Securities Transaction Tax and Market Behavior: Evidence from Euronext[◊]

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Abstract: Proponents of financial transaction taxes argue that these taxes dampen market volatility by reducing "noise trading". However, this is contrary to the efficient market hypothesis, according to which the introduction of such taxes would reduce liquidity and increase market volatility. In this paper, we study the impact of the securities transaction tax introduced in France in 2012 on market liquidity and volatility. To identify causality, we rely on the unique design of this tax, as it is imposed on large French firms only, all listed on Euronext. This provides two reliable control groups: smaller French firms and foreign firms also listed on Euronext. It allows using difference-in-difference methodology to isolate the impact of the tax from any other economic change during the period. We find that the introduction of the securities transaction tax has reduced volume and turnover of stocks and increased their bid-ask spread compared to foreign firms (although we do not detect the latter effect with French small firms as a control group). At the same time, we find no effect on theoretically based measures of liquidity, such as price impact or price reversal. We also find no significant and robust effect on volatility measures. We conclude that the securities transaction tax cannot be used as a Pigouvian tax to decrease market volatility, but it does not lead to any harmful distortions either.

Keywords: Financial transaction tax, Securities transaction tax, Tobin tax, Volatility, Liquidity.

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"And then there's the proposal for a Financial Transactions Tax... Even to be considering this at a time when we are struggling to get our economies growing is quite simply madness".

David Cameron, British Prime Minister

"And then there's the idea of taxing financial transactions, which have exploded in recent decades. The economic value of all this trading is dubious at best. In fact, there's considerable evidence suggesting that too much trading is going on… it suggests that to the extent that taxing financial transactions reduces the volume of wheeling and dealing, that would be a good thing."

Paul Krugman, economist and Nobel Laureate

1. Introduction

Is it possible to design a tax on financial transactions with the objective to curb speculative activity and render financial markets more stable? Or will additional taxation of financial transactions hurt market liquidity and price discovery, thus, making markets even more volatile? Although the idea to tax financial transaction dates to Keynes (1936) and Tobin (1978), it has received a renewed attention of policy leaders as a result of the global financial crisis. The idea appears to be particularly popular in Europe. In June 2011, the European Commission proposed to set up a financial transaction tax (FTT) as a source of the EU budget, but there was no unanimous support within the EU member states for a common FTT. Hence, in September 2012 eleven EU states have chosen to introduce a STT and the tax is planned to come in force in 2014. This will be the first time that the FTT will be introduced in a group of countries, but different versions of FTT exist in almost thirty countries in the world, including the United Kingdom, Switzerland, Hong-Kong, China, and Brazil. In some countries stocks and derivatives are taxed, like in the UE project, but most of the financial transaction taxes are levied only on stocks – and are referred as securities transaction taxes (STT).

The theoretical debate about STT focuses mainly on its effect on market volatility. In the framework of efficient market hypothesis, the increase in transaction costs due to the STT will reduce liquidity and automatically increase market volatility. Alternatively, the proponents of

STT rely on a new generation of theoretical models that loosen the hypothesis of rationality and assume that some market actors are not perfectly rational (De Long, Shleifer, Summers and Waldmann; 1990a, 1990b). Instead, they apply rules of thumb when making decisions to buy or sell, based on whatever information they have at their disposal. In this context, the introduction of a STT will dampen market volatility because it will reduce speculation by "noise traders".[1]

Since theoretical predictions are ambiguous, a number of papers empirically examine the impact of STT. However, there is no paper that can make a strong case for a causal relationship between STT and volatility, because most of these studies do not address endogeneity problems. One potential source of endogeneity relates to reverse causality. Since transaction taxes are often perceived as a tool to reduce market volatility, it is likely that they are introduced in countries and/or during periods exhibiting high market volatility. Another source of endogeneity is due to simultaneity and omitted variable biases. In other words, we do not know how the same market would have behaved if the tax had not been introduced, as these studies do not allow us to isolate the impact of the STT from other economic developments during the same time period. To do so, one needs to have a control group of stocks that is not affected by a tax. Although some studies follow this approach, their control groups are not fully convincing because they are located in a completely different institutional environment, such as different country or over-the-counter market (Umlauf, 1993; Saporta and Kan, 1997; Pomeranets and Weaver, 2012).

In this paper, we study the impact of the STT introduction in France, the second biggest stock-market in Europe, in 2012. We are interested to calculate the impact of the STT on market behavior measured by market liquidity and volatility to test the above theoretical models. Our contribution to the existing literature is twofold. First, we believe that our study provides the most rigorous investigation of causality between STT and market behavior. This is possible due to the unique design of the French STT. As the tax is levied only on large French firms – all of them listed on Euronext – this provides two control groups: smaller French firms and foreign firms also listed on Euronext. Hence, we can rely on difference-in-difference methodology to isolate the impact of the tax from any other economic or regulatory change during the analyzed period. It is important to note that the French STT is the only tax

[1] A comprehensive literature survey is provided later in the paper. See also Matheson (2011) and McCulloch and Pacillo (2011).

in the world that has affected differently large and small firms and, hence, it is impossible to reproduce the study in a different country.[2]

Our second contribution consists in the rigorous analysis of different measures of market liquidity and volatility. Unlike previous studies that focus on the impact of the STT on one or two measures of market behavior, we plan to analyze a very wide range of proxies. Usual measures of liquidity in the academic literature can be classified in three main categories: volume-based measures (volume and turnover ratio), transaction cost measures (bid-ask spread), and price-impact measures (liquidity ratio and price reversal). These measures gauge different aspects of market liquidity and are often complementary and not supplementary (Vayanos and Wang, 2012). Similarly, we plan to investigate the impact on market volatility measured by several alternative measures, such as squared close-to-close returns, daily conditional variance, and price range.

Our results show that the introduction of the STT has reduced volume and turnover of stocks and increased their bid-ask spread compared to foreign firms (although we do not detect the latter effect when relying on French small firms as a control group). At the same time, we find no effect on theoretically based measures of liquidity, such as price impact or price reversal. As to volatility measures, the results are mostly insignificant. We conclude that the STT cannot be used as a Pigouvian tax to decrease market volatility, but it does not lead to any harmful distortions either.

The remainder of the paper is structured as follows. Section 2 provides theoretical considerations and a critical overview of the empirical literature. Section 3 describes the data, the empirical strategy and the construction of the liquidity and volatility measures. Section 4 reports our empirical results and Section 5 concludes.

[2] In March 2013, Italy has introduced a similar STT which does not apply to companies whose average market capitalization is lower than €500 millions. However, this case is less suitable for the analysis because: i) the sample of Italian listed firms is quite small; ii) Italian stocks are not traded on a market with foreign firms, such as Euronext. It should be noted that the French and the Italian STT will be removed when the European tax (which does not tax differently large and small capitalization) will come into force.

2. Theoretical background and literature overview

2.1. Theoretical background

The idea of taxing financial activities – particularly transactions on the foreign exchange market and the stock market – can be attributed to John Maynard Keynes (1936), but it is now commonly associated with James Tobin who suggested (1978) throwing “a few grains of sand in the wheels of international finance”.

Standard financial theory is based on an archetype of markets in which agents are supposed to be perfectly rational, financial markets are efficient and, hence, stock prices reflect fundamentals. In this framework, volatility of stock prices reflects market illiquidity because sellers and buyers cannot find each other except after large price changes. Increasing liquidity and speculation are stabilising factors as rational traders react to unexploited profit opportunities and bring prices to their fundamental values. Accordingly, the increase in transaction costs due to the introduction of the STT will reduce liquidity and automatically increase volatility.

Null hypothesis: The introduction of the STT will amplify market volatility because it will reduce market liquidity by discouraging trading activity of rational investors.

A new generation of theoretical models assumes that market actors are not perfectly rational, but rather apply rules of thumb when making decisions to buy or sell, based on whatever information they have at their disposal. These models assume that there are different types of market actors and, as a result they are known as heterogeneous agent models. De Long, Shleifer, Summers and Waldmann (1990a, 1990b) formalized such a model in which fundamentalists are called ‘sophisticated traders’ and the chartists are ‘noise traders’. In the inefficient market, composed of heterogeneous participants, higher liquidity due to speculation increases volatility. More recently, Haberer (2004) suggests that there may be a U-shaped relationship between liquidity and excess volatility. At low levels of market volume, greater liquidity reduces excess volatility. However, after a certain point, the confusion caused by speculation creates a positive relationship between liquidity and excess volatility.

Hau (1998) develops a theoretical model on the relationship between taxes and volatility. His model allows for endogenous entry of traders subject to heterogeneous errors. Entry of a marginal trader into the market has two effects: it increases the capacity of the market to absorb exogenous supply risk, and at the same time it adds noise and endogenous trading risk. The competitive entry equilibrium is characterized by excessive market entry and excessively volatile prices. A positive tax on entrants can decrease trader participation and volatility while increasing market efficiency.

