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The Impact of the French Securities Transaction Tax on Market Liquidity and Volatility[◊]

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Abstract: In this paper, we assess the impact of the securities transaction tax (STT) introduced in France in 2012 on market liquidity and volatility. To identify causality, we rely on the unique design of this tax that is imposed only on large French firms, all listed on Euronext. This provides two reliable control groups (smaller French firms and foreign firms also listed on Euronext) and allows using difference-in-difference methodology to isolate the impact of the tax from other economic changes occurring simultaneously. We find that the STT has reduced trading volume, but we find no effect on theoretically based measures of liquidity, such as price impact, and no significant effect on volatility. The results are robust if we rely on different control groups (German stocks), analyze dynamic effects or construct a control group by propensity score matching.

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

JEL Classification: G21, H25.

L'impact de la taxation des transactions financières sur la liquidité et la volatilité des actions françaises

Résumé : Dans cet article, nous évaluons l'impact de la taxe sur les transactions financières (TTF), introduite en France en 2012, sur la liquidité et la volatilité des actions. Cette taxe se prête particulièrement bien à une étude d'impact dans la mesure où seules les grandes entreprises qui ont leur siège social en France sont taxées, permettant ainsi d'identifier deux groupes de contrôle : les autres entreprises françaises et les entreprises étrangères, toutes cotées sur Euronext. Nous utilisons la méthode des doubles-différences pour isoler l'impact de la taxe d'autres changements économiques survenus simultanément. Il en ressort que la TTF a réduit les volumes de transaction, mais sans que cela n'ait d'effet sur la liquidité. Nous ne décelons, en outre, aucun effet sur la volatilité. Ces résultats sont robustes même en utilisant d'autres groupes de contrôle (les actions allemandes) ou en appliquant une méthode d'appariement sur les scores de propension.

Mots-clés : Taxe sur les transactions financières, Taxe Tobin, Volatilité, Liquidité, Euronext.

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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: A 'madness' or a 'good thing'?

Will a tax on financial transactions curb speculative activity and render financial markets more stable? Or will it hurt market liquidity and price discovery, thus, making markets even more volatile? Although the idea to tax financial transactions 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 chose to introduce a FTT, which was initially planned to come in force in 2014.[1] This will be the first time that the FTT is 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 EU project, but most of the financial transaction taxes are levied only on stocks – and are referred as to securities transaction taxes (STT).

The debate on FTT is among the most visible and newsworthy aspects of financial regulation and one of the most controversial topics.[2] According to a survey conducted by the European

[1] Gabor (2013) provides an in-depth analysis of the political economics of the European Commission's proposal.
[2] To give a broad idea, the entry "Tobin tax" is listed in the top 250 controversial issues among Wikipedia editors for the category "Politics/Economics", along with such entries as Capital punishment, Holocaust, Gun

Commission, FTT is supported by six out ten Europeans. The strength of the support varies considerably among the countries: in France, Germany or Italy seven out of ten respondents are in favor of the FTT, while there are only four in Sweden or the UK and only three in the Netherlands.[3] At the same time, European political leaders are strongly divided on the merits of FTT and the opposition is expressed in harsh terms. For the Swedish Finance Minister, Anders Borg, such tax is "very dangerous", its Dutch counterpart, Jan Kees de Jager fears "devastating results", UK Prime Minister, David Cameron considers FTT as a "madness".[4] Several leading economists have also expressed strong views on this topic. For some (including Kenneth Rogoff[5]), FTT is not only inefficient, but counterproductive, while for others (among which Paul Krugman[6], Avinash Persaud[7], Jeffrey Sachs[8]), it might be a win-win initiative.

Despite the popularity of FTT and the surrounding controversies, the academic literature is rather scarce.[9] Theoretically, FTT should decrease trading volume due to an increase in transaction costs, but the ultimate impact on volatility depends on what type of traders is driven from the market. In the framework of the Efficient Market Hypothesis, agents are supposed to be perfectly rational and stock prices reflect fundamentals. Increasing liquidity and speculation are stabilising factors. Accordingly, the increase in transaction costs due to the FTT will reduce liquidity by driving away rational agents, thus, automatically amplifying market volatility (Schwert and Seguin, 1993; Dooley, 1996; Kupiec, 1996; Subrahmanyam, 1998; Amihud and Mendelson, 2003). Alternatively, if noise traders (either uniformed or not perfectly rational) prevent stock prices from converging to their fundamental value, increasing trading is destabilising. By discouraging noise traders' activity, the FTT will dampen market volatility (Stiglitz, 1989; Summers and Summers, 1989; Eichengreen, Tobin and Wyplosz, 1995).

Bloomfield, O'Hara and Saar (2009) provide an elegant framework which encompassed the two previous paradigms. They use a laboratory market to investigate the behavior of noise traders and their impact on the market. While FTT do "*reduce volume, [it] do[es] not affect*

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politics, Same-sex marriage, etc. If we restrict the list to economic issues, it appears in the top 10 together with some broad matters like Capitalism or Communism.

[3] EU 27 (In favor: 61%; Opposed: 25%), France (71%; 19%), Germany (74%; 16%), Italy (72%; 14%), Sweden (45%; 46%), UK (43%; 41%), Netherlands (36%; 53%). Source: Standard Eurobarometer n°74, January 2011.

[4] Quotes are from *The New York Times*, Oct. 9, 2012 and *The Telegraph*, Jan. 26, 2012.

[5] Kenneth Rogoff, The wrong tax for Europe, *Project Syndicate*, Oct. 3, 2011.

[6] Paul Krugman, Things to tax, *The New York Times*, Nov. 27, 2011.

[7] Avinash Persaud, EU's financial transaction tax is feasible, and if set right, desirable, *VoxEu*, Sept. 30, 2011.

[8] Jeffrey Sachs, Obama, the G20, and the 99 Percent, *Huffington Post*, Nov. 1, 2011.

[9] A comprehensive literature survey is provided in Matheson (2011) or McCulloch and Pacillo (2011).

spreads and price impact measures, and have at most a weak effect on the informational efficiency of prices." They explained this result by arguing that the FTT has driven away both rational and noise traders. Song and Zhang (2005) come to a similar conclusion in a general equilibrium setting.

