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The Effect of Short Selling Restrictions on Belgium Firms During The COVID-19 Crisis

Seminar Financial Economics

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Abstract

This paper examines the effect of the short selling restrictions that were put in place by the Financial Services and Markets Authority (FSMA) in Belgium in March – July 2020. These measures were a response to the shock in worldwide supply and demand caused by the COVID-19 pandemic. The rationale behind this ban is that in the pandemic context, in which price formation may be dominated by misleading information, rumours, or inexact information, an increase in short positions could destabilize markets by determining unjustified downward security price spirals. The central research question in this paper is the following: "What is the effect of the short selling restrictions lasting from March 2020 - May 2020 in Belgium on stock prices, trading volume and price volatility?". The data used consists of daily stock prices, turnover by volume, volatility and market capitalization of 42 firms. By comparing the stocks that were subject to the short selling ban with stocks that were not, the effects were estimated. The research consists of a descriptive statistics analysis, panel data fixed effects models, and difference-in-difference models. The findings suggest that the restrictions did not lead to overpricing of stocks, did not affect price volatility, but did cause trading volumes to decrease.

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1 Introduction

The role of short selling in abnormal market circumstances can be controversial. It has certainly been an important topic of debate in the past two decades. At present, we are once again faced with similar problems as the imposition of various lockdown measures across the globe, in an attempt to control the spread of the coronavirus, have caused an unprecedented shock in worldwide supply and demand. This has caused an extraordinary increase in economic uncertainty that ultimately resulted in a global stock markets crash in March 2020. Stock markets were down 25% compared with January 2020, which can be considered one of the fastest and most brutal declines in recent history. Additionally, volatility is also at an all-time high. In Europe, the VSTOXX, a measure for implied volatility that reflects market expectations of future volatility of EURO STOXX 50 Index call options, closed at 86% on 16 March 2020, its second-highest daily close ever (STOXX, n.d.). Financial regulators restricted short selling in response, as they identified it as a potential threat to market stability. By putting these restrictions in place, authorities attempted to keep the stock market fair, orderly and efficient. Despite a plethora of academic research arguing that short-selling bans do not stabilize, rather exacerbate market turbulence (Battalio & Schultz, 2011; Battalio et al., 2011; Beber & Pagano, 2013).

According to the European Securities and Markets Authority (ESMA), the destabilizing effect of short selling is imminent in various financial markets in the European Union (ESMA, 2020). In response to this, two specific measures were taken to control and restrict short selling activity across EU financial markets. Firstly, on 16 March 2020, the ESMA temporarily lowered the reporting threshold for when holders of net short positions in shares traded on an EU regulated market have to notify their relevant national competent authority (NCA), from a position reaching or exceeding 0.2% to a position reaching or exceeding 0.1% of the issued share capital. While the decision was originally supposed to last until 16 June 2020, it was extended until 17 September 2020 and subsequently 19 March 2021. This decision applies to all natural and legal persons, disregarding their country of residence (ESMA, 2020a). By adding this reporting threshold, it enables ESMA and NCAs to more effectively monitor any changes in short selling, because more information becomes available, i.e., the short selling data from the notifications in the 0.1-0.2% bandwidth. This additional information improves the NCA's ability to monitor short selling positions and helps to identify possible threats at an earlier stage, as changes in trends are exposed earlier (AFM, 2020). Secondly, for further legislation regarding short selling, the approach differs per jurisdiction. In Belgium, the Financial Services and Markets Authority (FSMA) issued a one-day short selling ban for shares of 17 stocks on Euronext Brussels on 16 March 2020. A subsequent restriction was issued on 17 March 2020, which prohibited entering into a short sale which might have increased or constituted a net short position on stocks admitted to trading on Euronext Brussels and Euronext Growth, the Belgian trading venues of which FSMA is the relevant competent authority. The scope of the restriction was any transaction, which related to or created a financial instrument of which the effect or one of the effects of that transaction was to gain a financial advantage

in the occurrence of a drop in the price or value of another financial instrument. Moreover, the ban applied to both trading venues and Over-The-Counter (OTC) markets. Within the scope of the ban were only index-related instruments. The restriction did not apply to market making activities. Originally, the ban was set to last until 17 April 2020. On 15 April 2020, the ban was extended for another month until 18 May 2020 (Matthews et al., 2021). These bans follow the same rationale as similar previous short selling bans, which is that in the pandemic context, in which price formation may be dominated by misleading information, rumours, or inexact information, an increase in short positions could destabilize markets by determining unjustified downward security price spirals (ESMA, 2016). Therefore, short-selling bans can be viewed as a tool to limit stock market volatility and increase investors' confidence (Siciliano & Ventoruzzo, 2020).

The central research question in this paper is the following: "What is the effect of the short selling restrictions lasting from March 2020 - May 2020 in Belgium on stock prices, trading volume and price volatility?".

The purpose of this study is to contribute to the existing literature on the subject of short selling bans. By examining whether the temporary short-selling bans in Belgium during the COVID-19 crisis have achieved the supervising authority's goal, implications can be made on the effectiveness of short-selling bans and whether it is desirable for authorities to interfere in this way in abnormal market circumstances or not. This question is especially pressing and prevalent in the current environment, an era governed by social media and algorithmic trading, in which the diffusion of information is easier than ever before. False rumours circulated on publicly available social media channels can lead to a loss of confidence in the stock markets, which can cause uninformed investors to act erratically by panic selling. Instances of this happening are plentiful, for example when Elon Musk expressed his opinion that his company, Tesla, was overvalued in a tweet on 1 May 2020: "Tesla stock price is too high imo". After the tweet, Tesla stock plummeted more than 10 percent, a loss of $20 million for its shareholders (Siddiqui, 2020). In situations where significant financial institutions, such as banks or pension funds, are involved, this chain reaction can threaten the disruption of the entire market (SEC, 2008). It is thus essential that authorities make well evaluated decisions and implement the correct policy accordingly, not only in abnormal market circumstances, but also in normal market circumstances.

In the following section, the potential benefits and costs of short selling and the link between short selling and market declines will be examined. Then, an overview of the ongoing discussion about the effectiveness of short sale bans in academic literature will be given. In sections 3 and 4, the hypotheses, data, and methods will be explained, after which the results will be analysed in section 5.

2 Literature review

2.1 Short selling

Short selling is when an investor sells shares that he does not own yet, with the expectation of covering the position at a later date by repurchasing the shares at a lower price. This way, the investor profits on the difference in prices. If the price rises, however, the short seller may take a loss. It is the mirror image of a long position, where an investor obtains an asset that he did not own before. Where a long position can be considered as a bet on the price of a security going up, short selling allows investors to bet on the prices of securities going down.