Another approach to modeling the behavior of financial markets is through the use of 'zero intelligence' models – so called because they assume that market traders in the aggregate, behave probabilistically rather than being driven by any intelligent maximizing behavior. Ehrenstein *et al.* (2005) used a zero intelligence model to evaluate the impact of a Tobin tax on volatility, and find that an introduction of a Tobin tax brings about a reduction in volatility, as long as the tax rate is not so high as to significantly reduce market liquidity. However, Mannaro *et al.* (2008) using a similar approach obtain a different result. They use a multi-agent simulation model to analyze the effects of introducing a transaction tax on two related stock markets. The market consists of four kinds of traders: random traders, who trade at random; fundamentalists, who pursue the 'fundamental' value; and chartists, who are either momentum traders (following the market trend) or contrarian traders (who go against the market trend). They find that when there are two markets, the imposition of a tax in a single market increases price volatility, as long as there are noise traders in the market. The intuition behind is that the volatility is higher as traders switch from one market to the other to try to reduce their risk. Hence, the taxed market is generally more volatile than the untaxed one because the tax reduces trading volume and market liquidity.

Alternative hypothesis: The introduction of the STT will dampen market volatility because it will reduce noise trading.

2.2. Critical overview of the empirical literature

Since theoretical predictions are ambiguous, a number of papers empirically examine the impact of the STT (see Table 1 for a summary). When measuring the impact on liquidly (often proxied by volume), studies arrive at similar results as five out of six studies summarized in Table 1 and reviewed below find negative impact on liquidity and one study finds statistically insignificant result. As to volatility, results are inconclusive. Four out of eight studies find no statistically significant results; three studies find an increase in volatility for some subsamples, and one study finds a decrease in volatility. However, most of these studies suffer from methodological shortcomings because they do not address endogeneity problems.

One potential source of endogeneity relates to reverse causality. Since transaction taxes are often perceived as a tool to reduce market volatility, it is likely that they are introduced in countries and during periods exhibiting high market volatility. Another source of endogeneity is due to simultaneity and omitted variable biases. In other words, we do not know how the same market would have behaved if the tax hadn't been introduced, as these studies do not allow us to isolate the impact of the STT from other economic developments or regulatory changes during the same time period. The three studies who suggest an increase of the stock market volatility (Baltagi, Li and Li, 2006; Phylaktis and Aristidou, 2007; Liau, 2012) do not control for simultaneity and omitted variable biases and, therefore, should be considered with cautious.

Several studies attempt to overcome the above endogeneity problems by relying on difference-in-difference methodologies.[3] In order to isolate the effect of the tax from other effects that could influence volatility, these studies compare the differential impact of STT changes on treatment and control groups. Three types of control groups have been considered: American Depository Receipts, stocks in a different country and over-the-counter transactions.

Umlauf (1993) studies the introduction of the 1% securities transaction tax in Sweden in 1984 and its eventual increase to 2% in 1986. To analyze the impact on volatility, they rely on the control group that consists of the New York Stock Exchange and London Stock Exchange indexes. Umlauf (1993) mentions that the Swedish tax was introduced for political reasons and, hence, the reaction of Swedish stock market could reflect increased political uncertainty that goes beyond the introduction of the tax. In this context, a control group from a different country does not allow isolating the effect of the tax from other economic and political developments in Sweden.

Saporta and Kan (1997) analyze changes in the UK stamp duty during 1955-1996 by comparing volatility of underlying shares of UK listed companies that are subject to the tax with volatility of their US listed American Depository Receipts. Although such approach is attractive, the reliability of their results suffers from small size of their control group that consists of only 4 American Depository Receipts. Liu (2007) relies on a similar methodology

[3] A paper by Foucault, Sraer and Thesmar (2011) analyse a reform of the French stock market that raises the relative cost of speculative trading for retail investors (who are often regarded as noise traders) and show that this significantly reduces the volatility of stocks.

to analyze STT change in 1989 in Japan. Their control group consists of 22 Japanese ADRs, but unfortunately they do not analyze impact on market volatility, but on volume. They find a negative impact.

Pomeranets and Weaver (2012) analyze nine changes in the New York state security transaction taxes between 1932 and 1981 that affected stocks traded on the New York Stock Exchange. They find that transaction taxes have a negative impact on volumes but no statistically significant impact on market volatility. Unfortunately, these results are likely to be of limited interest to policy makers because the STT in New York was abolished in 1981. In terms of methodology, they compare the impact of tax changes on the stocks traded on the New York Stock Exchange (treatment group) relatively to the stocks traded over-the-counter (control group). This approach was used earlier by Jones and Seguin (1997) who studied the 1975 introduction of lower, negotiated commissions on U.S. national stock exchanges that are analogous to a STT. The choice of such control group suffers from the fact that the decision to be listed or not on the organized exchange is likely to be endogenous, because reporting and regulatory requirements are smaller for stocks that are only traded over-the-counter.

3. Data and methodology

3.1.The French securities transaction tax

In January 2012, the French President Nicolas Sarkozy decided to impose a 0.1 percent tax on financial transactions related to French stocks. After the election of François Hollande and shortly before its introduction, the levy was doubled to 0.2 percent. The tax came into force on August 1, 2012.[4]

Importantly for our identification strategy, the STT should be paid on the purchase of stocks issued by companies whose headquarters are located in France and with market values of more than 1 billion Euros (on January 1, 2012). The list of the stocks subject to this tax was published on 2th of July 2012 and it is composed of 109 stocks listed on Euronext stock exchange. Hence, the design of the tax allows the division of the sample into a treatment and a control group by an ad-hoc cutoff of 1 billion Euros.

[4] It should be noted that the tax is collected once a day and, hence, intraday trading is not affected.

Among the 109 stocks subject to the French STT, 59 are included in the Euronext 100 index and 30 – in the Next 150. The remaining 20 stocks are not included in those indexes because their free float is too low (e.g. CIC or Autoroute Paris-Rhin-Rhone, with a free float lower than 3%) or because the company is controlled by a block of shareholders (e.g. Areva is held at 83% by the Commissariat à l'Energie Atomique and the French Government, Euler Hermes is held at 67% by the founding family and at 18% by LVMH).

Our sample consists of all the stocks included in the Euronext 100 or the Next 150 indexes. Our period extends over 12 months: 6 months before the introduction of the STT (February 2012-July 2012) and 6 months after the introduction of the STT (August 2012-January 2013).[5] Data are daily. Thus, our panel is composed of (a maximum of) 254 days * 250 firms = 63,500 observations. All the data are extracted from Datastream. For each stock, we have the opening and closing (adjusted) prices, the volume, the number of shares, the bid-ask spread quoted at the close of the market, the highest and the lowest prices achieved on the day.

*3.2. **A difference-in-difference approach***

To identify the impact of the STT, we rely on the generalized version of the difference-in-difference (DiD) methodology, and, hence we estimate the following econometric model:

$$V_{it} = \alpha_0 + \alpha_1 D_i + \alpha_2 D_t + \alpha_3 FTT_{it} + \epsilon_{it}, \qquad (1)$$

where V_{it} is a measure of market liquidity or volatility for the firm *i* at time *t*, D_i is a firm dummy variable, D_t is a time dummy variable, FTT_{it} is a dummy variable that is equal to 1 for large French firms (market values of more than 1 billion Euros) after the introduction of the STT on 1 August 2012 and ε_{it} is an error term. Our coefficient of interest is α_3. We estimate the equation allowing firm-level clustering of the errors that is allowing for correlation of the error term over time within firms (Bertrand et al., 2004).

The design of the French STT is well suited for DiD methodology because French authorities have introduced a tax on only large French firms traded on Euronext and, hence, providing us with two valid control groups: small French firms and foreign firms traded on Euronext. Time dummy variables capture all other changes in regulatory and economic environment during the period that should have affected large and small banks in a similar manner. Firm dummy variables capture differences between firms that are constant over time. In this way, the DiD

[5] We considered also a period of 1 year before the introduction of the STT to test the robustness. Results are available on request.

methodology allows for differences in market behavior between large and small firms before the introduction of the STT, but its underlying assumption is that these differences would remain constant if the STT has not been introduced (the "parallel trends" assumption).