Hau (1998) also develops a model in which endogenous entry of traders may increase the capacity of the market to absorb exogenous supply risk, but 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. Finally, there might be a U-shaped relationship between liquidity and excessive volatility (Haberer, 2004; Ehrenstein *et al.*, 2005). 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.

Since theoretical predictions are ambiguous, it is important to examine the impact of the FTT empirically. In this paper, we study the introduction, in 2012, of a 0.2 percent tax on daily acquisitions of French equity securities. We are interested in calculating the impact of this STT on market quality measured by market liquidity and volatility. Our contribution to the existing literature is twofold. First, we believe that our study provides a rigorous investigation of causality between STT and market quality. 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 other economic or regulatory developments during the analyzed period. Although some earlier studies follow this approach, their control groups are not fully convincing because stocks are traded in a completely different institutional environment, such as foreign or over-the-counter market (Umlauf, 1993; Pomeranets and Weaver, 2012). It is important to note that the French STT is virtually the only tax in the world that has affected differently large and small firms.[10]

Our second contribution consists in a rigorous analysis of different dimensions of market liquidity and volatility. Usual measures of liquidity in the academic literature can be classified in three main categories: volume-based measures (volume and turnover ratio), transaction cost

[10] In March 2013, Italy has introduced a similar STT which does not apply to companies whose average market capitalization is lower than €500 million.

measures (bid-ask spread), and price-impact measures (liquidity ratio and price reversal). These measures gauge different aspects of market liquidity and are often complements and not substitutes (Vayanos and Wang, 2012). Similarly, we plan to investigate the impact on market volatility measured by several alternative measures, such as absolute and squared close-to-close returns, daily conditional variance, and price range.

Our study shows that the introduction of the French STT has reduced market volume, but there is no effect on theoretically based measure of liquidity, such as price impact. As to volatility measures, the results are statistically insignificant. The results are robust if we rely on different control groups (German stocks included in DAX and MDAX), analyze dynamic effects or construct a control group by propensity score matching. Overall, our results give support to the laboratory observations made by Bloomfield, O'Hara and Saar (2009). For policy purposes, we can conclude that the French STT cannot be used as a Pigouvian tax to decrease market volatility, but it does not lead to harmful distortions either.

Recently, several unpublished studies have independently examined the impact of the French STT (Becchetti, Ferrari and Trenta, 2013; Colliard and Hoffman, 2013; Haferkorn and Zimmermann, 2013; Meyer, Wagener, and Weinhardt, 2013). All these studies rely on a difference-in-difference methodology, but they only examined short-term effects (over a maximum period of a few months after the introduction of the tax). They are mainly interested in the impact on liquidity, and do not provide much evidence on volatility. Overall, they support our results.

The remainder of the paper is structured as follows. Section 2 provides an 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. Section 5 provides several robustness tests: different samples (smaller but more homogeneous), and different method (propensity score matching). Section 6 concludes.

2. Overview of the empirical literature

Since theoretical predictions are ambiguous, a number of papers empirically examine the impact of the STT on financial market[11] (see Table 1 for a summary).[12] When measuring the impact on liquidity (often proxied by volume), studies arrive at similar results as four out of

[11] Empirical evidence form the housing market in Singapore is recently provided by Fu, Qian and Yeung (2013).
[12] A parallel body of literature examines the impact of the tick size on stock market quality. See Hau (2006) for a panel data study on the French market.

five studies in Table 1 find negative impact on liquidity and one study finds statistically insignificant result. As to volatility, results are inconclusive. Six out of eleven studies find inconclusive or statistically insignificant results; four 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 had not 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 that 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 caution.

Several studies attempt to overcome the above endogeneity problems by relying on difference-in-difference methodologies. 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. Different types of control groups have been considered: American Depository Receipts, foreign stocks, over-the-counter and forward markets.

Umlauf (1993) studies the introduction of the 1% securities transaction tax in Sweden in 1984 and its increase to 2% in 1986. To analyze the impact on volatility, he relies 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 shares of UK listed companies that are subject to the tax with the corresponding American Depository Receipts (ADRs). Although such approach is attractive, it only allows analyzing the impact on market volumes, because stocks and ADRs prices are closely related

due to arbitrage. Moreover, the reliability of their results suffers from small size of their control group that consists of only four ADRs. Liu (2007) relies on a similar methodology to analyze STT change in 1989 in Japan. His control group consists of 22 Japanese ADRs and he finds a negative impact on volumes.

Pomeranets and Weaver (2012) analyze nine changes in the New York state STT between 1932 and 1981 that affected stocks traded on the New York Stock Exchange. They find that the STT has a negative impact on traded volumes, but no statistically significant impact on market volatility. Moreover, they find no consistent evidence that traders avoid the tax by changing their location of trades. Unfortunately, these results are difficult to generalize because the STT in New York was abolished in 1981 and since then, the increase in traded volume has been tremendous. In terms of methodology, for tax changes from 1975, they compare stocks traded on the New York Stock Exchange (treatment group) to stocks traded on the Nasdaq (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 on the Nasdaq. Moreover, the difference-in-difference analysis is performed only for volatility, but not for liquidity.

Lastly, Foucault, Sraer and Thesmar (2011) analyze a reform of the French stock market that suppresses the possibility to trade with end-of-month settlement (the "*Règlement Mensuel*", similar to a forward market) for highly liquid stocks and, thus, raises the relative cost of speculative trading for retail investors, who are often regarded as noise traders. This reform could be compared to the introduction of a STT. The authors rely on difference-in-difference methodology (with spot market as a control group) and show that the reform has significantly reduced the volatility of stocks.