Short selling can be categorized into two categories: "naked" short sales and "covered" short sales. In the first category of so-called naked short sales, the short seller sells the security to a third party without initially owning the security and without having made any arrangements for delivery of the securities yet. For a naked short sale, the short seller must buy back the security within a short time frame. By doing so, the short seller can avoid the cost of borrowing the stock. For a covered short, the short seller borrows securities from a securities lender and enters into a contract to return them on demand. So, contrary to a naked short sale, for a covered short sale, arrangements are already in place for delivery of the securities and the short seller sells the stock and delivers the shares to a buyer on settlement. The usual market practice for this settlement is within three days after entering into the contract. Until the contract is settled, the lender requires collateral. To close a position, the short seller will buy back equivalent shares in the market and return them to the securities lender. The collateral is then returned to the borrower plus interest earned at a rebate rate, which is less than the normal market rate. The lender earns a 'lending fee', which is the spread between the normal market rate and the rebate rate (Lecce et al., 2012).

Short selling is a trading activity that is common. On average, short sellers account for more than 20% of trading volume. Moreover, they are generally regarded as market participants with access to value-relevant information (Boehmer et al., 2008). However, most of these short sales are made by market makers who short to hedge their options positions or by high-frequency traders who make profits by providing short-term liquidity to the market. Typically, these positions are closed within minutes or even seconds of opening them. The focus of this study is on investors who short stocks with the intention to hold the position for a longer period of time, to profit from an expected decline in the stock price. These short sellers borrow shares to sell, with the lender usually being an institution. According to some studies, short sellers play an important role in price discovery and price formation, by improving information efficiency and market liquidity, while at the same time decreasing information asymmetry (Boehmer & Wu, 2013).

In the EU, short selling is governed by Regulation No. 236/2012 of 14 May 2012. The focus of the regulation is on disclosure requirements and harmonization.

2.2 Short Selling and Market Declines

Most of academic literature and empirical work on short selling to date is related to Miller's (1977) model, which argues that constraints on short selling might lead to overpricing of an asset. Miller's view is that short selling constraints disturb the equilibrium created by demand and supply, as they restrict the supply of shares from short sellers. This will lead to a higher equilibrium price level than the equilibrium in absence of the constraints and will thus lead to overpriced shares. Harrison & Kreps (1978) put this idea into a more sophisticated, dynamic model. According to their model, the equilibrium price that is reached under short selling constraints is higher than without the constraints, because it only reflects the beliefs of the most optimistic investors and due to speculative motives, the actual price might be even higher.

In the long run, the overpricing of stocks relative to their fundamental values can lead to problems. Real resources will flow to the overpriced stock and while these stocks are initially a liquid instrument, the investments in the mispriced firm or industry are usually less liquid. This can lead to long-term disruptions in the real economy as it takes longer for employees, customers, suppliers, and lenders to react and recover from a readjustment than it takes the market to correct the mispricing. Similarly, an artificially under-priced stock will also provide a distorted signal to investors. Short sellers correct the mispricing by identifying overvalued securities and correcting it (Battalio et al., 2011). However, regulators are concerned that short selling will artificially drive prices down below their fundamental values. It is because of these concerns that NCAs are allowed to impose short selling restrictions in case of adverse market developments, which either constitute a serious threat to financial stability or market confidence. Additionally, the measure must be necessary and proportionate to address the threat (Regulation 236/2012). ESMA points out that in the bans of March 2020, an apparent increase in the amount of net short positions could further exacerbate downward price spirals in the already adverse market circumstances. They conclude that indeed, market integrity, financial stability, and the orderly functioning of financial markets were at risk (AFM, 2020).

On the other hand, a multitude of papers has concluded that the imposition of short selling bans has at best a neutral effect on stock prices. Beber & Pagano (2013) conclude in their study that the steep market declines during the 2008 global crisis continued, even during the short sale bans. Diamond & Verreccia (1978) predict that short selling constraints hinder price discovery. Bris et al. (2007) provide supporting evidence for these findings and demonstrate that in countries where short selling is allowed and practiced, prices incorporate information more efficiently, especially negative information. Similarly, Saffi & Sigurdsson (2011) find that stocks that face short selling constraints are less efficient.

All in all, the theoretical and empirical discussion on the stabilization function of short selling constraints is still heavily mixed. Some studies do find support for bans leading to less negatively skewed stock returns and lower volatilities, while other papers argue the contrary (Chang et al., 2007; Saffi & Sigurdsson, 2011). Boehmer et al. (2013) find that the short selling constraints in 2008 failed to stabilize prices and caused negative side-effects by reducing liquidity and slowing price discovery.

Moreover, the ban appeared to have increased the trading costs for the stocks affected. Boehmer et al. (2008) report that the median effective bid-ask spreads for banned stocks increased substantially more than for the control sample. Other measures of market quality, like price impact and volatility, also deteriorated for the stocks affected during the ban.

3 Hypotheses

In order to answer the research question, 3 hypotheses have been formulated.

Hypothesis 1: Belgium firms' stocks were overpriced during the period in which the short sale restrictions were in effect.

This hypothesis is based on Miller's (1977) overvaluation theory and other relevant models of short-sale constraints discussed in section 2.2, such as the model constructed by Harrison & Kreps (1978). Much like during the 2008 financial crisis, regulators imposed short-selling bans in the hopes that they will protect the stock market from financial panics. These expectations are in line with Miller's model and regulators might have regarded the bans as to prevent underpricing of stocks. There are several other academic papers that provide evidence for Miller's overvaluation theory. Jones & Lamont (2002) studied short selling restrictions that were in effect during the period 1926-1933. They found that stocks that were more expensive to short had a lower return, which is consistent with Miller's theory. Asquith, Pathak & Ritter (2005) also found that stocks subject to short selling restrictions subsequently had significantly lower returns than stocks that were under no restrictions.

Hypothesis 2: Belgium firms have a lower trading volume during the period in which the short sale restrictions were in effect.