We estimate equation (1) for three different subsamples that consist of two treatment groups and three control groups. Descriptive statistics for subsamples are provided in Table 2. In the first subsample, we consider all the firms that are included in the Euronext 100 index. All the French firms (59 firms, Panel A) in this subsample are subject to the tax, and our control group consists of foreign firms that are not subject to the STT (41 firms, Panel B). These foreign firms have headquarters in Belgium (11), Great Britain (1), Luxembourg (2), Netherlands (22), Portugal (4) or Spain (1). Second, we consider the sample of all French firms included in the Next 150 (79 firms). In this case, our treatment group is composed of large midcap French firms with a market value above 1 billion and that are subject to the STT (30 firms, Panel C), while our control group consists of small mid-cap French firms with market value of less than 1 billion and that are not subject to the STT (49 firms, Panel D). Finally, we consider the sample of firms that are included in the Next 150 with the exception of small French firms. Hence, our treatment group is, as before, the large French midcaps (30 firms, Panel C) and our control group consists of foreign firms included in Next 150 (71 firms, Panel E).

As explained in the previous section, a few previous studies analyze the effect of the STT by comparing the behavior of treatment and control groups before and after the tax changes (Pomeranets and Weaver, 2012; Umlauf, 1993; Saporta and Kan, 1997). The main advantage of our study is that stocks included both in the treatment and the control groups are traded on the same stock exchange and, hence, with the same organizational, regulatory and competitive environment. Both control groups have their advantages and disadvantages. The advantage of the smaller French stocks is that they allow a better control for country-specific shocks, because they belong to the same country as treatment group. The advantage of foreign firms traded on Euronext is that their size is more comparable with the treatment group. One can question, however, whether this control group allows isolating the effect of the STT from other shocks that could have affected France during the same time period. It is important to note that companies that are traded on the Euronext are virtually always multinational and about one half of the CAC 40 Index's market capitalization is held by non-residents. Hence, country-specific shocks might not be so important.

3.3. Measuring market liquidity and volatility

Our aim is to assess the impact of the French STT on market liquidity and stock volatility that can be measured by different variables, whose construction is described in this subsection. Descriptive statistics for these variables are provided Table 3.

Market liquidity

The (microeconomic) concept of liquidity is clearly multi-dimensional. As stated, among others, by Sarr and Lybek (2002), *"number of measures must be considered because there is no single theoretically correct and universally accepted measure to determine a market's degree of liquidity"*. While there is a very broad consensus on that statement[6], previous papers on the impact of financial transaction tax usually consider only a few indicators.

Usual measures of liquidity in the academic literature can be classified – from the less to the most sophisticated – in three main categories: volume-based measures (volume and turnover ratio), transaction cost measures (bid-ask spread), and price-impact measures (liquidity ratio and price reversal). Accordingly, in this study, we use the following variables:

- *Volume,* $V_{i,t}$= Number of shares traded for the stock i on day t $*P_{i,t}$ where $P_{i,t}$ is the closing price for the stock i on the day t; number of shares is expressed in thousands.
- *Turnover,* $T_{i,t}$ = 100*Number of shares traded for the stock i on day t / total number of shares for the stock i on day t available to ordinary investors; turnover is expressed in percentage.
- *Bid-ask spread,* $S_{i,t} = 2*100*(PA_{i,t}-PB_{i,t}) / (PA_{i,t}+PB_{i,t})$ where $PA_{i,t}$ and $PB_{i,t}$ are the asking price and the bid price offered for the stock i at close of market on day t, respectively; bid-ask spread is expressed in percentage.
- *Liquidity Ratio,* $LR_{i,t} = V_{i,t} / |R_{i,t}|$ where $R_{i,t}$ is the continuously compounded returns, $\log(P_{i,t} / P_{i,t-1})$, for the stock i on the day t, respectively; liquidity ratio is expressed in thousands euros of trade for a price change of one percent.
- *Price Reversal,* $PR_{i,t}$ is minus the coefficient of a regression of $R_{i,t}$ on $V_{i,t-1}*\text{sign}(R_{i,t-1})$, controlling for $R_{i,t-1}$.

These measures gauge different aspects of market liquidity and are often complementary and not supplementary. Measuring liquidity by trading volume and turnover is the most intuitive

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[6] Recent surveys on financial market liquidity include Gabrielsen, Marzo and Zagaglia (2011), and Vayanos and Wang (2012).

way because it captures markets' breadth and depth. However these measures suffer from some drawbacks (Vayanos and Wang, 2012). First, trading activity does not provide a direct estimate of the costs of trading. Second, trading activity can be influenced by other variables than market imperfections, such as the supply of an asset, the number of investors holding it and the size of their trading needs. Another widely used measure of liquidity is bid-ask spread and it is used to assess tightness. Note that this measure provides no information on the prices at which larger transactions take place. By the same token, it provides no information on how the market might respond to a long sequence of transactions in the same direction. Market's response to large buying or selling pressure is an important aspect of illiquidity.

Liquidity denotes the ability to trade large quantities quickly, at low cost, and without moving the price. Two indicators address this definition. The liquidity ratio, which assesses how much traded volume is necessary to induce a price change of one percent, measures price impact[7]: higher ratio is associated with higher liquidity. Price reversal is also a measure of price impact, albeit less intuitive. It is based on the idea that, if markets are illiquid, trades should generate transitory deviations between price and fundamental value[8]: higher price reversal is associated with lower liquidity.

Market volatility

Similarly, there are several alternative measures to assess market volatility. According to Engle and Gallo (2006), for instance, "*the concept of volatility itself is somewhat elusive, as many ways exist to measure it and hence to model it*". In this paper, we consider four different metrics:

- *Squared Return*, $SR_{i,t} = (R_{i,t})^2$ where $R_{i,t} = \log(P_{i,t} / P_{i,t-1})$.
- *Absolute Return*, $AR_{i,t} = |R_{i,t}| \sqrt{\pi/2}$.

[7] There are several alternative to compute this ratio, which idea goes back to Dolley (1938) and Beach (1939). This ratio can be also expressed as the inverse of the illiquidity measure of Amihud (2002). Common alternatives is to consider the difference between the highest and the lowest daily prices instead of the return, and to adjust traded volume for market capitalization. However, empirical results are not qualitatively different and, consequently, are not reported.

[8] The idea dates back to Niederhoffer and Osborne (1966), but was popularized by Roll (1984) who uses the autocovariance of daily stock returns to proxy price reversal. Campbell, Grossman, and Wang (1993) show that the autocovariance of returns correlates negatively with trading volume and, then, suggest to use a conditional estimator. Since then, several specifications have been proposed; amongst them, the measure of Pastor Stambaugh (2003), which our indicator is inspired by, is one of the most used.

- *Volatility, V_i* is the annualized (times $\sqrt{252}$) standard deviation of $R_{i,t}$; volatility is expressed in percentage.
- *Conditional variance, $CV_{i,t}$* is proxied with a GARCH(1,1) model.
- *High-low range, $HLR_{i,t}$* = $(\log PH_{i,t} - \log PL_{i,t})^2 / 4 \log(2)$ where $PH_{i,t}$ and $PL_{i,t}$ are the highest price and the lowest price achieved for the stock i on the day t, respectively.
- *Daily Price Amplitude, $DPA_{i,t}$* = $2*100*(PH_{i,t}-PL_{i,t})/(PH_{i,t}+PL_{i,t})$ where $PH_{i,t}$ and $PL_{i,t}$ are the highest price and the lowest price achieved for the stock i on the day t, respectively; price amplitude is expressed in percentage.

Squared close-to-close return is a common estimator of the daily variance.[9] Volatility clustering has been extensively documented, so we report results for the daily conditional variance, proxied by a conventional GARCH(1,1) model which parameters are estimated over the whole period of 12 months (February 2012 – January 2013).[10] Finally, we use a measure of price range, defined as the scaled difference between the highest and the lowest prices achieved on a day. The range provides volatility information from the entire intraday price path, without the need of high frequency data. Parkinson (1980) shows that the daily high-low range is an unbiased estimator of daily volatility more efficient than the squared daily return. More recently, Brandt and Diebold (2006) find that its efficiency is comparable with that of the realized variance computed as the sum of squared 3-hour returns[11], while it is more robust against the effects of market microstructure noise, particularly bid-ask bounce.[12]

4. Empirical results

4.1. Graphical representation of parallel trends assumption

In Figures 1-2, we provide figures that show the parallel evolution of our dependant variables for stocks included in the Euronext 100 and the Next1 50 indexes. For Euronext 100 and

[9] Jones and Seguin (1997) and Pomeranets and Weaver (2012) consider an unbiased estimator of the standard deviation computed as $\sqrt{(\pi/2)}|R_{i,t}|$. Because the first term is a constant, it does not influence the econometric results later on.

[10] We consider two specifications of the mean equation: a first one with only a constant term and an AR(1). This choice does not have any consequence, and we report only results corresponding to the AR(1).

[11] Recently, a lot of research has been devoted to the use of high-frequency data for measuring volatility and the so-called realized variance has rapidly gained popularity for estimating daily volatility.