Table 1. Previous studies on the impact of an increase[1] in STT (or akin transaction costs)

Studies	Sample	Type of reform	Control group	Measure of liquidity	Results for liquidity[1]	Measure of volatility	Results for volatility[1]
Roll (1989)	23 countries (1987-89)	STT	Countries without STT			Std .dev. of returns	Not significant
Umlauf (1993)	Sweden (1984-86)	STT	None or NYSE-FTSE			Variance of returns	Inconclusive
Jones & Seguin (1997)	U.S. (1974-1976)	Fixed commissions	Nasdaq			Std .dev. of returns, absolute returns	Positive impact
Saporta & Kan (1997)	G.B. (1963-86)	STT	ADRs			Variance of returns, GARCH	Not significant
Hu (1998)	H.-K., Japan, Korea, Taiwan (1977-93)	STT	None	Turnover	Inconclusive	Std .dev. of returns	Inconclusive
Baltagi et al. (2006)	China (1997)	STT	None	Volume	Negative impact	Variance of returns, GARCH	Positive impact
Chou & Wang (2006)	Taiwan (1999-2001)	STT	None	Volume, bid-ask	Negative impact	Realized volatility, high-low range	Not significant
Liu (2007)	Japan (1989)	STT	ADRs	Volume, Autocorrelation	Negative impact		
Phylaktis & Aristidou (2007)	Greece (1998-00)	STT	None			GARCH	Positive impact for highly traded stocks
Foucault et al. (2011)	France (1998 2002)	Cost of forward trading	Spot market	Autocovariance, Amihud illiquidity	Negative impact	Std .dev. of returns,	Negative impact
Pomeranets & Weaver (2012)	U.S. (1932-81)	STT	None or Nasdaq	Holden spread, Amihud illiquidity	Negative impact	Std .dev. of returns	Not significant
Liau et al. (2012)	Taiwan (1998-07)	STT	None			GARCH	Positive impact

[1] Although reviewed studies analyze increases or decreases in transaction costs, the reported results must be interpreted as a reaction to an increase in STT.

3. Data and methodology

3.1. The French securities transaction tax

In January 2012, the French President Nicolas Sarkozy announced the introduction a 0.1 percent tax on financial transactions related to French stocks.[13] The terms of the tax have been detailed in the Article 5 of the Supplementary Budget Act for 2012 (Act No. 2012-354 of 14 March 2012), published in the Official Gazette (*Journal Officiel*) on 15 March 2012 and completed with the fiscal instruction 3°P-3-12 (BOI n°61 of 3 August 2012).[14] The tax has three components: i) a tax on acquisitions of French equity securities and similar instruments (Article 235 ter ZD); ii) a tax on orders cancelled in the context of high frequency trading (Article 235 ter ZD bis); iii) a tax on naked sovereign credit default swaps (Article 235 ter ZD ter). After the election of François Hollande and shortly before its introduction, the rate of the tax on acquisitions of equity securities was doubled to 0.2 percent. The tax came into force on August 1, 2012.

According to the initial estimate of the government, the tax should have yielded €1.6 billion in 2013, that is around 0.2% of total fiscal revenues. One year later, based on the first result for 2012, the estimate was adjusted downwards by fifty percent. In fact, the total revenue for 2012 (August-December) was equal to €0.2 billion: 99.5% from acquisitions of equity securities and 0.5% from transactions on naked sovereign CDS. The tax on high-frequency trading generated no revenue (Finance committee of the French parliament's lower house, Information report n°1328 of 25 July 2013), as will be discussed later.

Hence, the main component of the taxing scheme is the tax on acquisitions of equity securities and similar instruments, defined as shares and other securities that provide or could provide access to capital or voting rights (hereafter, the STT). The tax does not apply to units in collective investment schemes and financial contracts (including options, futures and warrants). Exemptions also include: i) issuance of equity securities on the primary market, ii) transactions by a clearing house or a central depository, iii) activities related to market making (either for providing liquidity on a regular and continuous basis, or in response to orders initiated by clients, or by hedging positions arising from the fulfilment of the previous tasks),

[13] It should be noted that a STT already existed in France: it was called "*Impôt sur les opérations de bourse*", created in 1893 and abrogated in 2007 (see Figure A in appendix).
[14] Detailed of the French FTT are available on the website of the French Ministry of Economy: https://www.tresor.economie.gouv.fr/File/376507.

iv) acquisitions in the context of liquidity agreements, v) intra-group and restructuring transactions, vi) temporary transfers of securities, vii) employee saving scheme transactions, viii) exchange or conversion of bonds into shares. To prevent tax avoidance, the tax is due regardless of the place of establishment of the regulated market on which the security is traded, regardless of the place of establishment or residence of the parties to the transaction, and regardless of the place where the contract was entered into.

Importantly for our identification strategy, the STT must be paid on the acquisition of stocks issued by companies whose headquarters are located in France and with market values of more than 1 billion Euros on January 1st of the year of taxation. 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. Hence, the design of the tax allows the split of the sample into a treatment and a control group with an ad-hoc cutoff of €1 billion.

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) – see Table A in appendix.

Finally, the STT is collected once a day and, hence, intraday trading is not affected. To tax high-frequency trading, an additional tax of 0.01 percent was introduced on the amount of cancelled or modified orders, in excess of a threshold of 80%, within a time-span of half a second (Article 235 ter ZD bis and decree n°2012-957, August 6, 2012). As it was mentioned earlier, this tax on high-frequency trading had generated zero revenue in 2012. According to the French financial markets regulator (*Autorité des Marchés Financiers*), the market share of high-frequency trading in 2012 has remained virtually stable (slightly declined from 20% to 18%) and so, there is strong evidence that the tax on high-frequency trading has been bypassed.[15] In this context, this study focuses on daily measures of market quality.

[15] Subsequently, in October 2013, the Finance committee of the French parliament's lower house proposed to extent the STT to intraday trading. However, the French government was not in favor of this amendment which was finally rejected.

3.2. The sample

Our initial 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).[16] 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.

We exclude from the initial sample six companies that have experienced a takeover bid in 2012, plus a company for which information on trading volume is missing. This leaves 61,722 observations, *i.e*. 97% of the initial sample. Firms subject to the French STT represent about one third of the sample. Further, for robustness checks, we exclude companies for which stock price was lower than €2 at least one day over the period or the total volume over the period below k€60,000. This robustness sample contains 82% of the initial one – see Table B in appendix.

3.3. 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:

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

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) 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

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

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 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 had not been introduced (the "parallel trends" assumption).

We estimate equation (1) for three different subsamples based on two treatment groups and three control groups. 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 (40 firms, Panel B[17]). These foreign firms have headquarters in Belgium (11), Great Britain (1), Luxembourg (2), Netherlands (21), Portugal (4) or Spain (1). Second, we consider all French firms included in the Next 150 (78 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 (29 firms, Panel C[18]), 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 firms included in the Next 150 with the exception of small midcap French firms. Hence, our treatment group is, as before, the large French midcaps (29 firms, Panel C) and our control group consists of foreign firms included in Next 150 (66 firms, Panel E[19]).

