stocks	Paris		Amsterdam	
	96		96	
Market capitalization	mean	SD	mean	SD
	6.20E+09	1.57E+10	5.53E+09	1.50E+10
Industry	nb	%	nb	%
Basic Materials	6	6.2	6	6.2
Consumer Discretionary	13	13.5	13	13.5
Consumer Staples	7	7.3	7	7.3
Energy	5	5.2	5	5.2
Financials	14	14.6	14	14.6
Health Care	6	6.2	6	6.2
Industrials	21	21.9	21	21.9
Real Estate	9	9.4	9	9.4
Technology	11	11.5	11	11.5
Telecommunications	4	4.2	4	4.2
Liquidity = true (%)	53	55.2	53	55.2

To consider the potential exclusion from the matched sample analysis of some stocks (that might exhibit different features from Dutch stocks) due to the differences in number of stocks traded on each market, we systematically run two estimations: one considering the entire sample and one narrowing the analysis to the matched sample.¹⁰ Similarly, to exhibit potential different behavior between large capitalization stocks and small ones, we run separate regressions for the 10 stocks that are respectively the biggest and the smallest in each market in terms of market capitalization.

2.3 Results

Table 2 reports the results of our analysis to explain the behavior of equity returns and volatility. The pre-ban period saw a significant deterioration in prices for all stocks during the ban (-160 bp compared to the benchmark period) and returns significantly recovered after the ban came into effect (+184 bp). However, we did not observe any significant difference between banned stocks and the control group neither in the pre-ban period nor during the ban or once it was lifted (though positive and higher, points estimates are not significantly different from zero). Similarly, we did not observe a differentiated behavior between large cap stocks and small cap stocks. The period, however, has been marked by a very large and diversified support from all authorities. For example, the ECB purchase program was announced on 18 March 2020. This makes it difficult to properly assess the marginal impact of the ban on short sales on prices. This is confirmed by the explanatory power of the estimation, which is very low compared to all other estimations.

¹⁰ Results are similar considering the whole sample or the marched one. Hence, we only consider the matched sample in the comments.

Table 2 – Effects of short selling ban on returns and volatility

This table presents the results of estimating the model for returns and volatility. Column (1) displays regression results considering all stocks in the sample (419 stocks). Results for the matched sample (96 stocks) are displayed in Column (2). Column (3) and (4) give the results for the ten stocks that are respectively the biggest and the smallest in terms of market capitalization for the matched sample. Robust standard errors are displayed into parenthesis (**p<0.01, **p<0.05).

	Returns				Volatility			
	All data (1)	Matched sample (2)	Big10 (3)	Small10 (4)	All data (1)	Matched sample (2)	Big10 (3)	Small10 (4)
PreSSB	-164.9116*** (9.9950)	-160.3179*** (10.5058)	-159.0222*** (24.2553)	-108.5550** (50.3817)	115.2005*** (4.5750)	111.7900*** (4.8765)	66.8038*** (9.1350)	151.8098*** (25.3618)
SSB	166.5682*** (9.0396)	184.3470*** (10.9404)	152.1623*** (25.3389)	165.1731*** (44.0213)	122.0734*** (4.5430)	99.9965*** (5.4791)	80.6716*** (11.6434)	183.7888*** (24.6965)
PostSSB	136.1893*** (9.2404)	153.5036*** (10.6568)	140.5834*** (28.8417)	125.4370*** (42.8400)	49.3567*** (4.4918)	33.0184*** (5.2938)	87.5308*** (12.0277)	-3.0073 (21.3778)
PreSSB x Banned	-2.0174 (11.9416)	4.2403 (14.6811)	-14.8347 (40.3397)	-71.7307 (65.0799)	-25.4514*** (5.2853)	-19.4332*** (6.2921)	50.8231*** (14.0504)	48.1733 (31.3731)
SSB x Banned	9.9252 (8.5080)	21.9588 (10.4163)	12.6976 (29.1011)	30.7921 (43.9744)	-23.1759*** (4.5622)	-13.9346** (5.6140)	46.9250*** (14.1905)	-41.9234 (25.3511)
PostSSB x Banned	5.0805 (9.9170)	25.2143 (12.3578)	15.7698 (37.5806)	56.8804 (45.8303)	-10.0780** (4.8539)	0.7810 (5.8408)	-62.2365*** (12.5104)	92.6492*** (24.0045)
Observations	40,057	20,991	2,357	1,878	38,532	20,192	2,281	1,766
Adjusted R ²	0.0978	0.0988	0.0973	0.0819	0.3589	0.3887	0.5588	0.2669

Volatility increased significantly during the pre-ban and the ban period compared to the benchmark period before falling back once the ban was lifted.¹¹ Results indicate that volatility was lower for French stocks in the pre-ban period and that it remained the case during the ban period, though the observed difference was smaller. The difference in volatility between the two groups became non-statistically significant only in the post-ban period. Large caps stocks and small stocks behaved differently: volatility for the Big 10 is significantly larger for banned stocks before and during the ban. However, this differential was reduced between these two periods, suggesting that volatility decreased more for banned stocks during the ban. For small stocks, volatility peaked during the ban and is always in line with the behavior of control stocks before and during the ban.

Returns significantly increase for all stocks during the ban period with no significant difference between French and Dutch stocks. However, the conjunction of different measures taken during the ban period makes it difficult to assess its marginal impact as shown by the very poor explanatory power of the model.

Volatility decreased more for French stocks during the ban, with a more pronounced impact for large market cap stocks.

¹¹ It is worth noting that the new European harmonized tick size regime might have helped limiting volatility for all stocks during the crisis.