[12] We compute also the volatility for each portfolio before and after the introduction of the STT. However, because this indicator is not a daily metric, it can be used only for a descriptive purpose. Our final results (available on request) remain unchanged.

Next 150, we distinguish between French firms that are subject to STT (FR_STT) and foreign firms that are not subject to STT (noFR_noSTT). For Next 150, we additionally distinguish French firms that are not subject to STT (FR_noSTT). The figures show that market liquidity and volatility exhibit parallel trends before the introduction of the STT, albeit the level is different for different types of firms. The observation of such parallel trends before introduction of the tax allows us to make a counterfactual assumption that our variables of interest would preserve these trends if the tax was not applied.

4.2. Difference-in-difference results

We estimate the impact of the introduction of the STT on market behavior and present results of difference-in-difference estimation in Tables 4-5. Estimation is done for three difference subsamples that differ with respect to treatment and control group. In column 1, we present results for stocks included in the Euronext 100 index, whereas in columns 2-3 – for stocks in Next 150 index. The control group consists of foreign stocks in columns 1 and 3 and of French stocks that are not subject to the STT in column 2 (see section 3.2 for more details about subsamples).

Table 4 presents results for liquidity measured by volume, turnover, bid-ask spread, liquidity ratio, price reversal (see section 3.3 for definitions). The results show that the introduction of the STT has reduced volume and turnover of stocks subject to the STT relatively to control groups. The coefficients are not only statistically significant in all three subsamples but also economically meaningful. Relying on coefficients in columns 1-3, volumes have declined by 19%, 23% and 29% (corresponding to the coefficients of -0.2159, -0.2594 and -0.3464). There is also evidence that transaction costs have gone up as the bid-ask spread has increased. This result holds for the subsamples in columns 1-2, but is not robust for the sample of large French midcaps with other foreign firms as a control group (column 3). Our finding that the introduction of the transaction tax results in the increase of transaction costs and decline of activity is not surprising. This is in line with the both our hypotheses that are based on the idea that transaction taxes discourage participation of certain investors. The crucial question is whether the discouraged “rational” or “noise” traders.

As discussed in Section 3.3, the above liquidity measures suffer from a number of drawbacks and are imperfect measures of liquidity. As to more theoretically based measures, such as price impact and price reversal, there is no robust evidence that the STT has had a statistically significant impact. We can conclude that the introduction of the STT has not affected market liquidity, insofar as the market ability to trade large quantities without moving the price has not changed.

Next, we look at the effect of the STT on market volatility (Table 5). Volatility is measured by squared returns, absolute returns, conditional variance, high-low range and price amplitude (see section 3.3 for variable definition). Notwithstanding the measure of volatility, we find no robust evidence that the introduction of the STT has affected volatility. In the first two subsamples, the impact on volatility is not statistically significant. In the third sample (Next 150 with foreign stocks as a control group), our results show that, with the exception of absolute returns, all measures of volatility decline after the introduction of the tax. However, these results are sometimes significant only at 10%. Hence, our results reject the hypothesis that the introduction of the STT increases market volatility because of reduced liquidity. At the same time, the alternative hypothesis that the STT drives away mainly "noise traders" and decreases volatility is not supported either by our data in a robust way. Most likely, both effects are at work and the introduction of the STT has driven away both "rational" and "noise" traders, both effects canceling each other out. At the end, our results are very much in line with Bloomfield, O'Hara and Saar (2009) who conclude that *"[STT] reduces activity by noise and informed traders roughly equally (...), and perhaps as a result it does not alter bid-ask spreads or other price impact measures of liquidity, and has only a weak effect (if at all) on the informational efficiency of prices*".

5. Conclusion

This paper analyses the impact of financial transaction taxes on market volatility. This question is at the heart of economic policy debate about the use of financial transaction taxes to curb speculative activity and render financial markets more stable. The opponents argue that additional taxation of financial transactions will hurt market liquidity, thus, making markets even more volatile.

The theoretical predictions on this subject are ambiguous and, hence, there is a need for an econometric analysis. Although a number of papers empirically examine the impact of STT, our reading of the empirical literature is that there is no paper that can make a strong case for a causal relationship between STT and volatility. Most of these studies do not address endogeneity problems inasmuch as they cannot isolate the impact of the STT from other economic developments during the same time period.

In this paper, we study the impact of the STT introduction in France in 2012 on market liquidity and volatility. Unlike previous studies, we are able to isolate the effect of the tax due to the unique design of the French STT. As the tax is levied only on large French firms traded on Euronext, this provides us with two control groups (smaller French firms and foreign firms) and allows us to use difference-in-difference methodology. Our results show that the introduction of the STT has reduced volume and turnover of stocks and increased bid-ask spreads. At the same time, we find no effect on theoretically based measures of liquidity, such as price impact or price reversal. As to volatility measures, the results are mostly insignificant.

To sum up, our investigation shows that STT is neither a panacea nor a threat for financial markets. The only variables that are affected are volume and turnover and our results do not confirm expectations that STT decreases market volatility by curbing speculative activity. At the same time, our results show that the introduction of the tax is not “madness”, as there is no significant effect on market volatility and even liquidity.

References

Amihud, Y., 2002, Illiquidity and stock returns: Cross-section and time-series effects, *Journal of Financial Markets*, 5, 31–56.

Baltagi, B., Li, D. and Li, Q., 2006, Transaction Tax and Stock Market Behavior: Evidence from an Emerging Market, *Empirical Economics*, 31, 393–408.

Beach, W. E. (1939): Stock Market Continuity, *The American Economic Review*, 29(4), 774-789.

Bertrand, M., E. Duflo and S. Mullainathan, 2004, How Much Should We Trust Differences-in-Differences Estimates?, *Quarterly Journal of Economics* 119(1), 249-275.

Bloomfield, R., M. O'Hara, and G. Saar, 2009, How Noise Trading Affects Markets: An Experimental Analysis, Review of Financial Studies, 22(6), 2275-2302.

Brandt, M.W. and F.X. Diebold, 2006, A no-arbitrage approach to range-based estimation of return covariances and correlations, *Journal of Business*, 79, 61–74.

Campbell, John, Sanford Grossman, and Jiang Wang, 1993, Trading volume and serial correlation in stock returns, *Quarterly Journal of Economics* 108, 905–939.

De Long, J.B., Shleifer, A., Summers, L.H. and Waldmann, R.J., 1990a. Noise Trader Risk in Financial Markets, *Journal of Political Economy* 98: 703–38.

De Long, J.B., Shleifer, A., Summers, L.H. and Waldmann, R.J., 1990b. Positive Feedback Investment Strategies and Destabilizing Rational Speculation, *Journal of Finance* 45.2: 379–95.

Dolley, J. C. (1938): The Effect of Government Regulation in the Stock-trading volume of the New York Stock Exchange, *The American Economic Review*, 28(1), 8-26.

Ehrenstein, G.; Westerhoff, F., and Stauffer, D., 2005, Tobin Tax and Market Depth, Q*uantitative Finance* 5.2: 213–18.

Engle, R.F., and Gallo, G.M., 2006, A Multiple Indicators Model for Volatility Using Intra-Daily Data, *Journal of Econometrics*, 131(1–2), 3–27.

Foucault, T., D. Sraer and D.J. Thesmar, 2011, Individual Investors and Volatility, *Journal of Finance*, 66(4), 1369-1406.

Gabrielsen, A., M. Marzo and P. Zagaglia, 2011, Measuring market liquidity: An introductory survey, *Working paper*.

Haberer, M., 2004. *Might a Securities Transaction Tax Mitigate Excess Volatility? Some Evidence from the Literature*, CoFE Discussion Paper 04-06, Konstanz: Center of Finance and Econometrics, University of Konstanz.

Hau, H., 1998. Competitive Entry and Endogenous Risk in the Foreign Exchange Market, *Review of Financial Studies* 11(4), 757–87.

Hu, S., 1998, The Effects of the Stock Transaction Tax on the Stock Market: Experience from Asian Markets, *Pacific Basin Finance Journal*, 6, 347–64.

Jones, C.M. and Seguin, P.J., 1997. Transaction Costs and Price Volatility: Evidence from Commission Deregulation, *American Economic Review* 87(4), 728–37

Liu, S., 2007, Securities Transaction Tax and Market Efficiency: Evidence from the Japanese Experience, *Journal of Financial Services Research*, 32, 161–76.

Keynes, J.M. 1936. The general theory of employment, interest, and money. New York: Harcourt Brace.

Mannaro, K., Marchesi, M. and Setzu, A. (2008) 'Using an Artificial Financial Market for Assessing the Impact of Tobin-Like Transaction Taxes', *Journal of Economic Behavior and Organization* 67.2: 445–62

Matheson, T., 2011, Taxing Financial Transactions: Issues and Evidence, IMF Working paper, WP/11/54.