This hypothesis is also based on Miller's (1977) overvaluation theory. According to Miller, the supply of stocks should be higher when there are no restrictions. A restriction on short selling will lead to a lower supply and thus a lower trading volume. This theory has been tested empirically by Clifton & Snape (2008). They performed their study on trading volumes on the London Stock Exchange, after the FSA announced the short selling ban on certain banks and financial institutions in 2008. Their research consisted of 15 banned stocks and a control sample of 78 stocks that did not fall under the ban. The trading volume was measured by the actual number of stocks traded. They found that the traded volume of the banned stocks decreased consistently during the period in which the ban was in effect. This in contrast with the control group of non-restricted securities. They also found that the trading volume of the restricted securities increased after the shorting ban was lifted. Boulton & Braga-Alvas (2010) find similar results for their sample of 925 banned securities in the US from January 2005 – December 2008. They found a decrease in trading volume of 14,7% for the entire duration of the ban. Even more, they found that the decrease in trading volume persisted even after the ban was lifted. According to Boehmer, Jones & Zhang (2008), this decrease in trading volume is due to the lack of pessimistic investors, that cannot take short positions anymore. However, one thing to note is that the uncertain market conditions

and financial crisis might have contributed to the decrease in trading volume. This hypothesis implies that short sellers contribute significantly to the volume of stocks traded on the stock market.

Hypothesis 3: Belgium firms have lower price volatility during the period in which the short sale restrictions were in effect.

By imposing short selling restrictions, financial regulators aim to increase market stability. One way in which to measure market stability is through price volatility. If the short selling restrictions were indeed effective in stabilizing the market, then the stocks that were subject to short selling bans should have lower price volatility. Supporting evidence for this hypothesis can be found in a study performed by Pu & Zhang (2012), in which they looked at the effects of the 2010 short-sale bans in Germany. They conclude that the bans had led to lower volatility. Chang et al. (2007) found similar results in their event study into short selling restrictions on the Hong Kong stock market. This particular stock market was chosen, because on the Hong Kong stock market, short selling is only allowed when the stock is included on an official short selling list. Chang et al. found that the volatility of a stock increases when the stock is added to the short selling list.

However, it appears that no consensus on the effect of short selling restrictions on price volatility can be found in the academic literature. Saffi & Sigurdsson (2011) provide contrasting evidence and show that short selling bans lead to higher price volatility. Bai, Chang & Wang (2006) find similar results. They argue that the reason for the increase in price volatility is due to the increase in uncertainty for uninformed investors. This increase in uncertainty is caused by the absence of well-informed short sellers. Boehmer, Jones & Zhang (2013) also demonstrate that the 2008 shorting ban in the US can be associated with a significant increase in average daily and intraday range volatility. However, they do not draw any conclusions about the effect of the ban on market quality, because some of the effects could be attributable to a greater tumult in the fundamentals during this time period.

4 Data and methods

4.1 Data

The effect of short-selling bans on trading volume, stock prices, and price volatility will be identified by comparing the average values between the Netherlands and Belgium during the period in which the short sale restrictions were in effect: from 16 March 2020 to 18 May 2020. As short-selling bans were enacted in several, but not all EU countries, we have a sizable control sample of companies that were and were not subject to short-selling bans. The data used consists of the daily stock prices, turnover by volume, the volatility, and market capitalization of the BEL 20 index, which measures the performance of the 20 most representative companies traded on the Euronext Brussels (Euronext, 2021) and of those 20 companies respectively. Considering no short sale restrictions were enacted in the Netherlands, data on companies listed on the AEX index will be used as a benchmark, against which the returns from the BEL 20 will be evaluated. Data on 2 companies were not available, leaving a control sample of 23 companies. To measure volatility, the 10-day rolling standard deviation of stock returns was taken. A 10-day time period was chosen, because of the relatively short duration of the time period during which the short selling bans were in effect. Turnover by volume was used as a measure for trading volume, which is supported by academic literature (Lee & Swaminathan, 2000). The turnover ratio of a stock is computed by dividing the trading volume by the number of outstanding shares. Considering that the ban lasted for 46 trading days, the descriptive statistics for this period will be compared to the 46 trading days before 16 March 2020 and the 46 after 18 May 2020. By choosing this time frame, the impact of the short-selling bans will be less clouded by observations that are far away from the inception date of the ban. This means we will consider three time frames to apply an event study methodology:

1. Pre-ban period: 10 January 2020 – 16 March 2020.
2. Ban period: 16 March 2020 – 18 May 2020.
3. Post-ban period: 18 May 2020 -21 July 2020.

The data on the stocks will be retrieved from Eikon, the successor of both Datastream and ThomsonOne. Further data used consists short-selling ban characteristics, including inception and lifting dates, which are taken from the websites of NCAs and of the ESMA.

4.2 Descriptive statistics

In this section, the stock price, trading volume, and volatility of 42 companies for the period 10 January 2020 – 21 July 2020 will be analyzed. This period consists of the 46 trading days before the short selling bans were enacted, the 46 trading days during which they were in effect and the 46 trading days after the ban. After descriptive evidence about the trends that the stock price, trading volume, and volatility follow has been provided, further evidence will be provided based on regression analyses.

4.2.1 Stock prices

Figure 1 (appendix) shows the average stock prices of BEL20 and AEX stocks in the period 10 January 2020 – 21 July 2020. The BEL20 stocks were subject to short selling restrictions, while the AEX stocks were not. A drop in stock prices can be observed for both types of stocks in the period shortly before the ban was enacted. Notably, the stock prices remained stable for the Belgium stocks afterwards, while the Dutch stock prices increased in the period of the short selling ban. This trend continues after the ban was lifted.

	Average	**Median**	**St. Dev.**	**Minimum**	**Maximum**
Pre-ban	89.31	73.24	56.57	17.35	249.50
Ban	75.86	58.44	52.43	15.81	227.50
Post-ban	84.91	68.59	61.51	17.58	256.19

Table 1: BEL20 index stocks average stock price.

In table 1 the average stock prices for the BEL20 index stocks pre-ban, during the ban, and post-ban are shown. During the ban, the average stock price was 15.1% lower than before the ban and 12.2% lower than after the ban. The median decreased with 20.2% during the ban and increased with 17.4% after the ban was lifted. The standard deviation of the stock prices during the ban was lower and there was a smaller spread compared to before and after the ban was enacted.

	Average	**Median**	**St. Dev.**	**Minimum**	**Maximum**
Pre-ban	91.25	41.58	164.07	1.79	893.80
Ban	82.17	33.94	168.38	1.67	1034.5
Post-ban	109.52	39.70	253.95	2.077	1434.0

Table 2: AEX index stocks average stock price.

As illustrated in table 2, the price decrease during the period in which the short selling restrictions were in effect was 10% for the AEX stocks. These stocks were not subject to short selling restrictions. The stock prices recovered with 33.3% in the post-ban period. The median decreased with 18.4% in the ban period and increased with 17% in the period after. The standard deviation and spread of the stock prices were higher than before the ban period, but lower than after the ban period.