Table 3 – Effects of short selling ban on volumes

This table presents the results of estimating the model for daily volumes, average daily number of trades and the average daily trade size. Column (1) displays regression results considering all stocks in the sample (419 stocks). Results for the matched sample (96 stocks) are displayed in Column (2). Column (3) and (4) give the results for the ten stocks that are respectively the biggest and the smallest in terms of market capitalization for the matched sample. Robust standard errors are displayed into parenthesis (**p<0.01, *p<0.05, *p<0.1).

	Volumes				Number of trades				Trade size			
	All data (1)	Matched sample (2)	Big10 (3)	Small10 (4)	All data (1)	Matched sample (2)	Big10 (3)	Small10 (4)	All data (1)	Matched sample (2)	Big10 (3)	Small10 (4)
PreSSB	0.8552*** (0.0387)	0.7717*** (0.0418)	1.0066*** (0.0755)	-0.0808 (0.1776)	0.8384*** (0.0293)	0.7666*** (0.0312)	1.1113*** (0.0761)	0.0104 (0.1087)	0.0134 (0.0128)	0.0196 (0.0141)	-0.0583*** (0.0118)	0.0735 (0.0904)
SSB	0.0663** (0.0321)	-0.1784*** (0.0392)	-0.3590*** (0.0653)	-0.4078** (0.1849)	0.1046*** (0.0230)	-0.0911*** (0.0282)	-0.2210*** (0.0552)	-0.2030* (0.1136)	-0.0255** (0.0109)	-0.0140 (0.0131)	-0.0455*** (0.0122)	-0.0190 (0.0879)
PostSSB	0.3702*** (0.0417)	0.2307*** (0.0475)	0.1618** (0.0943)	-0.0842 (0.1943)	0.3012*** (0.0276)	0.1682*** (0.0310)	0.0634 (0.0670)	0.0483 (0.1174)	0.0050 (0.0126)	0.0235* (0.0141)	-0.0120 (0.0144)	0.0310 (0.0982)
PreSSB x Banned	-0.3126*** (0.0430)	-0.1743*** (0.0523)	-0.4085*** (0.0964)	0.9966*** (0.2268)	-0.2168*** (0.0332)	-0.1193*** (0.0400)	-0.1666 (0.1027)	0.8073*** (0.1511)	-0.0340*** (0.0140)	-0.0295** (0.0170)	-0.0787*** (0.0173)	0.0316 (0.0999)
SSB x Banned	-0.4833*** (0.0324)	-0.3835*** (0.0394)	-0.7038*** (0.0637)	0.8758*** (0.1885)	-0.4063*** (0.0225)	-0.3251*** (0.0273)	-0.4718*** (0.0541)	0.6048*** (0.1189)	-0.0218*** (0.0113)	-0.0296*** (0.0140)	-0.0507*** (0.0139)	0.0655 (0.0863)
PostSSB x Banned	-0.3654*** (0.0450)	-0.3691*** (0.0542)	-0.5404*** (0.1207)	0.1970 (0.2235)	-0.2165*** (0.0298)	-0.1957*** (0.0359)	0.0148 (0.0847)	0.0397 (0.1368)	-0.0809*** (0.0140)	-0.0863*** (0.0176)	-0.1976*** (0.0203)	-0.0253 (0.1074)
Observations	38,629	20,19	2,283	1,794	38,621	20,206	2,278	1,803	38,735	20,266	2,289	1,78
Adjusted R ²	0.3355	0.3568	0.6417	0.2186	0.3642	0.3821	0.5698	0.2685	0.2407	0.2294	0.5787	0.1317

Trading volumes increased dramatically in the pre-ban period (+77% compared to the level seen during the benchmark period) before decreasing beyond their benchmark level during the ban (-18%) and recovering after the lift (+23%). Trading volumes are lower for French stocks over the entire period compared to their Dutch counterparts. However, they were substantially lower during the ban for banned stocks, down by 20% from the benchmark period's level, and 38% lower than volume in control stocks in the same period. This pattern is even more pronounced for large cap stocks, which saw their volumes decrease by 35% from the benchmark level during the ban period. These results are in line with the fact that volatility level for banned stocks was lower than for control stocks and with the known positive relationship between volumes and volatility.

An analysis of the average daily number of number of trades and the average daily trade size show that the evolution of trading volumes was mainly driven by the number of trades which followed the same pattern: jumping by 77% in the pre-ban period and getting back at lower level than what observed in the benchmark level during the ban period. In turn, trade sizes remained at same levels throughout the sample period.

Trading volumes decreased more significantly for French stocks during the ban due to a decrease in the number of transactions rather than in the average size of transaction.

Once again, large cap stocks were more affected than small ones.

Table 4 – Effects of short selling ban on aggressiveness

This table presents the results of estimating the model for shares aggressively bought and sold. Column (1) displays regression results considering all stocks in the sample (419 stocks). Results for the matched sample (96 stocks) are displayed in Column (2). Column (3) and (4) give the results for the ten stocks that are respectively the biggest and the smallest in terms of market capitalization for the matched sample. Robust standard errors are displayed into parenthesis. (***) $p < 0.01$, (**) $p < 0.05$, (*) $p < 0.1$.