McCulloch N. and G. Pacillo, 2011, The Tobin Tax: A Review of the Evidence, IDS Research Report, n°68, *Institute of Development Studies*.

Niederhoffer, Victor, and M. Osborne, 1966, Market making and reversal on the stock exchange, *Journal of the American Statistical Association*, 61, 897–916.

Parkinson, M., 1980, The extreme value method for estimating the variance of the rate of return, *Journal of Business*, 53, 61–65.

Pastor, Lubos, and Robert Stambaugh, 2003, Liquidity risk and expected stock returns, *Journal of Political Economy* 111(3), 642–685.

Phylaktis, K. and Aristidou, A., 2007, Security transaction taxes and financial volatility: Athens stock exchange, *Applied Financial Economics*, 17(18), 1455-1467.

Pomeranets, A., and Weaver, D.G., 2011. Securities Transaction Taxes and Market Quality, Bank of Canada, *Working Paper* 2011-26.

Roll, Richard, 1984, A simple implicit measure of the effective bid-ask spread in an efficient market, *Journal of Finance* 39, 1127–1139.

Roll, R., 1989, Price Volatility, International Market Links and Their Implication for Regulatory Policies, *Journal of Financial Services Research*, 3(2-3), 211–46.

Sahu, D., 2008, Does Securities Transaction Tax Distort Market Microstructure? Evidence from Indian Stock Market, *Working Paper*, Banaras Hindu University.

Saporta, V. and Kan, K., 1997, The effects of stamp duty on the level and volatility of UK equity prices, Bank of England, *Working Paper*, No. 71.

Sarr, A., and Lybek, T., 2002, Measuring Liquidity in Financial Markets (December 2002). *IMF Working Paper*, 1-64.

Tobin, J., 1978, A proposal for international monetary reform, *Eastern Economic Review*, 153-159.

Vayanos, D., and J. Wang, 2012, Market Liquidity: Theory and Empirical Evidence, *Handbook of the Economics of Finance*, forthcoming.

Umlauf, S.R., 1993, Transaction taxes and the behavior of the Swedish stock market, *Journal of Financial Economics*, 33, 227-40.

Figure 1. Dynamic of the stock market activity

These figures present weekly (un-weighted) average for five different sub-samples (or portfolios). Euronext 100: FR STT (59 firms) + no FR, no STT (41 firms); Next 150: FR STT (30 firms) + FR, no STT (49 firms) + no FR, no STT (71 firms). Filters applied.

Daily Volume$_{i,t}$ = Number of shares traded for the stock *i* on day *t* * $P_{i,t}$ where $P_{i,t}$ is the closing price for the stock *i* on the day *t*. *Total Daily Volume*$_t$= $\sum_i$ *Daily Volume*$_{i,t}$. *Share of Volume*$_t$ is expressed in %.

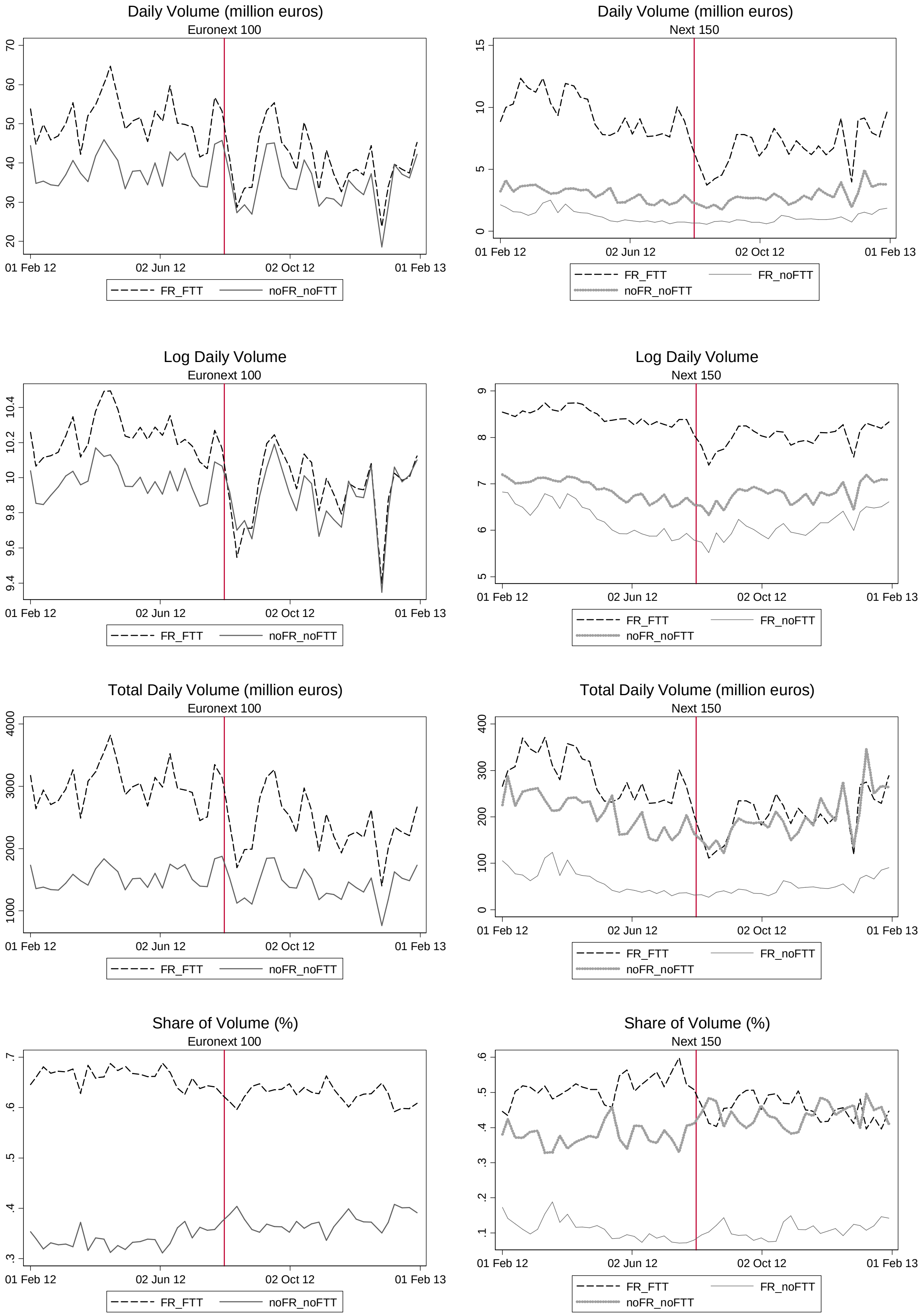

Figure 1. Dynamic of the stock market activity (continued)

These figures present weekly (un-weighted) average for five different sub-samples (or portfolios). Euronext 100: FR STT (59 firms) + no FR, no STT (41 firms); Next 150: FR STT (30 firms) + FR, no STT (49 firms) + no FR, no STT (71 firms). Filters applied.

Daily Turnover$_{i,t}$ = 100*Nb. of shares traded for the stock i on day t divided by total number of shares for the stock i on day t available to ordinary investors. *Bid-ask spread*$_{i,t}$ = $2*100*(PA_{i,t}–PB_{i,t})/(PA_{i,t}+PB_{i,t})$ where $PA_{i,t}$ and $PB_{i,t}$ are the asking price and the bid price offered for the stock i at close of market on day t, respectively. *Total transaction cost*$_t$ = $\sum_i$ (1/2 *Bid-ask spread*$_{i,t}$ * $V_{i,t}$). *Liquidity Ratio*$_{i,t}$ = $V_{i,t} / |R_{i,t}|$ with $R_{i,t} = \log(P_{i,t} / P_{i,t–1})$; expressed in thousands euros of trades for a price change of 1%.