4.2.2 Trading volume

Figure 2 shows the average trading volume of BEL20 and AEX stocks in the period 10 January 2020 – 21 July 2020. The left axis shows the values for the AEX stocks, the right axis shows the values for the BEL20 stocks. In absolute terms, the AEX stocks consistently have higher trading volumes. However, when we look at the general trend, they behave similarly. Trading volumes increased in the period

shortly before the ban and dropped by a large amount when the ban was in effect. In the last period analyzed, post-ban, spikes in trading volumes can again be observed.

	Average	Median	St. Dev.	Minimum	Maximum
Pre-ban	505.92	268.60	784.17	4	8114.9
Ban	500.68	236.50	839.23	8.9	7821.8
Post-ban	452.06	239.25	704.39	0.1	7082.5

Table 3: BEL20 index stocks average trading volume measured in turnover by volume.

In table 3, the average trading volumes measured in turnover by volume are shown for the BEL20 index stocks. There is a small drop in average trading volume during the ban period of 1%. The average trading volume drops even further in the post-ban period with 9.7%. However, the median trading volume shows a different pattern. The median drops with 12% initially in the ban period and then increases with 1.2% in the post-ban period. The trading volume has a higher standard deviation in the ban period compared to the period before and after and has a smaller spread than before, but a larger spread than after the period in which the ban was in effect.

	Average	Median	St. Dev.	Minimum	Maximum
Pre-ban	4582.20	1096.10	9126.59	40.40	79125.10
Ban	6584.48	1350.60	12269.99	71.20	133015.80
Post-ban	4663.88	990.15	8598.09	64.40	88632.60

Table 4: AEX index stocks average trading volume measured in turnover by volume.

Table 4 shows the average trading volumes measured in turnover by volume for the AEX index stocks. The average trading volume for AEX index stocks has higher absolute values than the BEL20 index stocks. There is an increase in average trading volume during the ban period of 43.7%. After the ban was lifted, the trading volume drops down again with 29.2%. The median of the trading volumes increases with 23.2% and then drops down with 26.7%. The standard deviation and spread of the trading volume increase significantly during the ban period and then drop down again.

4.2.3 Volatility

Figure 3 shows the average volatility of BEL20 and AEX stocks in the stocks in the period 10 January 2020 – 21 July 2020. The figure shows a sharp increase for both types of stocks around the inception date of the short selling restrictions. In the ban period, the volatility decreased again but remained at a higher point than before the ban. In the last period, the volatility appears to remain stable with a slight decrease to its initial pre-ban level. The stocks that were not subject to short selling restrictions do not seem to behave differently than those that were.

	Average	Median	St. Dev.	Minimum	Maximum
Pre-ban	0.019	0.014	0.014	0	0.076
Ban	0.040	0.034	0.022	0	0.107
Post-ban	0.023	0.020	0.013	0	0.110

Table 5: BEL20 index stocks average volatility.

Table 5 shows the average volatility for the BEL20 index stocks. The average volatility of the stocks increases with 110.5% in the period in which the ban was in effect. After the ban is lifted, the average volatility drops with 42.5%. The median increases with 142.9% in the ban period and decreases with 41.2% after the ban was lifted. The spread is bigger in the ban period than before the ban period.

	Average	Median	St. Dev.	Minimum	Maximum
Pre-ban	0.020	0.017	0.012	0.0292	0.090
Ban	0.043	0.039	0.024	0.006	0.134
Post-ban	0.025	0.022	0.012	0.006	0.095

Table 6: AEX index stocks average volatility.

Table 6 shows the average volatility for the AEX index stocks. The average volatility of the stocks increases with 115% in the ban period and decreases with 41.9% in the post-ban period. The median increases with 129.4% in the ban period and decreases with 43.6% after the ban was lifted. The spread is bigger in the ban period than in the periods before and after.

4.3 Methods

Hypothesis 1: Belgium firms' stocks were overpriced during the period in which the short sale restrictions were in effect.

Hypothesis 1 will be tested by comparing the median and mean stock prices for stocks subject to short sale bans to those that are not. By comparing the prices of stocks for which short sales were banned to the prices of stocks for which short sales were permitted, the effect of short selling bans on stock prices can be determined. Additionally, panel data on the BEL20 index companies will be used from the period 10 January 2020 to 21 July 2020, which consists of the 46 trading days before, during and after the short selling restrictions. Some resemblance to this analysis can be found in the work by Beber & Pagano (2013), who perform a cross-country analysis with international panel data of stocks that were subject to various shorting bans in the years 2007-2009. Their main result is that short sale bans increase end-

of-day bid-ask spreads. Moreover, they found no effect on share prices by the bans. This study complements Beber & Pagano's work well, because while their data is broader with an analysis of thirty different countries, this work analyzes one market in depth. This has the advantage that it does not require subjective decisions on how to weigh each observation and does not suffer from cross-country heterogeneity, such as differences in the information environment and investor protection regulations. The following fixed effect panel data regression will be run to determine the effect of the short selling ban on stock price:

$$lnPRICE_{it} = \beta_0 + \beta_1 * BAN_{it} + \beta_2 * lnTRADINGVOLUME_{it} + \beta_3 * lnMARKETVALUE_{it} + \varepsilon_{it}$$

Where $lnPRICE_{it}$ is the dependent variable, which in this case, is the natural logarithm of the stock price. The distribution of stock prices is skewed and does not follow a normal distribution, because they will always be positive and cannot fall below 0. Thus, the natural logarithm is taken to make the data more robust to outliers and for interpretation purposes. The log transformation makes it more like a normal distribution and is common in academic literature (Siciliano & Ventoruzzo, 2020).

β_0 is the constant term. This is where the regression intercepts the y-axis. This coefficient will not be interpreted, because it does not provide relevant information.

BAN_{it} is a dummy variable that takes on the value 1 in the period in which the short selling ban was in effect and the value 0 otherwise. The coefficient of interest is β_1, which measures the percentage change in stock prices that is induced by the short selling ban.

$TRADINGVOLUME_{it}$ is included as a control variable, because lower or higher trading volumes might affect the stock price. The control variables will pick up the time-varying effects. The trading volume was measured in turnover by volume.

$MARKETVALUE_{it}$ is also included as a control variable. Beber & Pagano (2013) find that short-selling restrictions have different effects for stocks of firms with different market capitalization. The reason for this is that even in the absence of short-selling restrictions, market makers tend to be more reluctant in providing liquidity for riskier stocks of smaller firms than for bigger firms. In their study, the coefficient on the ban dummies is about 30% to 40% larger for small stocks. This difference was found to be statistically significant from zero at a 1% confidence level. Boehmer, Jones & Zhang (2008) also found that trading volume and market capitalization had a significant effect on the dependent variables in their study. Bris (2008) included a number of other control variables in his study but found that none of those effects were important. The inference remained unchanged whether or not the control variables were included. Therefore, no other control variables were included in the regression.