	Shares aggressively bought				Shares aggressively sold			
	All data (1)	Matched sample (2)	Big10 (3)	Small10 (4)	All data (1)	Matched sample (2)	Big10 (3)	Small10 (4)
PreSSB	0.7640*** (0.0415)	0.6696*** (0.0448)	0.9154*** (0.0778)	-0.4005** (0.1758)	0.9528*** (0.0406)	0.8778*** (0.0437)	1.1306*** (0.0793)	0.1005 (0.1797)
SSB	0.1766*** (0.0351)	-0.0876** (0.0427)	-0.3649*** (0.0661)	-0.1939 (0.2029)	0.0227 (0.0326)	-0.1969*** (0.0401)	-0.2942*** (0.0682)	-0.5294*** (0.1807)
PostSSB	0.4080*** (0.0438)	0.2359*** (0.0496)	0.2103** (0.1002)	-0.1156 (0.2061)	0.3064*** (0.0412)	0.1922*** (0.0466)	0.2156** (0.0980)	-0.1845 (0.1766)
PreSSB x Banned	-0.3770*** (0.0459)	-0.2492*** (0.0551)	-0.4796*** (0.0962)	0.9574*** (0.2247)	-0.3767*** (0.0451)	-0.2308*** (0.0556)	-0.6596*** (0.0974)	1.2677*** (0.2571)
SSB x Banned	-0.5391*** (0.0355)	-0.4461*** (0.0427)	-0.6477*** (0.0653)	0.6191*** (0.2042)	-0.4635*** (0.0328)	-0.3893*** (0.0404)	-0.7667*** (0.0654)	0.9030*** (0.1935)
PostSSB x Banned	-0.3985*** (0.0472)	-0.3925*** (0.0563)	-0.6177*** (0.1247)	0.3745 (0.2378)	-0.4089*** (0.0446)	-0.4561*** (0.0536)	-0.7098*** (0.1234)	0.1499 (0.2134)
Observations	38,607	20,18	2,285	1,786	38,568	20,144	2,283	1,762
Adjusted R ²	0.2991	0.3216	0.6213	0.1601	0.3267	0.3473	0.6308	0.2464

Table 4 addresses more particularly the issue of the aggressiveness of the order flow. The stated objective of the ban was to decrease the selling pressure on stocks. One way of measuring to what extent the pressure has evolved is to look at the amount of market buy orders relative to market sells. Significant selling pressure on both markets is observed in the pre-ban period compared to the benchmark period driven by a higher proportion of shares sold aggressively (+88% of shares aggressively sold against +66% of shares aggressively bought). These results confirm that both markets were unidirectional and under greater selling pressure at that time.

It appears that aggressive buy and sell orders decreased symmetrically during the ban period. Identically, order aggressiveness decreased on both side of the markets for banned stocks compared to the control group during the ban period: -20 percentage points for both types of orders. We observe no differences between large cap and small cap stocks.

This means that, during the ban, not only the selling pressure decreased but also the aggressiveness on the buy side and that the aggressiveness decreased more for French stocks during the ban than for Dutch stocks.

A significant selling pressure was observed on both markets before the ban inception. During the ban both the selling pressure and the aggressiveness on the buy side decreased. Aggressiveness lowered significantly more on both sides for French stocks during the ban compared to Dutch stocks. Large and small cap stocks exhibit the same pattern.

Turning to the impact on liquidity, Table 5 reports the results of our difference in difference analysis for quoted bid ask-spreads and for our order book slippage measures i.e. the average trading prices of a market buy and a market sell order of a given size, using the full order book information and taking depth into consideration.

Table 5 - Effects of short selling ban on transaction costs

This table presents the results of estimating the model for quoted spread and slippage measures on the bid and the offer side. Results for the matched sample (96 stocks) are displayed in Column (2). Column (3) and (4) give the results for the ten stocks that are respectively the biggest and the smallest in terms of market capitalization for the matched sample. For the slippage results, the percentage figure in the header refers to the size of the order considered as a percentage of the average daily trading volume (ADV). For sake of clarity and given the linear increase in costs with the size of the order considered, only 0.1% and 1% of 1% of the ADV orders are displayed. Robust standard errors are displayed into parenthesis (**p<0.01, *p<0.05, *p<0.01).

	Quoted Spread			Average price of a market sell order						Average price of a market buy order					
	Matched sample (1)	Big 10 (2)	Small 10 (3)	Bslip 0.10%			Bslip 1%			Oslip 0.10%			Oslip 1%		
				Matched sample (1)	Big 10 (2)	Small 10 (3)	Matched sample (1)	Big 10 (2)	Small 10 (3)	Matched sample (1)	Big 10 (2)	Small 10 (3)	Matched sample (1)	Big 10 (2)	Small 10 (3)
PreSSB	9.2134*** (1.3982)	0.4419*** (0.1331)	27.0032** (13.0070)	4.9425*** (0.8915)	0.9714 (1.0694)	29.9347*** (8.540)	9.1856*** (1.2469)	1.5269 (1.0698)	38.7535*** (8.961)	4.5440*** (0.8042)	0.6832 (0.7434)	1.0512 (9.4287)	6.1649*** (1.1538)	1.1844 (0.7439)	4.9662 (9.5468)
SSB	11.3052*** (1.4578)	1.3628*** (0.1452)	29.6114*** (13.3579)	7.3621*** (0.9062)	1.2036** (0.6873)	52.8190*** (8.789)	13.3543*** (1.2093)	2.2406*** (0.6874)	63.9302*** (9.046)	7.7065*** (0.8030)	1.3743*** (0.6010)	29.3110*** (9.8588)	13.0345*** (1.1597)	2.3540*** (0.6052)	33.9103*** (10.0351)
PostSSB	4.2633*** (1.5122)	-0.1368 (0.1359)	6.1888 (13.2735)	1.3286 (0.8481)	2.3102*** (0.7922)	21.6095*** (8.752)	3.1117** (1.2188)	3.3771*** (0.7807)	27.9962*** (8.913)	2.4792*** (0.7602)	2.3639*** (0.7333)	-8.5567 (8.6620)	6.3187*** (1.1760)	3.3470*** (0.7234)	-5.1742 (8.9776)
PreSSB x Banned	6.0960*** (1.9079)	-0.2342 (0.2170)	8.3653 (15.0216)	2.0876* (1.1502)	2.1725* (1.2271)	-12.2413 (9.509)	-1.3035 (1.4855)	1.8372 (1.3264)	-20.6015*** (9.961)	2.6753** (1.0894)	2.6301*** (0.8544)	17.1163** (10.2249)	2.2411 (1.4320)	2.3660*** (1.0143)	14.1806 (10.4574)
SSB x Banned	7.1226*** (1.5704)	2.2576*** (0.2405)	4.1979 (13.1128)	2.6171*** (0.9310)	8.4055*** (0.5807)	-31.5894** (8.594)	3.3647*** (1.2026)	10.6597*** (0.7478)	-41.9069*** (8.877)	2.1939*** (0.8461)	8.7731*** (0.5734)	-10.1366 (9.5060)	3.6694*** (1.1446)	11.4969*** (0.8064)	-15.7843 (9.7324)
PostSSB x Banned	3.3803* (1.8062)	1.0381*** (0.1770)	-0.5313 (14.2747)	1.6213** (0.9630)	1.7426** (0.7867)	-22.0376*** (8.945)	3.8741*** (1.3228)	3.5532*** (0.8825)	-28.5987*** (9.103)	0.5439 (0.8843)	1.8435** (0.7390)	6.4917 (8.7014)	-0.9994 (1.2500)	3.5810*** (0.8589)	0.7542 (9.0497)
Observations	19,956	2,287	1,616	19,305	2,392	1,495	19,305	2,392	1,495	19,257	2,392	1,363	19,257	2,392	1,363
Adjusted R ²	0.7382	0.7533	0.4720	0.6437	0.3936	0.4831	0.6837	0.4977	0.4815	0.6523	0.4684	0.4658	0.6942	0.5591	0.4636