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, and hence are usually subject to the same shocks. Nevertheless, both control groups used in this study (the foreign firms and the small midcaps) 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

[17] TNT Express, which experienced a takeover bid in 2012, has been removed from the initial sample.
[18] CFAO, which experienced a takeover bid in 2012, has been removed from the initial sample.
[19] Degven, Dockwise, Mediq, and LBI International which experienced a takeover bid in 2012, have been removed from the initial sample. Espirito Santo Finl GP has been also removed due to infrequent trading.

control group allows isolating the effect of the STT from other shocks that could have affected France during the same time period.

One may argue that the STT might have a global impact on all Euronext stocks due to co-movement in liquidity. Cespa and Foucault (2011) have shown that liquidity spillover can be positive or negative depending on the cost of price information. In either case, our estimate of the impact could be biased if we consider securities from Euronext as a control group. Therefore, we use also a control group consisting of German stocks traded on Deutsche Boerse (Xetra) and included in the DAX 30 or the MDAX 50 indexes. This sample is less likely to be impacted by potential co-movement in liquidity.

The choice of the control groups is intended to be theoretically grounded. To confirm their relevance, we report in Table 2 the correlation of daily portfolio returns between treatment and control groups and compare it with previous studies that relied on control groups (Umlauf, 1993; Pomeranets & Weaver, 2012). Because we do not have access to data samples of earlier papers, we consider, as a proxy, the main stock indexes in Sweden, the US and the UK. To insure comparability, we first do the same for French, Belgium, Dutch and German stocks. Then we measure the correlation for our exact samples.

Looking at our sample, we find that the correlation of returns between the French, the Belgium and the Dutch stock indexes is high. Precisely, for the largest firms (Euronext 100) correlation of daily returns between Panel A (FR, STT) and Panel B (noFR, no STT) is more than 90% over the period. The correlation for mid-caps (Next 150) is slightly lower, but still large: 90% between Panel C (FR, STT) and Panel D (FR, no STT) and 84% between Panel C and Panel E (noFRR, noSTT). Finally, co-movement with firms listed on Deutsche Boerse is also high with a correlation of 92% between our Panel A and the DAX index and a correlation of 83% between Panel C and the MDAX index.

Our correlation results compare well to earlier studies. Umlauf (1993) analyzed the impact of the STT on the Swedish market, relying on the US and UK markets as control groups. The correlations of 9-19% are very low due to the large distance (geographical, economical, institutional…) of Sweden to the UK or the US in the 1980s, therefore making these stock markets not very suitable as control groups. Pomeranets & Weaver (2012) consider the impact of a STT on the NYSE by relying on Nasdaq as a control group. Although stocks listed on the NYSE and the Nasdaq are very different, the correlation of returns (85%) seems sufficiently large to allow confidence in such control group.

Table 2. Correlation of returns between treatment and control groups

This table presents the coefficient of correlation of daily (portfolio) returns between treatment and control groups for previous studies and for our sample. For our sample, Panel A (59 French large caps) and Panel B (40 non-French large caps) compose the Euronext 100 index. Panel C (29 French large midcaps), Panel D (49 French small midcaps) and Panel E (66 non-French midcaps) compose the Next 150 index.

Study	Period	Treatment group	Control group	Correlation of returns
Umlauf (1993)	1980-1987	Sweden	MSCI UK	19.54%
			MSCI US	8.83%
Pomeranets & Weaver (2012)	1971-1981	NYSE	Nasdaq	85.93%
This study	Feb. 2012-Jan. 2013	MSCI France	MSCI Belgium	78.95%
			MSCI Netherlands	91.03%
		Euronext 100 Panel A (FR, STT)	Euronext 100 Panel B (noFR, noSTT)	90.61%
		Next 150 Panel C (FT, STT)	Next 150 Panel D (FR, no STT)	90.15%
			Next 150 Panel E (noFR, no STT)	84.42%
		Euronext 100 Panel A (FR, STT)	DAX 30	92.62%
		Next 150 Panel C (FT, STT)	MDAX 50	83.42%

3.4. Measuring market liquidity and volatility

Unlike previous studies (summarized in Table 1) that relied on only few measures of liquidity or volatility, we compute a wide range of measures to account for different dimensions of market quality. This section describes variable construction and Table 3 reports descriptive statistics.

Market liquidity. The concept of liquidity is clearly multi-dimensional.[20] 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, previous papers on the impact of financial transaction tax usually consider only a few indicators.

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

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, transaction cost measures (bid-ask spread), and price-impact measures (liquidity ratio). 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.
- *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.

These measures gauge different aspects of market liquidity and can be considered as complements and not substitutes. Measuring liquidity by trading volume is the most intuitive way because it captures markets' breadth and depth. However, this measure suffers 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. Several indicators of market resiliency address this definition and we choose to use the liquidity ratio, which assesses how much traded volume is necessary to induce a price change of one percent[21]: higher ratio is associated with higher liquidity.

For the sake of robustness, we also consider the turnover and price reversal:

[21] 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.

- *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.
- *Price Reversal*, $PR_{i,t}$ is minus the coefficient of a regression of $R_{i,t}$ on $V_{i,t-1}$*sign($R_{i,t-1}$), controlling for $R_{i,t-1}$.

Similar to volume, turnover captures markets' breadth and depth, but takes into account the number of shares available for sale. Price reversal is a measure of price impact, like the liquidity ratio, albeit less intuitive. It is based on the idea that, if markets are illiquid, trades should generate transitory deviations between price and fundamental value[22]: 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 three different metrics:

- *Squared Return*, $SR_{i,t} = (R_{i,t})^2$ where $R_{i,t} = \log(P_{i,t} / P_{i,t-1})$.
- *Conditional variance*, $CV_{i,t}$ is proxied by a GARCH(1,1) model – the model for the conditional mean is an AR(1) with a constant.[23]
- *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.

Squared close-to-close return is a common estimator of the daily variance.[24] Volatility clustering has been extensively documented, so we estimate daily conditional variance, proxied by a conventional GARCH(1,1) model over a period of 12 months (February 2012 – January 2013).[25] 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.

[22] 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.