ε_{it} is the error term. This is the residual and represents the variation in stock price that the model cannot explain. The regressions are run with robust standard errors.

Hypothesis 2: Belgium firms have a lower trading volume during the period in which the short sale restrictions were in effect.

Hypothesis 2 will also be tested using the panel data. The regression formula is as follows:

$$lnTRADINGVOLUME_{it} = \beta_0 + \beta_1 * BAN_{it} + \beta_2 * lnMARKETVALUE_{it} + \varepsilon_{it}$$

With $lnTRADINGVOLUME_{it}$ being the dependent variable: the natural logarithm of the stock's trading volume. β_0 is the constant term, BAN_{it} is a dummy variable that takes on the value 1 in the period in which the short selling ban was in effect and 0 otherwise, $MARKETVALUE_{it}$ is a control variable and ε_{it} is the error term as explained above.

Hypothesis 3: Belgium firms have lower price volatility during the period in which the short sale restrictions were in effect.

To test hypothesis 3, the following regression was analysed:

$$lnVOLATILITY_{it} = \beta_0 + \beta_1 * BAN_{it} + \beta_2 * TRADINGVOLUME_{it} + \beta_3 * MARKETVALUE_{it} + \varepsilon_{it}$$

With $lnVOLATILITY_{it}$ being the dependent variable: the natural logarithm of the stock's volatility. β_0 is the constant term, BAN_{it} is a dummy variable that takes on the value 1 in the period in which the short selling ban was in effect and 0 otherwise, $TRADINGVOLUME_{it}$ and $MARKETVALUE_{it}$ are control variables and ε_{it} is the error term.

4.3.1 Difference-in-Differences Framework

Difference-in-Differences (DiD) estimators will be used as a robustness check to determine the treatment effects on the BEL20 index stocks stemming from the short selling restrictions. This method addresses the concerns about endogeneity that the changes found in the stock's prices, trading volume, and liquidity would have changed over the period of observation even if no short selling restrictions had been enacted. It also addresses concerns about possible omitted trends, that stem from the inability to control perfectly for business cycle forces, variation in investor demand, or other trending factors (Roberts & Whited, 2013). Moreover, if financial regulators tend to impose such short sale restrictions at times when stock prices are already very volatile for external reasons, the relationship found with regular OLS regressions might not be interpretable as a causal relationship (Beber & Pagano, 2013). The DiD model isolates the relationship from these external factors. In order to estimate a causal effect, the DiD estimation relies on strong assumptions. In particular, it relies on a parallel trends assumption, which implies that in the absence of a treatment, the treatment and control group would have followed

parallel paths. Put differently, pre-treatment, the treatment and control groups should follow the same trends. The assumption is needed for the internal validity of the model and to estimate the average effect of treatment on the treated. The true effect cannot be observed, because we can never observe both potential outcomes for any treated unit. With the DiD design, the untreated outcomes for the treatment group are imputed with data from the control group. If the parallel trends assumption holds, then the outcomes in the control group are a good proxy for the unobservable change in untreated potential outcomes in the treatment group (Abadie, 2005). This assumption will be tested visually. Considering the visual evidence provided in figure 1, figure 2, and figure 3 and the descriptive evidence provided in section 4.2, it is assumed that the treatment and control group follow the same trends. As with the previous methods, market value and trading volume will be incorporated as control variables to further enhance the robustness of the analysis.

$$lnPRICE_{it} = \beta_0 + \beta_1 * BAN_{it} + \beta_2 * TREATMENT_{it} + \beta_3 * INTERACTION_{it} + \beta_4 * TRADINGVOLUME_{it} + \beta_5 * MARKETVALUE_{it} + +\varepsilon_{it}$$

As previously described, the BAN_{it} variable is a dummy variable that takes on the value 1 in the period in which the short selling ban was in effect and 0 otherwise. The $TREATMENT_{it}$ variable is the treatment variable that takes on the value 1 if a stock belongs to a constituent of the BEL20 index and were subject to short selling restrictions and 0 if a stock belongs to a constituent of the AEX index and were not impacted by the short selling ban. The variable of interest is $INTERACTION_{it}$ which is calculated as $(ban_{it} * treatment_{it})$. This interaction term measures the difference across the two groups of stocks during the short selling ban. To enhance the robustness of the analysis, the control variables $MARKETVALUE_{it}$ and $TRADINGVOLUME_{it}$were included in the regression. Moreover, similar regressions were run for the dependent variables $lnTRADINGVOLUME_{it}$ and $lnVOLATILITY_{it}$. Respectively these regressions can be written as:

$$lnTRADINGVOLUME_{it} = \beta_0 + \beta_1 * BAN_{it} + \beta_2 * TREATMENT_{it} + \beta_3 * INTERACTION_{it} + \beta_4 * MARKETVALUE_{it} + \varepsilon_{it}$$

$$lnVOLATILITY_{it} = \beta_0 + \beta_1 * BAN_{it} + \beta_2 * TREATMENT_{it} + \beta_3 * INTERACTION_{it} + \beta_4 * TRADINGVOLUME_{it} + \beta_5 * MARKETVALUE_{it} + \varepsilon_{it}$$

5 Results

5.1 Regression analysis

Panel data containing the stock prices, turnover by volume, volatility, and market value of the companies affected by the short selling restrictions was used to determine the effect of the ban on the stock price, trading volume, and volatility. As described under section 4.2, the following model was determined:

$$Y_{it} = \beta_0 + \beta_1 * BAN_{it} + \beta_2 * TRADINGVOLUME_{it} + \beta_3 * MARKETVALUE_{it} + \varepsilon_{it}$$

To determine the suitability of either a fixed effect panel data model or a random effect panel data model, a Hausman test was performed. The results from this test are given in table 7 (appendix). Under the null hypothesis of the Hausman test, a random effect model is a better fit and under the alternative hypothesis the fixed effect model is a better fit. As can be seen, in all three models the null hypothesis is rejected, meaning a fixed effect model is more suitable for the data. Firm-fixed effects to control for unobserved heterogeneity due to liquidity-related characteristics, such as firm leverage, were included in the regressions. This was also done in similar studies by Beber & Pagano (2013) and Siciliano & Ventoruzzo (2020).