Quoted bid ask spreads in the pre-ban period widened substantially for all stocks by around 9 bp compared to their benchmark level. The spreads remained high during the ban period with an additional increase of 2 bp and fell once the ban was lifted, though without returning to their benchmark level as they were still exhibiting an additional 4 bp charge. We observe that spreads for banned stocks were higher than for the control group through the whole sample period and followed the same pattern, exhibiting a positive 6 bp differential during the pre-ban, which rose to 7bp during the ban and went back to around 3.5 bp after the ban was lifted. However, the increase observed between the pre-ban and the ban period is not statistically significant indicating that displayed prices at the best limits did not deteriorate more for banned stocks during the pre-ban than the ban period¹². Some different patterns are observed depending on the size of the companies: the biggest ten French companies faced significantly higher spreads during the ban period compared to their Dutch counterparts (+2.3 bp), whereas they remained identical for small cap stocks.

Considering the full order book it is clear that the depth decreased significantly during the ban period leading to higher costs ranging from +1.5 bp for large cap stocks to 30 bp for smallest ones. The higher the size of the orders, the higher the increase in costs. Moreover, whereas we did not observe a significant difference in prices between banned and non-banned stocks during the pre-ban period, it became positive and statistically significant during the ban (increasing linearly for order executions that go beyond the first limit, i.e. greater than the 0.1% of 1% of the ADV) on the bid and on the offer side¹³. Slippage costs fell after the removal of the

¹² This might be driven by the fact that market-making activities were excluded from the ban.

¹³ This increase in costs might also be a consequence of the reduction in volumes and order size that might discourage market participants to provide liquidity to the market.

ban but are still higher than the benchmark levels, particularly so for banned stocks. Again, patterns are very similar for the different order size considered and the size of the companies.

As in March and Payne (2012), we observe that both sides of the order book suffered approximately equally from liquidity drain. Whereas the decrease in the supply of limit orders to sell can be an expected consequence of the ban, leading to an increase in the cost of market buy orders (*Oslip*), the equal rise of costs of sell orders reflects that liquidity was also hit by the ban. The authors attribute this increase to the knowledge that the cost of exiting a position is also increased given the fall in liquidity on the offer side. A possible explanation, also identified by the authors, is that primary impact of the ban on short selling was to force market-neutral equity hedge funds out of the market. These funds take long and short positions in different but (statistically) related stocks, seeking to profit from short-term adjustments in relative prices. Since their positions are often neutral, once unable to take short positions in the concerned stocks these funds were also much less likely to take long positions. Their withdrawal from the French stock market therefore reduced liquidity on both sides of the book approximately equally. This result is moreover in line with what is observed on the aggressiveness analysis, its reduction being symmetrical on the bid and on the offer side for French stocks during the ban.

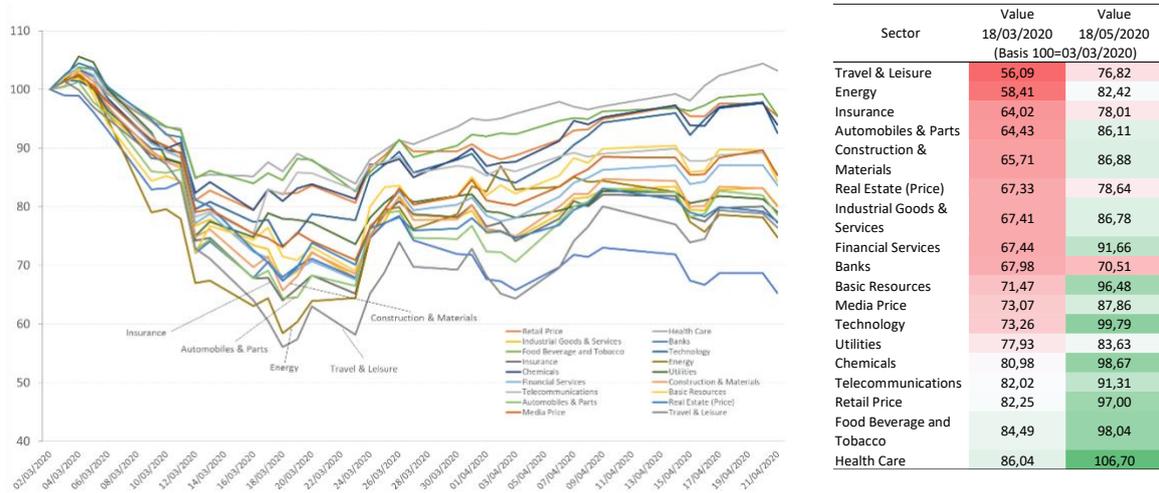
We do not observe a significant deterioration at the best bid and offer price between French and Dutch stocks during the ban.