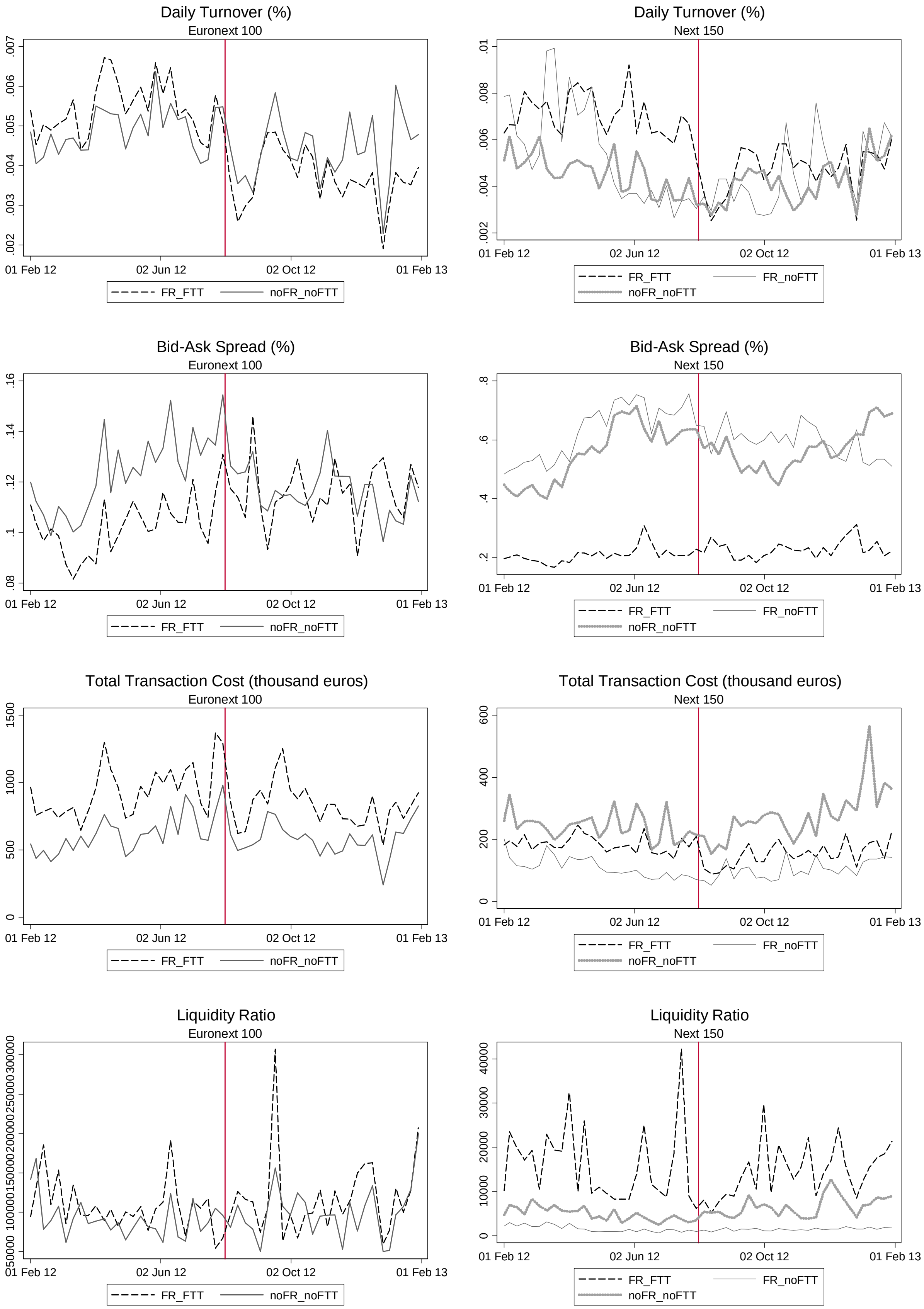

Figure 2. Dynamic of the stock market volatility

These figures present weekly (un-weighted) average for five different sub-samples (or portfolios). Euronext 100: FR STT (59 firms) + no FR, no STT (41 firms); Next 150: FR STT (30 firms) + FR, no STT (49 firms) + no FR, no STT (71 firms). Filters applied.

Squared Return$_{i,t}$ = $(R_{i,t})^2$ with $R_{i,t}$= 100*log($P_{i,t}$ / $P_{i,t-1}$). *Absolute Return*$_{i,t}$ = $|R_{i,t}|\ \sqrt{\pi/2}$. *Portfolio Squared Return*$_{m,t}$ = $(R_{m,t})^2$ with $R_{m,t}$= 100*log($\sum_i MV_{i,t}$ / $\sum_i MV_{i,t-1}$) where $MV_{i,t}$ is the market value for the stock i at close of market on day t. *Portfolio Absolute Return*$_{i,t}$ = $|R_{m,t}|\ \sqrt{\pi/2}$.

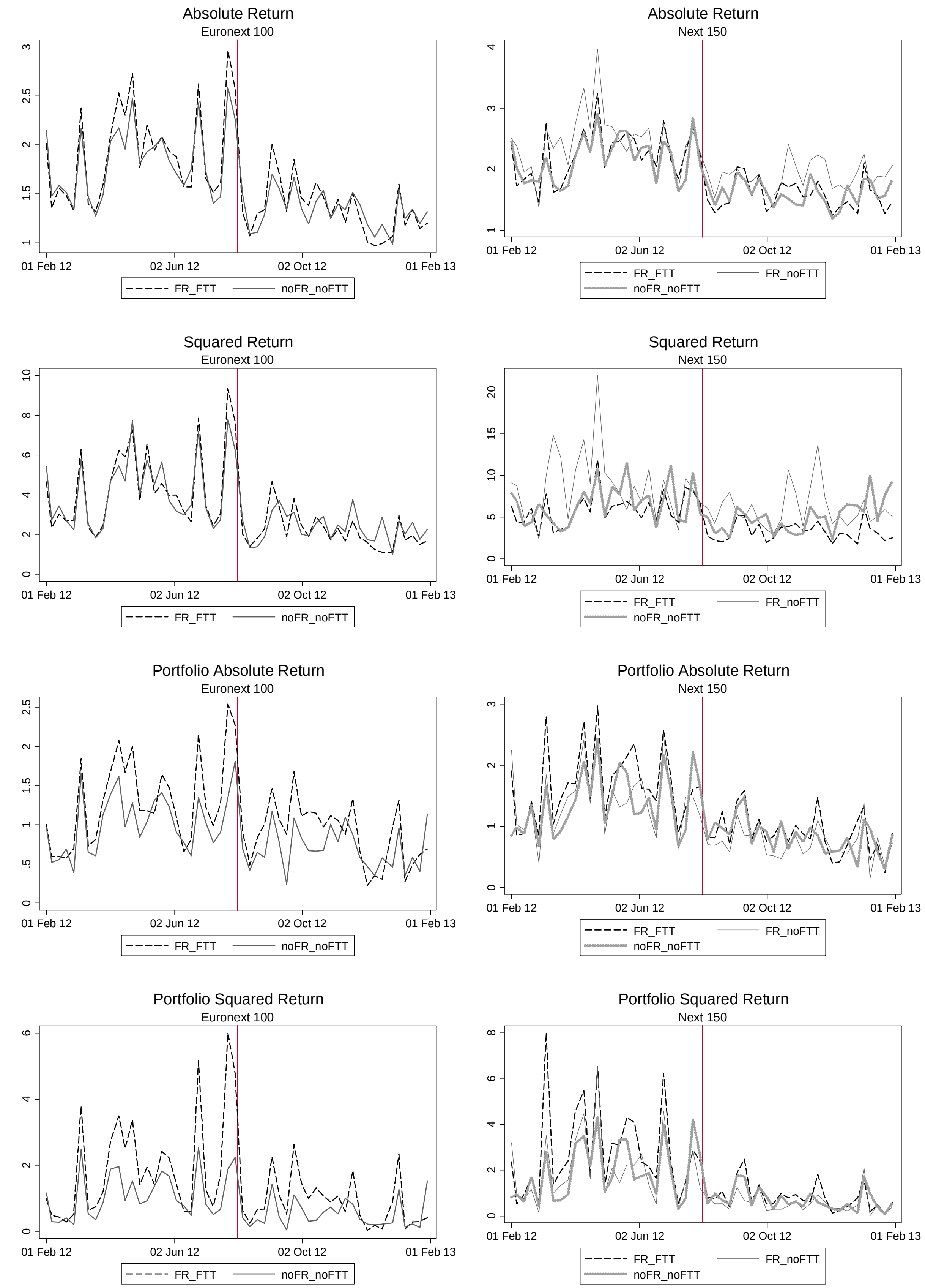

Figure 2. Dynamic of the stock market volatility (continued)

These figures present weekly (un-weighted) average for five different sub-samples (or portfolios). Euronext 100: FR STT (59 firms) + no FR, no STT (41 firms); Next 150: FR STT (30 firms) + FR, no STT (49 firms) + no FR, no STT (71 firms). Filters applied.

Conditional variance$_{i,t}$ is estimated with a GARCH(1,1) over 18 months. *High-low range*$_{i,t}$ = $(\log PH_{i,t} - \log PL_{i,t})^2 / 4 \log(2)$ where $PH_{i,t}$ and $PL_{i,t}$ are the highest price and the lowest price achieved for the stock *i* on the day *t*, respectively. *Daily Price amplitude*$_{i,t}$ = $2*100*(PH_{i,t}-PL_{i,t})/(PH_{i,t}+PL_{i,t})$.