	(1) **lnPRICE**
BAN	0.00175*** (2.89)
lnTRADINGVOLUME	0.00202*** (480.97)
lnMARKETVALUE	1.00082*** (4.44)
_cons	-4.750*** (-245.54)
N	2584
R^2	0.9917

*Table 8: Fixed effect panel regression on stock price. Statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

The estimates in Table 8 show that the ban on short selling is associated with an increase of 0.00175 percentage points in stock prices. Though the coefficient BAN_{it} is found to be significantly different from zero at the 1% level, the effect of the ban appears to be small. The R^2 displayed is the within R^2.

This displays how much of the variation in the dependent variable within firm stocks is captured by the model.

	(1) **lnTRADINGVOLUME**
BAN	-0.169*** (-6.49)
lnMARKETVALUE	-1.199*** (-13.71)
_cons	16.04*** (20.56)
N	2584
R^2	0.0685

*Table 9: Fixed effect panel regression on trading volume. Statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

The estimates in table 9 show that the ban on short selling is associated with a decrease of 0.169 percentage points in trading volume. The coefficient BAN_{it} is found to be significantly different from zero at the 1% level.

	(1) **lnVOLATILITY**
BAN	0.0607*** (14.05)
lnTRADINGVOLUME	0.0000305*** (-6.96)
lnMARKETVALUE	-0.00000753*** (-17.27)
_cons	-1.336*** (-194.45)
N	2584
R^2	0.1981

*Table 10: Fixed effect panel regression on price volatility. Statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

The estimates in table 10 show that the ban on short selling is associated with a decrease of 0.0607 percentage points in price volatility. The coefficient BAN_{it} is found to be significantly different from zero at the 1% level.

5.2 Difference-in-Difference analysis

In the second step of the analysis, the stock prices, trading volumes, and price volatility were compared across firms subject to the short selling ban and firms that were not subject to the short selling ban. The results of these difference-in-difference regressions can be found in the following tables.

	(1) **lnPRICE**
BAN	0.0789*** (3.42)
TREATMENT	-0.272*** (-13.01)
INTERACTION	-0.135*** (-4.20)
lnTRADINGVOLUME	-0.643*** (-84.70)
lnMARKETVALUE	0.587*** (66.89)
N	5689
R^2	0.7405

*Table 11: DiD model on dependent variable stock price. Statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

The estimates in table 11 show the results from the difference-in-difference regression on stock prices. The coefficient of the BAN_{it} dummy is significantly positive at the 1% level. This coefficient represents the change in stock prices for both groups of firms during the ban period. Thus, this positive coefficient suggests that during the short selling ban, the stock prices generally increased. The coefficient of the $TREATMENT_{it}$ dummy is negative and significant at the 1% significance level, which indicates that firms that were under short selling restrictions had relatively lower stock prices than firms that faced no restrictions in the pre-ban and post-ban period. The most interesting finding is in the coefficient of interest, which is the interaction term between the BAN_{it} dummy and the $TREATMENT_{it}$ dummy. This term is found to be significantly negative at the 1% level, which means that the banned firms experienced a decrease in stock prices during the ban period compared to the stock prices of the non-banned firms, when taking into account the general trends for all the firms. These findings confirm the visual evidence

drawn from figure 1 and discussed in section 4.2.1, in which the stock prices for the BEL20 index stocks also appear to be lower than the stock prices for the AEX index stocks.

	(1) **lnTRADINGVOLUME**
BAN	0.365*** (6.07)
TREATMENT	-1.510*** (-34.12)
INTERACTION	-0.293*** (-3.75)
lnMARKETVALUE	0.529*** (31.48)
N	5689
R^2	0.3998

*Table 12: DiD model on dependent variable trading volume. Statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

The estimates in table 12 show the results from the difference-in-difference regression on trading volume. The coefficient of the BAN_{it} dummy is significantly positive at the 1% level. This coefficient represents the change in trading volume for both groups of firms during the ban period. Thus, this positive coefficient suggests that during the short selling ban, the trading volume generally increased. The coefficient of the $TREATMENT_{it}$ dummy is negative and significant at the 1% significance level, which indicates that firms that were under short selling restrictions had relatively lower trading volumes than firms that faced no restrictions in the pre-ban and post-ban period. The most interesting finding is in the coefficient of interest, which is the interaction term between the BAN_{it} dummy and the $TREATMENT_{it}$ dummy. This coefficient is found to be significantly negative at the 1% level, which means that the banned stocks experienced a decrease in trading volume during the ban period compared to the trading volume of the non-banned stocks, when taking into account the general trends for all the firms. These findings confirm the visual evidence drawn from figure 2 and discussed in section 4.2.2.

	(1) **lnVOLATILITY**
BAN	0.552*** (4.70)
TREATMENT	-0.114*** (-9.92)
INTERACTION	0.010 (0.58)
lnTRADINGVOLUME	0.044*** (11.76)
lnMARKETVALUE	-0.069*** (-15.33)
N	5689
R^2	0.115

*Table 13: DiD model on dependent variable price volatility. Statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

The estimates in table 13 show the results from the difference-in-difference regression on price volatility. The coefficient of the BAN_{it} dummy is significantly positive at the 1% level. This coefficient represents the change in price volatility for both groups of firms during the ban period. Thus, this positive coefficient suggests that during the short selling ban, the price volatility generally increased. The coefficient of $TREATMENT_{it}$ dummy is negative and significant at the 1% significance level, which indicates that stocks that were under short selling restrictions had relatively lower volatilities than stocks that faced no restrictions in the pre-ban and post-ban period. The most interesting finding is in the coefficient of interest, which is the interaction term between the BAN_{it} dummy and the $TREATMENT_{it}$ dummy. This coefficient is found to be significantly positive at the 1% level, which means that the banned stocks experienced an increase in price volatility during the ban period compared to the non-banned stocks, when taking into account the general trends for all the firms. These findings confirm the visual evidence drawn from figure 3 and discussed in section 4.2.3.

6 Conclusion

This paper examines the effect of the short selling restrictions lasting from March 2020 – May 2020 in Belgium on stock prices, trading volume, and price volatility. The central research question in this paper is the following:

"What is the effect of the short selling restrictions lasting from March 2020 - May 2020 in Belgium on stock prices, trading volume, and price volatility?"

These effects were determined by investigating the information contained in stock prices in the period before, during, and after the short selling ban. Panel data was used to conduct the research consisting of multiple fixed effects regression models. Additionally, a difference-in-difference (DiD) design was used in order to provide further insights for the research. This design makes it possible to compare between banned and non-banned stocks while taking into account general trend differences. The findings in this paper provide the necessary means to analyse the effectiveness of short selling bans as a tool to interfere in abnormal market circumstances and whether the financial regulators were successful in their goal to stabilize the market in the current pandemic context. The three hypotheses constructed earlier will now be evaluated.