However, beyond these best limits, trading costs increased significantly due to a decrease on the order book depth. This increase in costs observed for both sides of the market and for both large and small caps stocks.

3 Sectoral analysis

The epidemic origin of the crisis contributes to the unprecedented nature of the situation compared to previous experiences. It is thus worth investigating whether the ban has had a differentiated impact by sector. Indeed, as shown below in figure 5 not all sectors have been equally affected by the crisis.

Figure 5 - Evolution of sectoral Stoxx 600 Europe Index



Interestingly, the most affected sectors were the most shorted in the French market. Among them, the ‘consumer discretionary’¹⁴ was the most shorted sector on the French market before the ban whereas this was not the case in the Netherlands. On the contrary, the ‘technology’ sector totalized around 40% of total short sell value in the Netherlands when it represented less than 3% on the French market.

We thus run the same estimates as in the second part of the paper, differentiating the results by sector. For sake of clarity, only the coefficients that capture the difference in behavior between the French and the Dutch market for main metrics are reported.

¹⁴ Which includes companies from the ‘Travel & Leisure’ and ‘Automobiles & Parts’.

Table 6 – Impact of the short sell ban- sectoral Analysis

Sectors most impacted by the crisis

	Consumer Discretionary			Energy			Industrials			Financials			Real Estate		
	PreSSB x Banned	SSB x Banned	PostSSB x Banned	PreSSB x Banned	SSB x Banned	PostSSB x Banned	PreSSB x Banned	SSB x Banned	PostSSB x Banned	PreSSB x Banned	SSB x Banned	PostSSB x Banned	PreSSB x Banned	SSB x Banned	PostSSB x Banned
Returns	10.1063 (43.0949)	0.4455 (28.7396)	48.6818 (34.8780)	85.9597 (82.5675)	-57.7661 (52.7227)	-81.0810 (64.8618)	18.9273 (35.1887)	28.0790 (25.1944)	19.1985 (28.4652)	-78.8572* (39.6164)	38.5526 (29.4052)	39.6074 (35.6972)	-25.5009 (48.5774)	-57.5194 (40.2653)	-122.6095** (53.4305)
Volatility	-23.5447 (19.0972)	-48.3905*** (15.8769)	10.7959 (16.0418)	-59.7363** (29.2559)	-45.6208* (24.1284)	-4.8072 (27.6858)	-5.8267 (14.9201)	-24.1195* (12.8135)	-32.6253** (13.0982)	-12.2773 (15.5536)	-7.8861 (14.7616)	-25.5347* (14.1903)	57.2525*** (18.9899)	0.5896 (21.8887)	-64.6576*** (22.4676)
Volumes	0.4444*** (0.1561)	0.4227** (0.1663)	-0.2071 (0.1317)	0.2724 (0.1890)	-0.4021* (0.2261)	-0.7419*** (1.4789)	-0.4132*** (0.0949)	-0.2854** (0.1190)	0.1172 (0.0858)	0.0629 (0.1112)	-0.1179 (0.1394)	-0.4214*** (0.1003)	0.5539*** (0.1967)	0.2297 (0.2154)	0.1583 (0.1611)
Shares aggressively bought	0.5032*** (0.1665)	0.2911* (0.1741)	-0.2920** (0.1418)	0.5186** (0.2493)	-0.4181 (0.2605)	-0.6031*** (1.7199)	-0.5798*** (0.0893)	-0.1566 (0.1294)	0.1739* (0.0957)	0.1021 (0.1141)	-0.1851 (0.1441)	-0.4201*** (0.1091)	0.7354*** (0.2133)	0.0199 (0.2232)	0.0229 (0.1716)
Shares aggressively sold	0.5007*** (0.1582)	0.5934*** (0.1814)	-0.2774* (0.1432)	0.2955 (0.2003)	-0.3979* (0.2176)	-0.7947*** (1.6021)	-0.4535*** (0.0869)	-0.3211** (0.1301)	0.0592 (0.0883)	0.0149 (0.1149)	-0.2553* (0.1496)	-0.4688*** (0.1072)	0.5580*** (0.1936)	0.1904 (0.2280)	0.2819* (0.1489)
Quoted Spread	-1.1115 (6.5407)	4.4117 (5.3518)	0.6375 (6.4691)	5.0466 (7.5860)	35.4674*** (6.5111)	28.1565*** (7.1811)	4.7974 (4.4231)	0.0727 (3.7663)	-1.7564 (4.3504)	-12.0880*** (4.2318)	-24.8944*** (3.8625)	-19.1273*** (4.1428)	-2.2309 (5.8205)	-1.1102 (4.4661)	-3.6167 (6.3057)
Average price of a market sell order (Bslip 1%)	-27.0647*** (6.4250)	-19.6214*** (4.8209)	-15.3372*** (5.2386)	11.3128*** (4.470)	24.5731*** (3.078)	11.0168*** (3.635)	1.8433 (3.3579)	1.8105 (2.8743)	3.2049 (3.2278)	0.6469 (3.6177)	-6.5580** (3.0943)	-4.2826 (3.1820)	17.3144*** (3.7450)	19.2573*** (3.0248)	6.9919** (3.3208)
Average price of a market buy order (Oslip 1%)	-12.9478** (6.0056)	-18.3235*** (4.6982)	-11.7940** (4.6505)	8.0499** (3.5854)	24.9988*** (2.9426)	15.6888*** (3.5882)	3.3185 (3.3262)	-1.6885 (2.5946)	-3.9716 (2.9071)	-3.0144 (3.4618)	-5.5327 (2.7058)	-9.5887*** (2.9677)	5.7897 (3.7496)	16.7600*** (3.5881)	0.7152 (5.1035)