[23] We have considered alternative GARCH models, but it does not change the results.

[24] 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.

[25] 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).

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[26], while it is more robust against the effects of market microstructure noise, particularly bid-ask bounce.[27]

Additionally, for robustness purpose we use also the following measures:

- *Absolute Return,* $AR_{i,t} = |R_{i,t}| \sqrt{\pi}/2$.
- *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.

Absolute return is very similar to squared return, but the mean is less impacted by extreme variations. We use also a different measure of condition variance by using a different specification for the conditional mean. Daily price amplitude is similar to High-low range, but its computation is somewhat more intuitive.

Table C in appendix provides pairwise correlation coefficients for the measures of liquidity and volatility. Unsurprisingly, all coefficients are significantly different from zero (unless between daily turnover and liquidity ratio). However, they are sufficiently low to justify empirically the use of a wide range of measures. Among the liquidity measures, the highest correlation (in absolute value) is between daily volume and bid-ask spread and it is less than 0.4. The volatility measures are more correlated with each other. Absolute and squared returns are obviously very correlated (0.7), as well as range and price amplitude (0.8). Range is also correlated with squared returns, while price amplitude is more correlated with absolute returns. Conditional variance is the measure the less correlated with the other measures of volatility.

[26] 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.

[27] 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.

Table 3. Descriptive statistics of the sample

This table provides some descriptive statistics of the stocks included in the Euronext 100 and Next 150 indexes (excluding 7 firms that have experienced a takeover bid or infrequent trading). 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-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*$_{i,t}$, $SR_{i,t} = (R_{i,t})^2$ with $R_{i,t}= \log(P_{i,t} / P_{i,t–1})$.-*Conditional variance*$_{i,t}$ 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)	61,722	.1810	.3851	0	1
FR (D)	61,722	.5638	.4959	0	1
Euronext100 (D)	61,722	.4074	.4914	0	1
Next150 (D)	61,722	.5926	.4879	0	1
$P_{i,t}$ (€)	61,596	29.28	28.14	.03	187.95
$MV_{i,t}$ (thousand €)	61,596	6,795	14,482	31	112,345
$NBST_{i,t}$ (thousand)	61,578	1,771	10,187	0	778,655
$NOSH_{i,t}$ (thousand)	61,596	414,746	1,084,616	2,786	1.97e+07
$NOSHFF_{i,t}$ (%)	61,555	67.26	22.37	12	100
$Volume_{i,t}$ (thousand €)	61,578	19,158	38,788	0	1,161,686
$Turnover_{i,t}$ (%)	61,537	.0048	.0088	0	.5128
Bid-ask spread$_{i,t}$ (%)	61,301	.3493	.7022	.0100	28.5714
High-low range$_{i,t}$	61,578	.0004	.0014	0	.0941
Price amplitude$_{i,t}$ (%)	61,578	2.6895	1.9994	0	50
Return$_{i,t}$ (%)	61,594	.0348	2.2761	–44.4855	53.9536
$(Return_{i,t})^2$ (%)	61,594	5.1819	28.1369	0	2,910.99
Abs(Return$_{i,t}$*)* (%)	61,594	1.8623	2.1614	0	67.6208
Conditional variance$_{i,t}$	61,722	5.2470	10.2932	0.0005	796.549
Liquidity Ratio$_{i,t}$ (thousand €)	60,006	47,147	273,230	0	1.85e+07

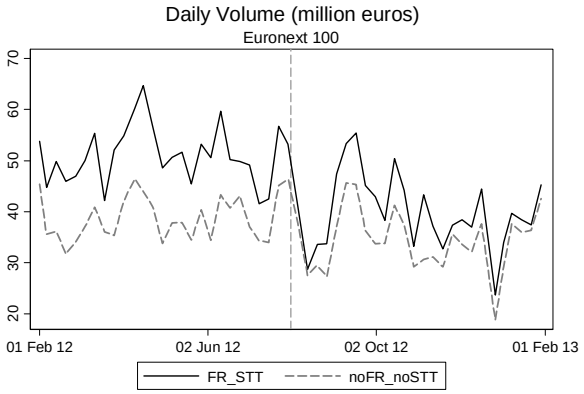
4. Empirical results

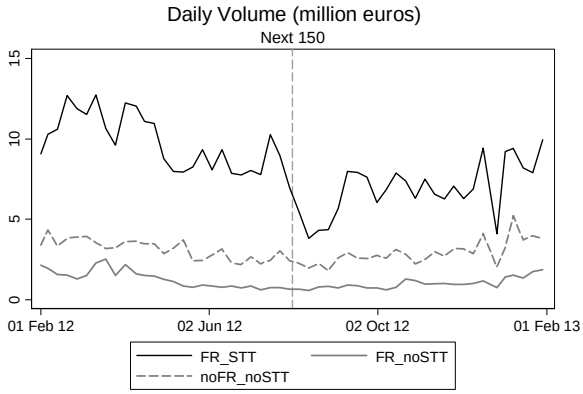
4.1. Graphical representation of the parallel trends assumption

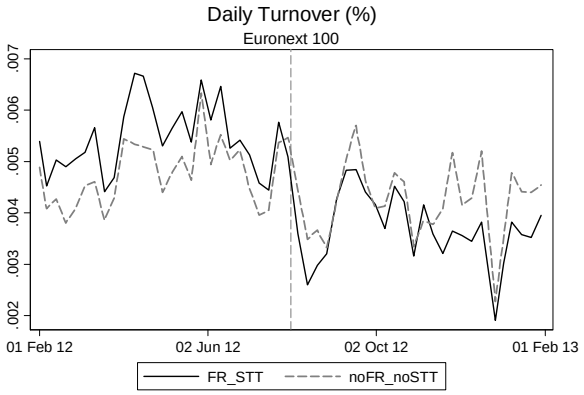
Figures 1-2 show parallel evolution of our dependant variables for stocks included in the Euronext 100 and the Next 150 indexes. For Euronext 100 and Next 150, we distinguish between French firms that are subject to STT (FR_STT) and foreign firms that are not subject to STT (noFR_noSTT). For Next 150, 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 had not applied.