Hypothesis 1: Belgium firms' stocks were overpriced during the period in which the short sale restrictions were in effect.

First, the descriptive evidence will be evaluated. In the period shortly before the short selling ban was enacted, stock prices dropped for both BEL20 index and AEX index stocks. This could be attributed to announcement effects. While the Dutch stock prices increased in the ban period, the Belgium stocks prices remained low. Moreover, the prices of the Belgium stocks decreased more than the Dutch stocks. Both the mean and median were relatively lower compared to their pre-ban averages. This trend does not seem to provide any supporting evidence for the first hypothesis.

When looking at the regression analysis, overall, significant results were found. However, the estimated effects were relatively small. The short selling ban was found to have a small, significant, positive effect on stock prices. However, the DiD model contrasts these findings. When applying a DiD model, the relationship is isolated from external factors and general trends. The model shows that stocks that were subject to short selling restrictions had significantly lower prices in the ban period compared to stocks that were under no such restrictions. This implies that the first positive relationship found can be attributed to external factors.

All in all, no conclusive evidence was found to accept the first hypothesis, and the hypothesis is thus rejected. The results from the DiD model even imply that the short selling ban resulted in lower prices rather than prices that were too high.

Hypothesis 2: Belgium firms have a lower trading volume during the period in which the short sale restrictions were in effect.

Trading volumes increased in the period shortly before the ban was enacted, followed by a big drop afterwards for both types of stocks. The effect of the ban on the average trading volume seems small for the BEL20 index stocks. However, a bigger decrease in the median levels can be observed. The remaining observed short sale of banned stocks can most likely be attributed to market makers, as they are still able to short as part of their market-making and hedging activities (Beber & Pagano, 2013). These findings seem to provide moderate supporting evidence for the second hypothesis.

In the regression analysis of the effect of the short selling ban on trading volumes, a small, significant, negative relationship was found. However, the R2 of the model is not very high, indicating that there might be some issues with the model. So, for further evidence the results from the DiD model will be considered. The results show that stocks that were subject to restrictions had significantly lower trading volumes in the ban period compared to stocks that were not banned from short selling. All three methods provide supporting evidence for the hypothesis. Thus, the second hypothesis is accepted.

Hypothesis 3: Belgium firms have lower price volatility during the period in which the short sale restrictions were in effect.

Lastly, we consider the average price volatility. The volatility increased sharply for both types of stocks around the date that the short selling ban came into effect. In the ban-period, the volatility decreased again, but remained at a higher average than before the ban. The stocks that were not subject to any restrictions do not seem to have behaved differently than those that were. Thus, these findings do not provide any evidence for the third hypothesis.

From the regression analysis we can conclude that there is a small, significant, positive effect of the short selling ban on price volatility. The results from the DiD model were not found to be significant and will therefore not be taken into consideration. Because of this, the evidence found is inconclusive and the hypothesis cannot be accepted. One other potential explanation for the increased volatility during the short sale ban could be the greater tumult in the fundamentals during this time period, attributable to the uncertainty caused by the COVID-19 pandemic. Boehmer, Jones & Zhang (2013) also found a significant increase in average daily and intraday range volatility during the 2008 short sale ban, but do not draw any conclusions about the effect of the ban on market quality for similar reasons.

The evidence in this paper suggests that the reaction of the Belgium financial regulator to the market destabilizing effects of the pandemic did not have the desired effects. Rather than stopping the downward spiral of stock prices and lowering price volatility, the findings suggest that the restrictions lead to even lower prices, did not affect price volatility, and caused less trading to occur.

7 Discussion

This study could be expanded by observing firms in multiple countries in the period March - July 2020, at the height of the COVID-19 pandemic, that either were or were not limited by short selling restrictions. This would provide a broader data set and a more comprehensive analysis. In such a panel design, greater and lesser weights can be given to firms in countries with for example longer lasting or broader shorting bans. However, such a study would face different limitations, caused by possible cross-country heterogeneity within firms.

Moreover, it is important to note that the internal validity of the DiD model relies on the parallel trends assumption, which implies that in the absence of a treatment, the treatment and control group would have followed parallel paths. In this paper, the assumption was tested visually, and it was assumed that the parallel trends assumption holds. However, in further research additional statistical evidence or methods could be performed to support the validity of the DiD model. One alternative way in which the design of the DiD model could be improved is by creating a matched sample in which a control stock is selected for each treatment stock based on certain criteria such as size and trading activity. This has been done by for example by Lecce et al. (2012).

Appendix

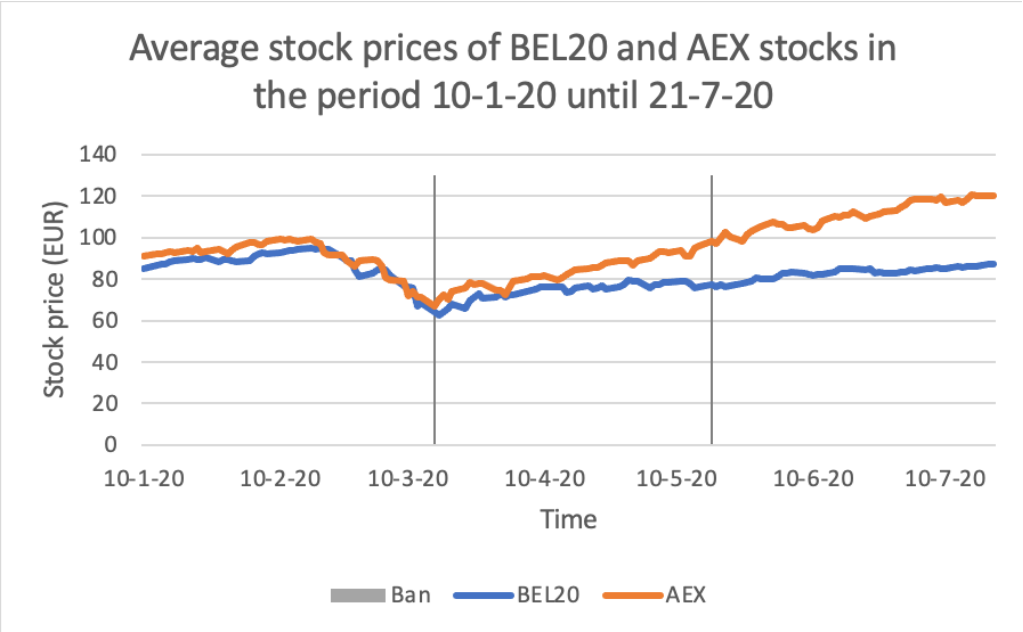

Figure 1: Average stock prices of BEL20 and AEX stocks during the period 10-1-20 until 21-7-20.