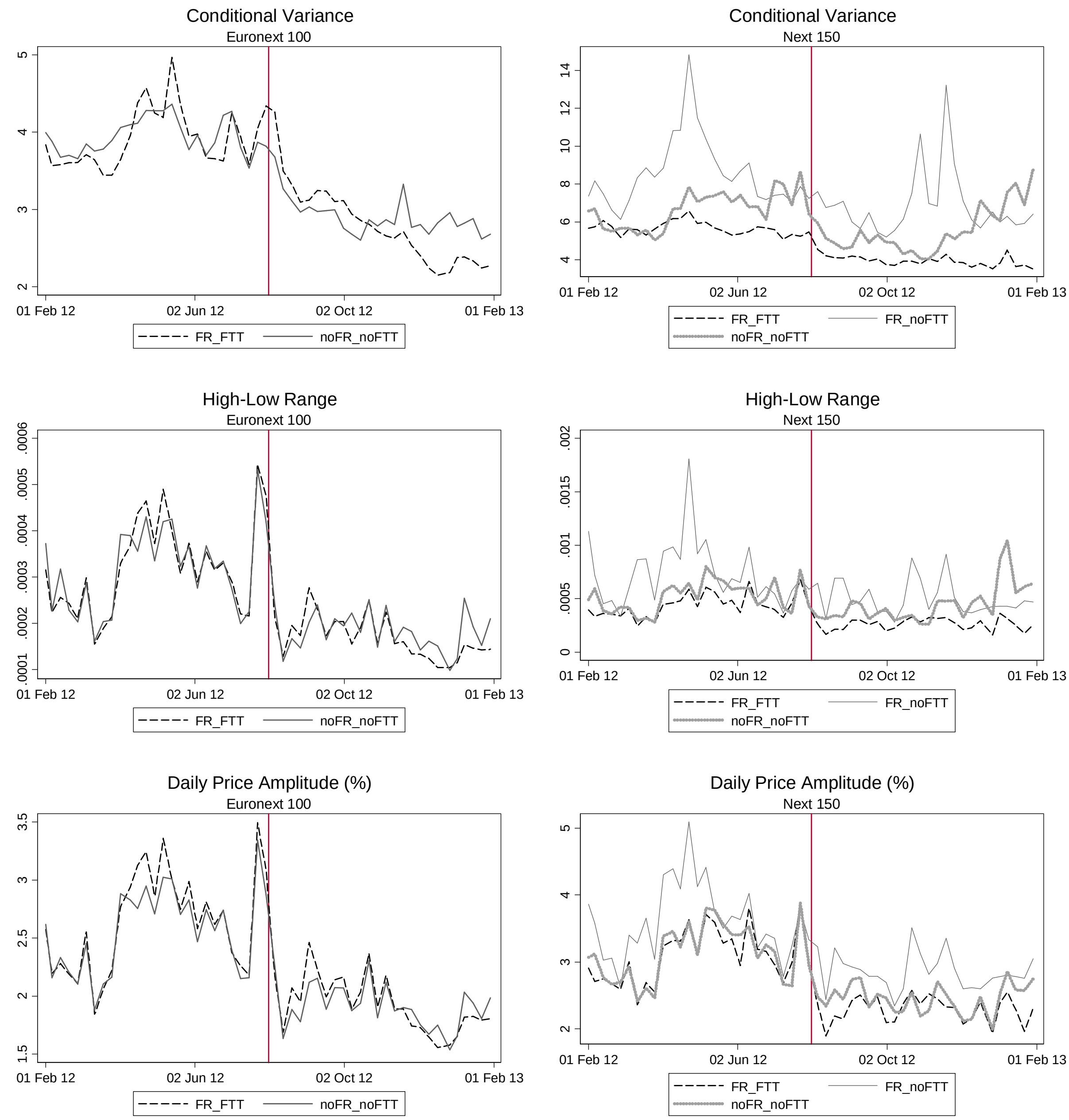

Table 1. Previous studies on the impact of STT

Studies	Sample	Methodology	Results for volume	Results for volatility
Roll (1989)	23 countries (1987-89)	OLS		Not significant
Umlauf (1993)	Sweden (1984-86)	Difference-in-difference		Inconclusive
Saporta & Kan (1997)	G.B. (1963-86)	Difference-in-difference		Not significant
Hu (1998)	Hong Kong (1991-93), Japan (1977-80) Korea (1978-90) Taiwan (1978-86)	OLS	Not significant	Inconclusive
Baltagi, Li & Li (2006)	China (1997)	Comparison before-after	Negative impact	Increase
Liu (2007)	Japan (1989)	Comparison before-after	Negative impact	
Phylaktis & Aristidou (2007)	Greece (1998-00)	Comparison before-after		Increase for highly traded stocks
Sahu (2008)	India (2004)	Comparison before-after	Negative impact	Not significant
Pomeranets & Weaver (2012)	U.S. (1932-81)	Difference-in-difference	Negative impact	Not significant
Liau (2012)	Taiwan (1998-07)	Comparison before-after		Increase

Table 2. Descriptive Statistics

	Stocks subject to the French STT		Stocks not subject to the French STT			
	Free Float %	*Market Value (bil. €)*	*Free Float %*	*Market Value (bil. €)*	*Free Float %*	*Market Value (bil. €)*
Euronext 100	**Panel A (FR, STT), # 59**		**Panel B (noFR, no STT), # 41**			
Mean	69	17,256	71	14,642		
Min	16	3,186	22	2,902		
Max	100	94,688	100	109,345		
SD	23	20,128	24	22,179		
Next 150	**Panel C (FR, STT), # 30**		**Panel D (FR, no STT), # 49**		**Panel E (noFR, no STT), # 71**	
Mean	61	2,118	62	459	70	848
Min	24	996	24	96	15	113
Max	100	4,025	100	1 756	100	3,536
SD	21	828	20	382	22	695
Stocks not included in the indexes [a], # 20						
Mean	18	5,366				
Min	1	1,025				
Max	39	24,862				
SD	13	6,740				

Source: Datastream (December 11, 2012). Authors' computation. Note: [a] Altarea, Areva, Bollore, Cambodge (Cie), Christian Dior, CIC, Ciments français, CNP assurances, Colas, Dassault aviation, Euler Hermes, Financière de l'Odet, Foncière Développement Logements, Foncière lyonnaise, Fromageries Bel, Hermes international, Autoroute Paris-Rhin-Rhone, Somfy, Vicat, Vilmorin et Cie.

Table 3. Descriptive statistics of the 250 largest stocks on Euronext

This table provides some descriptive statistics of the stocks included in the Euronext 100 and Next 150 indexes. The sample period extends over 12 months: 6 months before (Feb. 2012-July. 2012, 127 days) and 6 months after (Aug. 2012-Jan. 2013, 127 days) the introduction of the STT. All the data are daily. STT is a dummy variable = 1 after August 1, 2012 if the firm is subject to the STT; 0 otherwise. FR is a dummy variable = 1 if the stock has an ISIN code starting with FR; 0 otherwise. Euronext100 is a dummy variable = 1 if the stock is included in the Euronext 100 index; 0 otherwise. Next150 is a dummy variable = 1 if the stock is included in the Next 150 index; 0 otherwise. $P_{i,t}$ is the closing price for the stock *i* on the day *t*. $MV_{i,t}$ is the market value of the stock *i* at close of market on the day *t*. $NBST_{i,t}$ is the number of shares traded for a stock *i* on the day *t*. $NOSH_{i,t}$ is the total number of ordinary shares for the stock *i* on day *t*. $NOSHFF_{i,t}$ is the percentage of shares available to ordinary investors for the stock *i* on day *t*. $Volume_{i,t} = NBST_{i,t} * P_{i,t}$. $Turnover_{i,t} = 100*NBST_{i,t} / (NOSH_{i,t} * NOSHFF_{i,t})$. $Bid\text{-}ask\ spread_{i,t} = 2*100*(PA_{i,t}–PB_{i,t}) / (PA_{i,t}+PB_{i,t})$ where $PA_{i,t}$ and $PB_{i,t}$ are the asking price and the bid price offered for the stock *i* at close of market on day *t*, respectively. *High-low range*, $HLR_{i,t} = (\log PH_{i,t} – \log PL_{i,t})^2 / 4 \log(2)$ where $PH_{i,t}$ and $PL_{i,t}$ are the highest price and the lowest price achieved for the stock *i* on the day *t*, respectively. $Price\ amplitude_{i,t} = 2*100*(PH_{i,t}–PL_{i,t})/(PH_{i,t}+PL_{i,t})$. $Return_{i,t}$ is the continuously computed return $R_{i,t} = 100*\log(P_{i,t} / P_{i,t–1})$. ~~*Squared Return*~~$\cancel{_{i,t}, SR_{i,t} = (R_{i,t})^2}$ ~~with~~ $\cancel{R_{i,t} = \log(P_{i,t} / P_{i,t–1})}$~~.~~ ~~*Conditional variance*~~$\cancel{_{i,t}}$ ~~is estimated with a GARCH(1,1)~~. $Absolute\ Return_{i,t} = |R_{i,t}|\ \sqrt{\pi/2}$. $Liquidity\ Ratio_{i,t} = V_{i,t} / |R_{i,t}|$; liquidity ratio is expressed in thousand euros of trades for a price change of 1%.