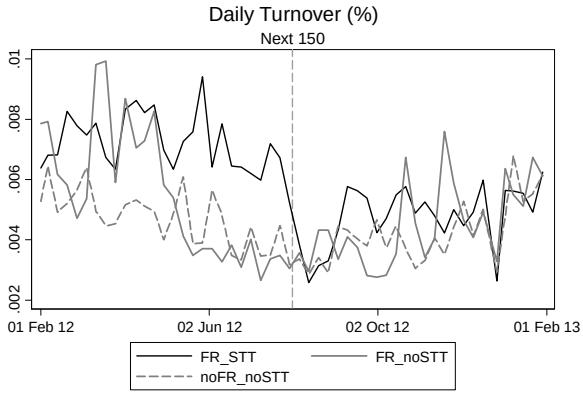
Figure 1. Dynamic of the stock market activity

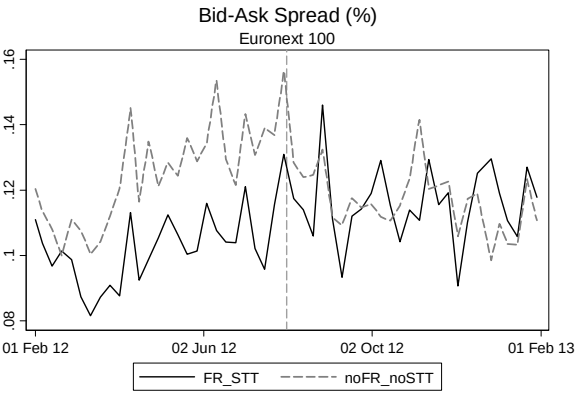
These figures present weekly un-weighted average for five different sub-samples. Euronext 100: FR STT (59 firms) + no FR, no STT (40 firms); Next 150: FR STT (29 firms) + FR, no STT (49 firms) + no FR, no STT (66 firms). *Daily Volume*$_{i,t}$ = Number of shares traded for the stock *i* on day *t* * $P_{i,t}$ where $P_{i,t}$ is the closing price for the stock *i* on the day *t*. *Daily Turnover*$_{i,t}$ = 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*$_{i,t}$ = $2*(PA_{i,t}–PB_{i,t})/(PA_{i,t}+PB_{i,t})$ 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 $R_{i,t} = \log(P_{i,t} / P_{i,t-1})$; expressed in thousands euros of trades for a price change of 1%.

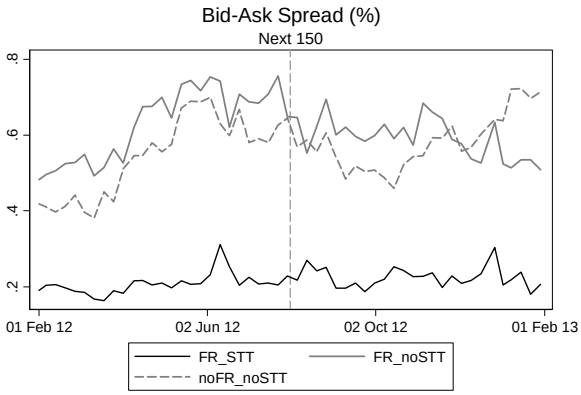


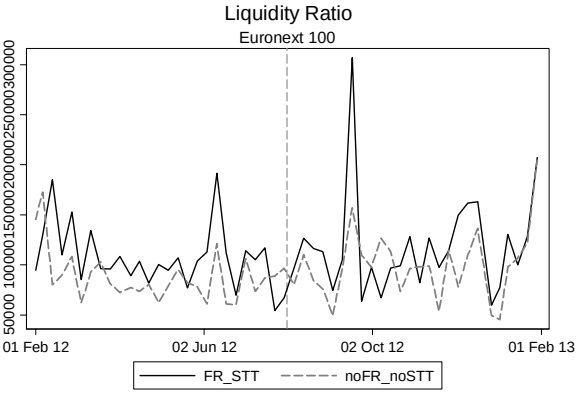












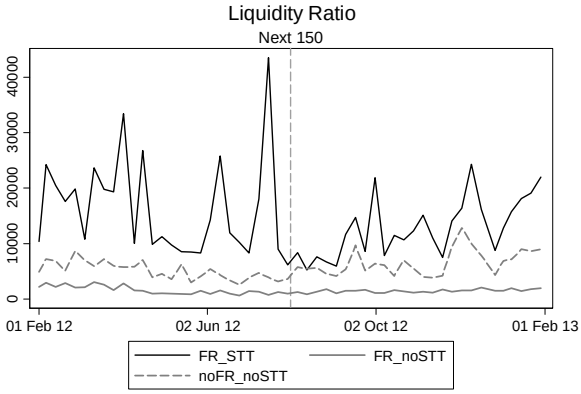
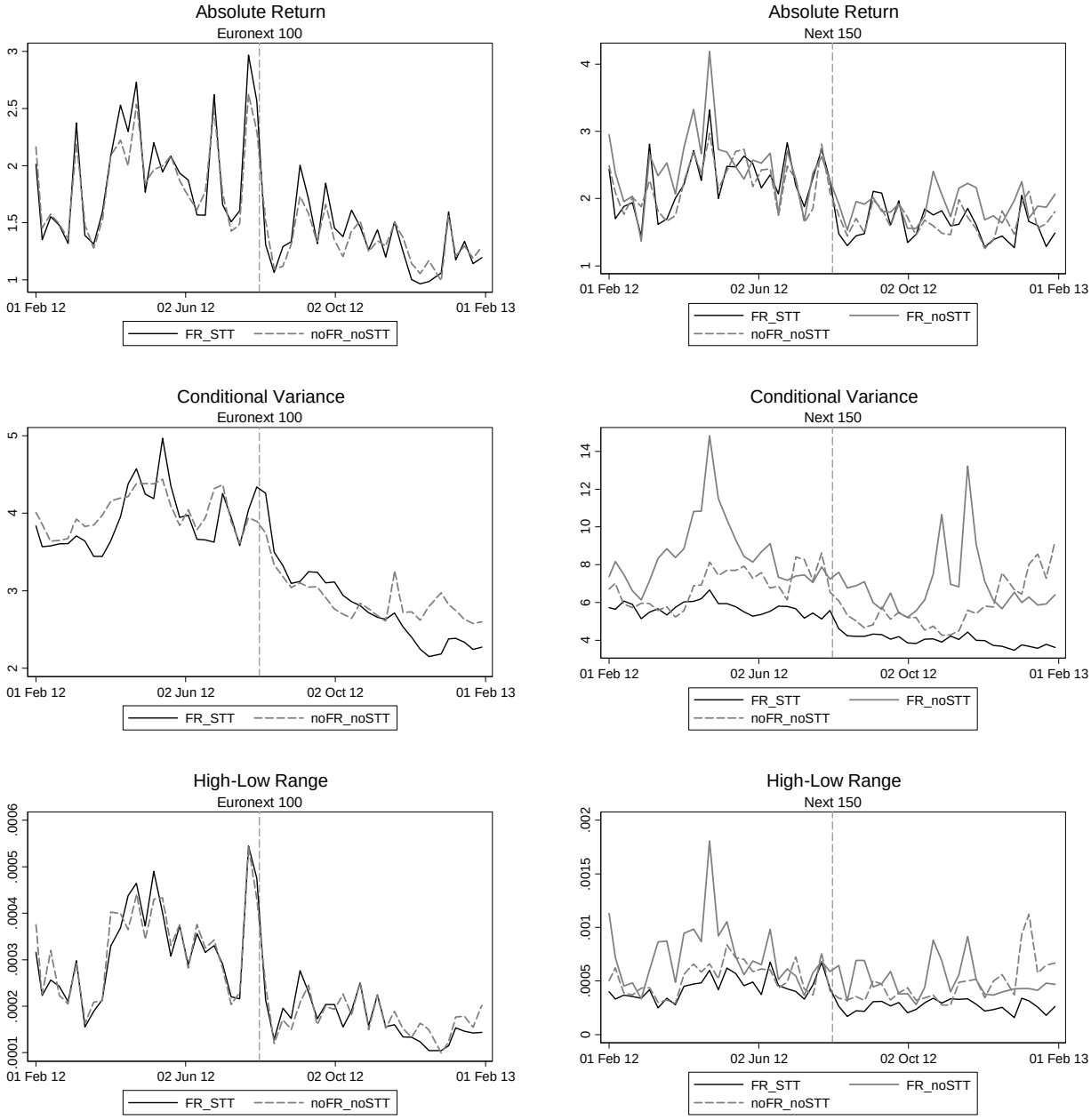