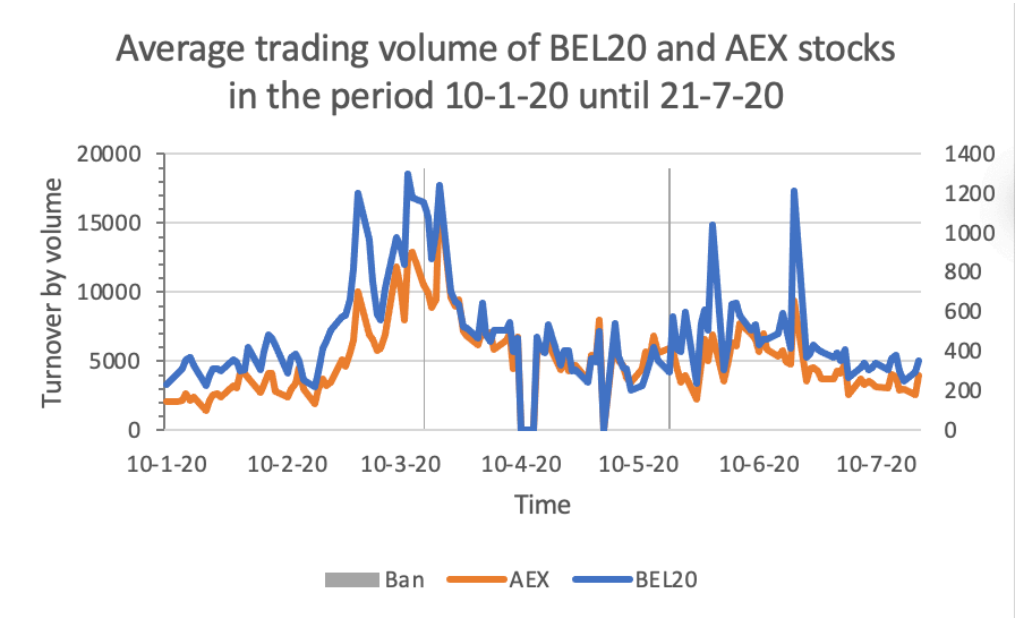

Figure 2: Average trading volume of BEL20 and AEX stocks in the period 10-1-20 until 21-7-20.

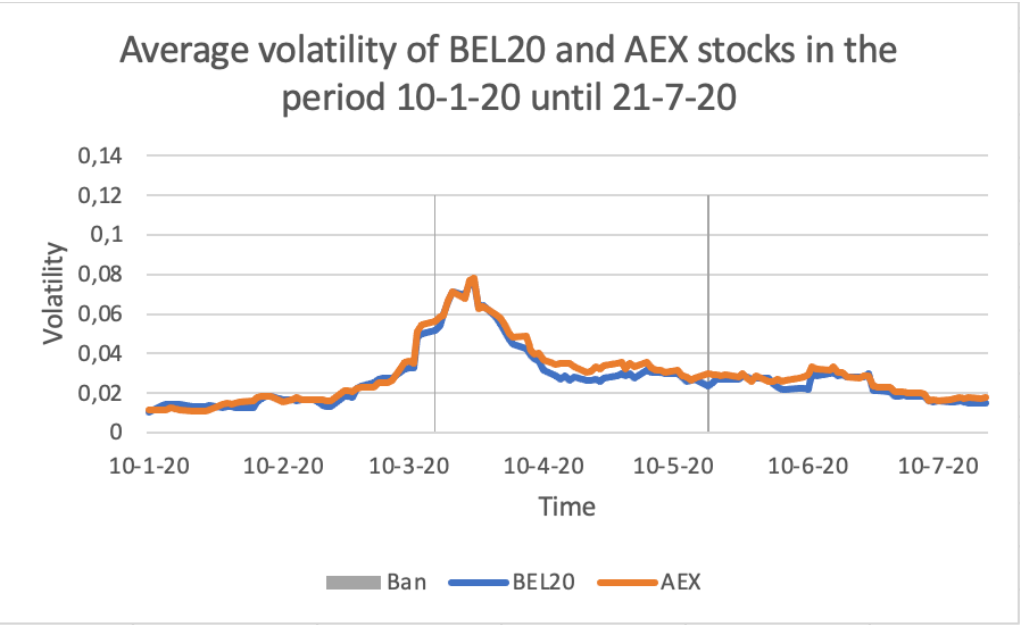

Figure 3: Average volatility of BEL20 and AEX stocks in the period 10-1-20 until 21-7-20.

Dependent Variable	P value
Price	0.008
Trading Volume	0.000
Volatility	0.000

Table 7: Hausman test results.

Base sample – BEL20 Constituents		Control sample – AEX Constituents	
1 AB InBev	ABI	**1 ABN AMRO**	ABN
2 Achermans & van Haaren	ACKB	**2 Adyen**	ADYEN
3 Aedifica	AED	**3 Aegon**	AGN
4 Ageas	AGS	**4 Ahold Delhaize**	AD
5 Aperam	APAM	**5 AkzoNobel**	AKZA
6 arGEN-X	ARGX	**6 ArcelorMittal**	MT
7 Cofinimmo	COFB	**7 ASM International**	ASM
8 Colruyt	COLR	**8 ASML Holding**	ASML
9 Elia	ELI	**9 ASR Nederland**	ASRNL
10 Galapagos	GLPG	**10 DSM**	DSM
11 GBL	GBLB	**11 Galapagos**	GLPG
12 KBC	KBC	**12 Heineken**	HEIA
13 Melexis	MELE	**13 IMCD**	IMCD
14 Proximus Group	PROX	**14 ING Group**	INGA
15 Sofina	SOF	**15 Just Eat Takeaway**	TKWY
16 Solvay	SOLB	**16 KPN**	KPN
17 Telenet Group	TNET	**17 NN Group**	NN
18 UCB	UCB	**18 Philips**	PHIA
19 Umicore	UMI	**19 Randstad**	RAND
20 WDP	WDP	**20 RELX**	REN
		21 Royal Dutch Shell	RDSA
		22 Unibail-Rodamco-Westfield	URW
		23 Wolters Kluwer	WKL

Table 14: Base and control samples.

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