Variable	Obs.	Mean	Std. Dev.	Min	Max
STT (D)	63,500	0.178	0.383	0	1
FR (D)	63,500	0.552	0.497	0	1
Euronext100 (D)	63,500	0.400	0.490	0	1
Next150 (D)	63,500	0.600	0.490	0	1
$P_{i,t}$ (€)	63,374	28.81	27.93	0.0300	187.9
$MV_{i,t}$ (thousand €)	63,374	6,642	14,308	31.55	112,346
$NBST_{i,t}$ (thousand)	63,105	1,747	10,075	0	778,656
$NOSH_{i,t}$ (thousand)	63,374	407,300	1.071e+06	2,786	1.970e+07
$NOSHFF_{i,t}$ (%)	63,333	67.29	22.28	12	100
$Volume_{i,t}$ (thousand €)	63,105	18,853	38,478	0	1.162e+06
$Turnover_{i,t}$ (%)	63,064	0.00479	0.00882	0	0.513
$Bid\text{-}ask\ spread_{i,t}$ (%)	62,826	0.351	0.700	0.00976	28.57
$High\text{-}low\ range_{i,t}$	63,344	0.000402	0.00136	0	0.0941
$Price\ amplitude_{i,t}$ (%)	63,344	2.664	2.002	0	50
$Return_{i,t}$ (%)	63,363	0.0336	2.229	–28.77	37.08
$Abs(Return_{i,t})$ (%)	63,363	1.839	2.104	0	46.48
$Liquidity\ Ratio_{i,t}$ (thousand €)	61,409	46,931	271,341	0	1.850e+07

Source: Datastream. Authors' computation.

Table 4. The impact of the French STT on stock market liquidity

This table presents difference-in-difference econometric tests. Models are estimated on 6 months before (Feb. 2012-July 2012, 127 days) and 6 months after (Aug. 2012-Jan. 2013, 127 days) the introduction of the STT. STT is a dummy variable = 1 after August 1, 2012 if the firm is subject to the STT; 0 otherwise. $ln(Volume_{i,t})$ = ln(Number of shares traded for the stock i on day t * $P_{i,t}$) where $P_{i,t}$ is the closing price for the stock i on the day t; number of shares is expressed in thousands. $Turnover_{i,t}$ = 100*Nb. of shares traded for the stock i on day t divided by total number of shares for the stock i on day t available to ordinary investors. $Bid\text{-}ask\ spread_{i,t} = 2*100*(PA_{i,t}–PB_{i,t})/(PA_{i,t}+PB_{i,t})$ where $PA_{i,t}$ and $PB_{i,t}$ are the asking price and the bid price offered for the stock i at close of market on day t, respectively. $Liquidity\ Ratio_{i,t} = V_{i,t} / |R_{i,t}|$ with $R_{i,t} = 100*\log(P_{i,t} / P_{i,t–1})$, for the stock i on the day t, respectively; liquidity ratio is expressed in thousands euros of trades for a price change of 1%. $Price\ Reversal_{i,t}$ is minus the coefficient of a regression of $R_{i,t}$ on $V_{i,t–1}$*sign($R_{i,t–1}$). Time and firms dummies are included but not reported.

Model	**(1)**	**(2)**	**(3)**
Sample	**Euronext 100**	**Next 150**	
Nb. of firms	**FR STT (59) no FR, no STT (41)**	**FR STT (30) FR, no STT (49)**	**FR STT (30) no FR, no STT (71)**
ln(Volume$_{i,t}$)			
STT	–0.2159***	–0.2594***	–0.3464***
(t-stat)	(21.20)	(14.05)	(20.68)
Nb. of obs.	25,270	20,056	25,397
adj. R^2	0.893	0.821	0.817
***Turnover$_{i,t}$ (%)* × 100**			
STT	–0.1327***	–0.1344***	–0.1925***
(t-stat)	(14.66)	(5.34)	(10.18)
Nb. of obs.	25,229	20,056	25,399
adj. R^2	0.388	0.279	0.244
Bid-ask spread$_{i,t}$ (%)			
STT	0.0221***	0.0558***	0.0033
(t-stat)	(8.27)	(6.05)	(0.26)
Nb. of obs.	25,091	20,015	25,312
adj. R^2	0.271	0.494	0.538
***Liquidity ratio$_{i,t}$* × 1,000**			
STT	1.7732	–1.5126	–3.2407
(t-stat)	(0.19)	(0.89)	(1.86)
Nb. of obs.	25,051	19,359	24,505
adj. R^2	0.098	0.058	0.057
Price reversal (dependent variable: R$_{i,t}$)			
$R_{i,t–1}$	–0.0025	–0.0074	–0.0413*
(t-stat)	(0.24)	(0.39)	(2.14)
$V_{i,t–1}$*sign($R_{i,t–1}$)	–0.0000	–0.0000	0.0000*
(t-stat)	(1.73)	(0.49)	(2.15)
$V_{i,t–1}$*sign($R_{i,t–1}$)*STT	–0.0000	0.0000	–0.0000
(t-stat)	(1.87)	(0.41)	(0.68)
Nb. of obs.	25,266	20,056	25,399
adj. R^2	0.342	0.205	0.203

Source: Datastream. Authors' computation.

*, **, *** indicates a coefficient statistically different from zero at the 10%, 5%, 1% level, respectively.

Table 5. The impact of the French STT on stock market volatility

This table presents difference-in-difference econometric tests. Models are estimated on 6 months before (Feb. 2012-July 2012, 127 days) and 6 months after (Aug. 2012-Jan. 2013, 127 days) the introduction of the STT. STT is a dummy variable = 1 after August 1, 2012 if the firm is subject to the STT; 0 otherwise. *Squared Return*$_{i,t}$, $SR_{i,t} = (R_{i,t})^2$ with $R_{i,t} = 100*\log(P_{i,t} / P_{i,t-1})$. *Absolute Return*$_{i,t}$ = $|R_{i,t}|\sqrt{\pi/2}$. *Conditional variance*$_{i,t}$ is estimated with a GARCH(1,1). *High-low range*, $HLR_{i,t} = (\log PH_{i,t} - \log PL_{i,t})^2 / 4\log(2)$ where $PH_{i,t}$ and $PL_{i,t}$ are the highest price and the lowest price achieved for the stock *i* on the day *t*, respectively. *Price amplitude*$_{i,t}$ = $2*100*(PH_{i,t}-PL_{i,t})/(PH_{i,t}+PL_{i,t})$ where $PH_{i,t}$ and $PL_{i,t}$ are the highest price and the lowest price achieved for the stock *i* on the day *t*, respectively. Time and firms dummies are included but not reported.

Model	**(1)**	**(2)**	**(3)**
Sample	**Euronext 100**	**Next 150**	
Nb. of firms	**FR STT (59) no FR, no STT (41)**	**FR STT (30) FR, no STT (49)**	**FR STT (30) no FR, no STT (71)**
Squared return*$_{i,t}$ *(%)			
STT	–0.2678	0.1026	–1.0327*
(t–stat)	(1.29)	(0.16)	(2.21)
Nb. of obs.	25,270	20,064	25,649
adj. R^2	0.163	0.053	0.092
Absolute return*$_{i,t}$ *(%)			
STT	–0.0626	–0.0743	–0.0951
(t–stat)	(1.76)	(1.29)	(1.93)
Nb. of obs.	25,270	20,064	25,649
adj. R^2	0.292	0.175	0.198
***Conditional variance*$_{i,t}$**			
STT	–0.0530	–0.0110	–0.4537*
(t–stat)	(1.00)	(0.05)	(2.57)
Nb. of obs.	25,400	20,066	25,654
adj. R^2	0.578	0.281	0.362
***High-low range*$_{i,t}$**			
STT	–0.0000	0.0001	–0.0001***
(t–stat)	(1.09)	(1.61)	(3.35)
Nb. of obs.	25,270	20,056	25,638
adj. R^2	0.255	0.112	0.162
Price amplitude*$_{i,t}$ *(%)			
STT	–0.0361	–0.0372	–0.1111**
(t–stat)	(1.34)	(0.78)	(2.79)
Nb. of obs.	25,270	20,056	25,638
adj. R^2	0.427	0.330	0.351

Source: Datastream. Authors' computation.

*, **, *** indicates a coefficient statistically different from zero at the 10%, 5%, 1% level, respectively.