Figure 2. Dynamic of the stock market volatility

These figures present weekly un-weighted average for five different sub-samples. Euronext 100: FR STT (59 firms) + no FR, no STT (40 firms); Next 150: FR STT (29 firms) + FR, no STT (49 firms) + no FR, no STT (66 firms). *Absolute Return*$_{i,t}$ = $|R_{i,t}|$ $\sqrt{\pi}/2$. *Conditional variance*$_{i,t}$ is estimated with a GARCH(1,1). *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*($PH_{i,t}$–$PL_{i,t}$)/($PH_{i,t}$+$PL_{i,t}$).



4.2. Difference-in-difference results

We estimate the impact of the introduction of the STT on market quality and present results of difference-in-difference estimation in Tables 4-5. Estimation is done for three different 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 and price reversal (see section 3.3 for definitions). The results show that the introduction of the STT has reduced market 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. According to coefficients in columns 1-3, volumes have declined by 19%, 23% and 29% (corresponding to the coefficients of -0.2159, -0.2671 and -0.3395).[28] 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).

This decrease in volume and the (possible) increase of bid-ask spreads should be put into their historical context as stock market development worldwide has been tremendous. Since 1990, the value of share trading at the Bourse de Paris has increased by approximately 2 000%, that is an increase of 50% on average per year (see Figure B - Panel A in appendix). This trend is similar in most of the Western countries. Moreover, the value of share trading might vary considerably from one year to another depending on economic situation. In 1997 and 2000, for instance, market volume increased by 75% compared to the previous year; in 2009 it decreased by almost 50% (see Figure B - Panel B in appendix). At the same time, there is a sharp downward trend in financial market transaction costs. Comerton-Forde, Hendershott, Jones, Moulton, and Seasholes (2010) report, for instance, that the value-weighted effective spread in the NYSE was divided by ten between 1994 and 2005.

[28] Since transaction tax is levied on volumes, this is translated in the tax base decline of the same magnitude.

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. $ln(Volume_{i,t})$ = 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-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. Robust standard errors are clustered at the firm level and are presented in parentheses.

Model	**(1)**	**(2)**	**(3)**
Sample	**Euronext 100**	**Next 150**	
Nb. of firms	**FR STT (59)** **no FR, no STT (40)**	**FR STT (29)** **FR, no STT (49)**	**FR STT (29)** **no FR, no STT (66)**
ln(Volume$_{i,t}$)			
STT	–0.2158***	–0.2671***	–0.3395***
(s.e.)	(0.0456)	(0.0834)	(0.0900)
Nb. of obs.	25,016	19,802	24,125
adj. R^2	0.897	0.827	0.835
***Turnover$_{i,t}$ (%)* × 100**			
STT	–0.1275***	–0.1460	–0.1907**
(s.e.)	(0.0245)	(0.1120)	(0.0791)
Nb. of obs.	24,975	19,802	24,126
adj. R^2	0.447	0.279	0.256
Bid-ask spread$_{i,t}$ (%)			
STT	0.0232***	0.0530**	–0.0186
(s.e.)	(0.0071)	(0.0254)	(0.0830)
Nb. of obs.	24,838	19,762	24,040
adj. R^2	0.272	0.497	0.540
***Liquidity ratio$_{i,t}$* × 1,000**			
STT	–1.4628	–3.7223	–5.2771**
(s.e.)	(10.5141)	(2.4368)	(2.4889)
Nb. of obs.	24,800	19,118	23,351
adj. R^2	0.099	0.058	0.057
Price reversal (dependent variable: $R_{i,t}$)			
$R_{i,t-1}$	0.0009	–0.0069	–0.0458
(s.e.)	(0.0081)	(0.0151)	(0.0344)
$V_{i,t-1}$*sign($R_{i,t-1}$)	–0.0000	–0.0000	0.0000*
(s.e.)	(0.0000)	(0.0000)	(0.0000)
$V_{i,t-1}$*sign($R_{i,t-1}$)*STT	–0.0000**	0.0000	–0.0000
(s.e.)	(0.0000)	(0.0000)	(0.0000)
Nb. of obs.	25,012	19,802	24,126
adj. R^2	0.365	0.207	0.221

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

Our finding that the introduction of the transaction tax results in the increase of transaction costs and a decline of trading activity is not surprising. The crucial question is whether the tax discouraged "rational" or "noise" traders and, thus, its impact on market resiliency. As discussed in Section 3.3, measures of traded volumes are imperfect measures of liquidity. When considering theoretically based measures, such as liquidity ratio 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. Hence, our results reject the hypothesis that the introduction of the STT increases market volatility because of decreased traded volumes. At the same time, the alternative hypothesis that the STT drives away mainly "noise traders" and decreases volatility is neither supported by our data. 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*".