Sectors least impacted by the crisis

	Health Care			Consumer Staples			Telecommunications			Technology			Basic Materials		
	PreSSB x Banned	SSB x Banned	PostSSB x Banned	PreSSB x Banned	SSB x Banned	PostSSB x Banned	PreSSB x Banned	SSB x Banned	PostSSB x Banned	PreSSB x Banned	SSB x Banned	PostSSB x Banned	PreSSB x Banned	SSB x Banned	PostSSB x Banned
Returns	45.7475 (59.1994)	55.9531 (43.8431)	-10.2909 (43.8613)	66.1993 (48.0001)	-35.0510 (33.2894)	25.2322 (40.7510)	45.4431 (72.1607)	-124.7222* (48.5348)	-93.4880 (64.7280)	-0.1669 (45.4562)	19.7329 (34.1328)	20.5114 (36.9554)	-98.3559 (66.6118)	2.3032 (43.3151)	11.2947 (47.7510)
Volatility	51.0476 (31.6337)	111.5166*** (29.8130)	175.8636*** (27.2469)	54.4993*** (19.0224)	38.6639** (17.5457)	-5.6035 (17.7128)	-18.5833 (33.6237)	-95.3764*** (29.7215)	45.8654 (31.7509)	-73.3768*** (21.6782)	3.9257 (20.1156)	11.9164 (19.5941)	86.1956*** (30.6727)	126.7107*** (28.4291)	0.6972 (32.8651)
Volumes	-0.5674*** (0.1279)	0.1558 (0.1657)	0.1680 (0.1406)	0.2511 (0.1585)	-0.2656 (0.1716)	-0.1515 (0.1256)	0.1210 (0.2429)	-0.1643 (0.2082)	0.5079*** (0.1712)	-0.2854** (0.1411)	0.1400 (0.1808)	0.0353 (0.1436)	0.0242 (0.1787)	0.2612 (0.2245)	0.9174*** (0.1739)
Shares aggressively bought	-0.6864*** (0.1351)	0.3051* (0.1737)	0.3319** (0.1568)	0.4050** (0.1836)	-0.1966 (0.1853)	-0.3556** (0.1470)	-0.1521 (0.2376)	-0.2640 (0.2174)	0.3962* (0.2024)	-0.2210 (0.1561)	0.2100 (0.1879)	0.2069 (0.1499)	-0.0907 (0.1665)	0.3000 (0.2202)	0.8000*** (0.1714)
Shares aggressively sold	-0.3946** (0.1555)	0.0794 (0.1874)	0.1335 (0.1451)	0.1646 (0.1493)	-0.3659* (0.1903)	-0.0474 (0.1273)	0.2848 (0.2598)	0.1684 (0.2501)	0.5979*** (0.1830)	-0.2922** (0.1345)	0.1912 (0.1804)	0.0859 (0.1417)	-0.0875 (0.1502)	0.2553 (0.2176)	0.9722*** (0.1756)
Quoted Spread	-12.3863* (6.4471)	-3.6920 (4.7667)	-17.9329*** (6.4514)	8.4229 (5.6832)	8.5360** (3.9617)	8.9207** (3.7944)	40.3466*** (12.8689)	58.7246*** (9.4400)	22.1826*** (9.8895)	0.6484 (8.1468)	-1.3411 (6.4040)	8.1736 (7.1448)	-13.6167*** (5.1794)	-24.3538*** (5.1744)	5.9133 (5.4297)
Average price of a market sell order (Bslip 1%)	-0.1059 (4.6236)	-9.1138*** (3.5474)	-5.0820 (4.4278)	2.4594 (4.0279)	5.3569* (3.2513)	5.8030* (3.1789)	27.3156*** (8.2292)	29.3743*** (6.6126)	18.6470*** (6.1263)	-1.6014 (5.0566)	-11.8481*** (4.2621)	-9.8627*** (4.3426)	1.8767 (4.027)	16.7555*** (3.038)	22.9481*** (4.251)
Average price of a market buy order (Oslip 1%)	-5.7354 (4.9703)	-14.6242*** (3.7080)	-8.9219* (4.6851)	-3.7029 (4.4736)	4.3896 (3.1597)	4.6013 (3.2798)	27.9560*** (8.0614)	22.7061*** (7.1206)	13.4301 (8.3474)	-1.9121 (5.3634)	-5.3286 (4.1481)	3.6353 (4.2334)	2.6490 (3.8439)	7.5312* (3.9975)	24.8941*** (5.0792)

The results show that:

- The sectoral analysis does not show any specific impact on returns for French stocks compared to Dutch stocks.
- Most affected sectors ('Consumer discretionary', 'Energy', 'Industrials', 'Financials', 'Real estate') tend to exhibit lower volatility, lower volumes and a lower aggressiveness on the French market than on the Dutch market during the ban period. Moreover, the cost of execution increased, testifying of a decrease in limit order book depth on both sides of the market. Among these sectors, we observe some noticeable behaviors: 'Financials' react in the same way on the French and on the Dutch market, with non significant variations observed for most variables except for the quoted spread that decreases and an increase of depth on the bid side. 'Energy' still exhibits higher volatility than their Dutch counterparts do after the ban. Finally, 'Consumer discretionary' (the most affected sector and the most shorted sector on the French market, long time before the crisis), seems to continue to undergo a significant selling pressure despite the ban: the proportion of shares sold aggressively continue to increase thanks to higher liquidity provision on the offer side.
- Less affected sectors ('Health care', 'Consumer staples'¹⁵, 'Telecommunication' and 'Technology' show mixed behavior with respect to volatility: whereas it increases for 'Health care' and 'Technology' on the French market relative to the Dutch one during the ban period, it decreases for 'Telecommunication' and 'Consumer staples'. Volumes traded and the degree of aggressiveness increase more or do not vary

¹⁵ This sector includes 'Food, Beverage and Tobacco' and 'Personal Care, Drug and Grocery Stores' sectors.

significantly. This does not come at the expense of a decrease in order book depth as prices paid remain unchanged or decrease.¹⁶

- Finally, 'Basic materials', includes both 'Construction & Materials' and 'Chemicals', which were not hit equally by the crisis: whereas 'Construction & Materials' has been hardly hit 'Chemicals' was much less affected. This leads to a more difficult interpretation of the results with an increased volatility on the one hand and a decrease in the quoted spread and an increase in prices of executions on the sell side, on the other hand

Sectors that were most affected by the crisis tend:

(i) to exhibit lower volatility, lower volumes and a lower aggressiveness on the French market than on the Dutch market during the ban period. They also experienced a decrease in the depth of their order book on both side of the market; (ii) or to react the same way as their Dutch counterparts.

On the other side, for less affected sectors the impact on volatility is mixed (higher or lower depending on the sector). In any case, French stocks did not experience a decrease in order book depth as prices paid remain unchanged or decrease compared to Dutch stocks during the ban.

Conclusion

Investigating whether there was an improvement in market conditions once the ban was in force, we find that volatility decreased during that period for French stocks whereas we find no significant increase in returns. However, given the poor explanatory power of the model for this variable and the conjunction of different national and supranational measures taken at that time, it remains difficult to drive strong conclusions from the results.

In line with the decrease of volatility, trading volumes fell significantly due to the decrease in the number of trades rather than the size of the transactions executed. This came with a symmetric reduction of the aggressiveness on both the bid and the offer side.

The effect of the ban on liquidity conditions is also mixed: whereas we did not observe a greater deterioration of prices at the best limits for French stocks during the ban, compared to their pre ban level, trading costs increased significantly beyond these best limits due to the decrease of order book depth, meaning that general liquidity conditions were poor at this time. Interestingly, the decrease in depth occurred on both side of the market, suggesting that the withdrawal from short sellers was symmetric in line with their usual risk-neutral position. A sectoral analysis shows that these effects were most present in most affected sectors. For less affected sectors, the impact on volatility is mixed: higher or lower depending on the sector. Nevertheless, in any case, French stocks did not experience a decrease in their order book depth as prices paid remained unchanged or decreased compared to Dutch stocks during the ban.

Additionally, analyzing data from daily net short sell positions reporting, we find that total net short positions decreased in both France and Netherlands, although there was no obligation to unwind positions during the ban. Short sell positions are very concentrated on both markets. The observed decrease is driven by the top 5 position holder and occurred homogeneously across sectors. Finally, we did not find any evidence of a displacement effect (the positions holders shifting their positions) from France to the Netherlands.

¹⁶ Even if we observe that for 'Telecommunication' sector the quoted spread increases.

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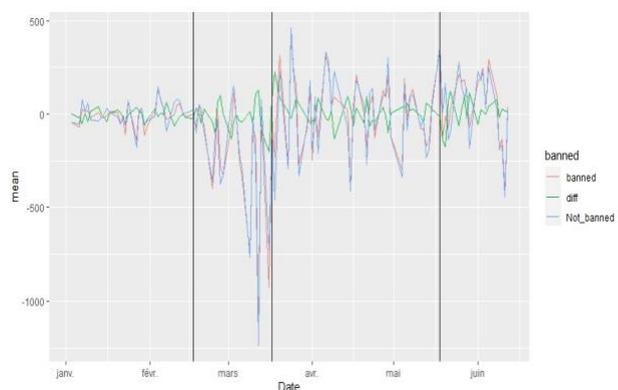
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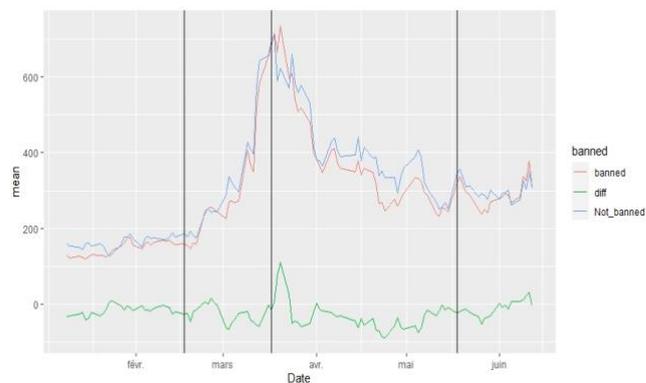
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Annex – Graphical evolution of the chosen metrics for the matched sample

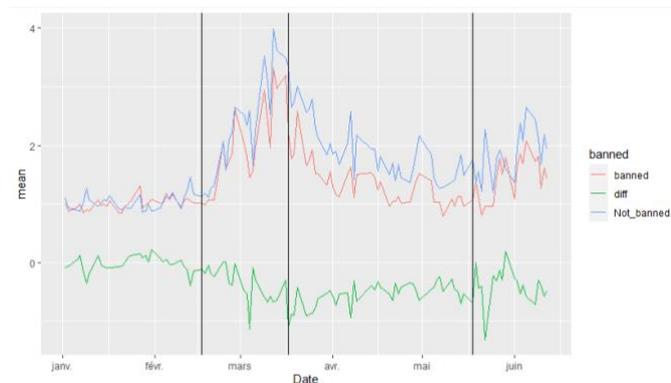
Returns



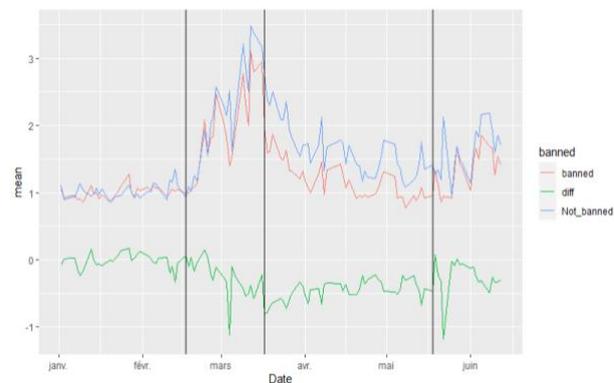
Volatility



Volumes traded daily



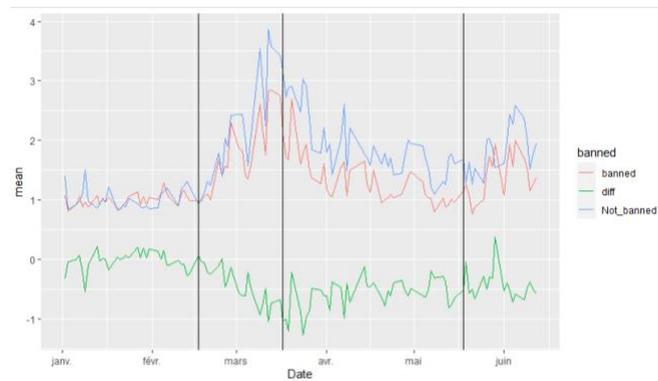
Number of trades daily



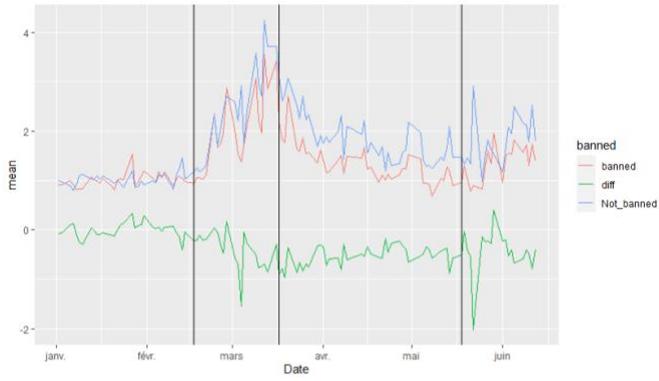
Trade size



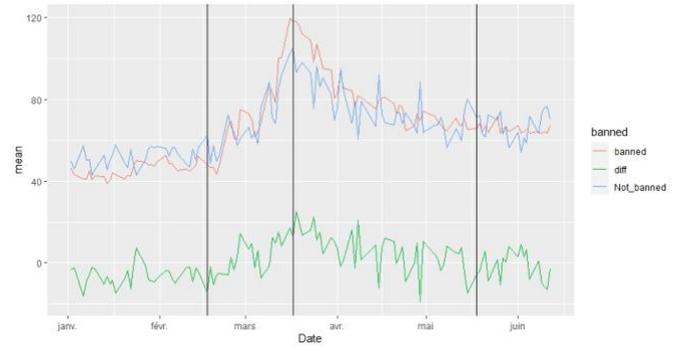
Aggressiveness - Buyer initiated trades



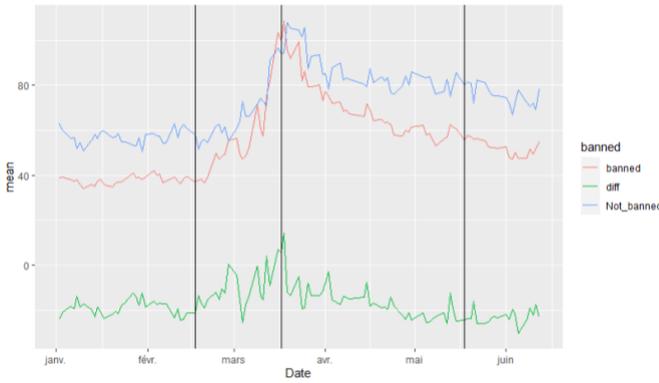
Aggressiveness - Seller initiated trades



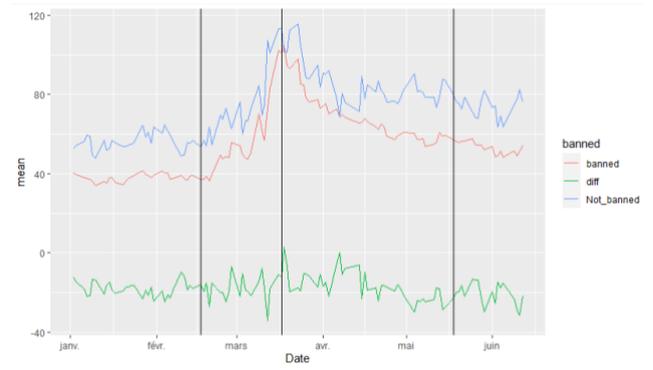
Quoted spread



Cost of a market buy order of 1% of 1% ADV



Cost of a market sell order of 1% of 1% ADV





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