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. *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. Robust standard errors are clustered at the firm level and are presented in parentheses.

Model	**(1)**	**(2)**	**(3)**
Sample	**Euronext 100**	**Next 150**	
Nb. of firms	**FR STT (59) no FR, no STT (40)**	**FR STT (29) FR, no STT (49)**	**FR STT (29) no FR, no STT (66)**
Squared return$_{i,t}$ (%)			
STT	–0.1795	0.8566	–1.1502
(s.e.)	(0.3904)	(1.3615)	(0.9570)
Nb. of obs.	25,018	19,812	24,130
adj. R^2	0.165	0.034	0.063
Absolute return$_{i,t}$ (%)			
STT	–0.0341	–0.0450	–0.0994
(s.e.)	(0.0767)	(0.1182)	(0.0954)
Nb. of obs.	25,018	19,812	24,130
adj. R^2	0.296	0.168	0.190
Conditional variance$_{i,t}$			
STT	0.0341	0.0141	–0.4725
(s.e.)	(0.4568)	(1.0874)	(0.8709)
Nb. of obs.	25,146	19,812	24,130
adj. R^2	0.589	0.281	0.362
High-low range$_{i,t}$			
STT	0.0000	0.0001	–0.0001
(s.e.)	(0.0000)	(0.0001)	(0.0001)
Nb. of obs.	25,016	19,802	24,126
adj. R^2	0.276	0.111	0.161
Price amplitude$_{i,t}$ (%)			
STT	0.0091	–0.0130	–0.1304
(s.e.)	(0.1006)	(0.1329)	(0.1445)
Nb. of obs.	25,016	19,802	24,126
adj. R^2	0.441	0.329	0.348

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

5. Robustness checks

5.1. Robustness sample

First, for robustness checks, we applied more stringent filters in order to preclude any outliers that might bias the results. Precisely, we exclude companies for which stock price was lower than €2 at least one day over the period or the total volume over the period below k€60,000. This robustness sample contains 82% of the initial one. Results are reported in Tables D-E of the appendix and they are very similar with Tables 4-5.

5.2. Impact over time

To analyze the impact of the STT, we have chosen a window of 12 month around the tax introduction, mainly due to the recent nature of the tax that was introduced in August 2012. To test, whether our results are sensitive to the choice of window length and whether we need to consider a longer period after the introduction of the tax, we estimate the effect of the tax separately for every month after the tax introduction. The results, presented in Tables F, indicate that our earlier findings that the STT has a negative effect on market volume and turnover, but positive effect on bid-ask spread are manifested from the first month, are not driven by one month and are rather stable over time. Interestingly, we find that in two subsamples there are strong negative effects on liquidity ratio but they disappear after four months. As before, we find no effect on volatility: almost all coefficients are not statistically significant and when some isolated coefficients appear significant they have conflicting signs.

5.3. DAX and MDAX as control groups

One may argue that the STT might have a global impact on all Euronext stocks due to co-movement in liquidity that result, inter alia, from the fact that modern investors often buy all stocks in the same index. Cespa and Foucault (2011) have shown that liquidity spillover can be positive or negative depending on the cost of price information. In either case, our estimate of the impact could be biased if we consider other securities from Euronext as a control group. Therefore, we test robustness of our results by relying on a control group consisting of German stocks traded on Deutsche Boerse (Xetra) and included in the DAX 30 and the MDAX 50 indexes. This sample is less likely to be impacted by potential co-movement in liquidity, but at the same time it is tightly correlated with Euronext stocks to justify its use as

a control group (see Table 2).

Results of difference-in-difference estimation are presented in Tables G-H. In column 1, the sample consists of largest French stocks in Euronext 100 (treated group) and largest German stocks in DAX (control group). In column 2, the sample covers mid-cap French stocks in Next 150 (treated group) and mid-cap German stocks in MDAX (control group). Both samples confirm our earlier findings. The introduction of the STT always has a negative effect on market volume and there is also evidence that it might increase the bid-ask spread. At the same time, the effect on liquidity ratio is insignificant, meaning that markets are sufficiently liquid to be able to absorb large market transactions without any price effects. Finally, there is no effect on volatility.

5.4. Propensity score matching

To further improve the quality of the control group, we rely on propensity score matching. This will allow us to compare stocks that were subjected to a STT with comparable (foreign and French) stocks listed on Euronext that were not subjected to a tax. In order to determine "comparable" stocks we compute average market capitalization and turnover of stocks included in Euronex 100 and Next 150 before the introduction of the STT and then run a logistic regression, where a probability of a stock being subjected to a tax is a function of these observable characteristics (market capitalization, turnover and volatility). The choice of the first two variables follows Foucault et al. (2011) and we augment the model with an additional volatility measure (squared returns, conditional variance, high-low range). We assure that all variables in the model are statistically significant, because we rely on model coefficients to assign to each stock a probability of being taxed and then match stocks subjected to the STT with stocks that were the "closest" in terms of the propensity score. We test robustness of our results with "the nearest neighbor" and "Kernel" matching. In the second step, we compare the performance of the taxed stocks with the matched stocks that were not subjected to STT by estimating the following econometric model:

$$V_{it} - V_{it}^{match} = \alpha_0 + \alpha_1 D_i + \alpha_2 D_t + \alpha_3 FTT_{it} + \epsilon_{it}.$$

Estimation results, presented in Tables 6-7, confirm our earlier findings that the introduction of the STT always has a negative effect on market volume, but no effect on market liquidity or volatility. Similar to our earlier findings, a negative effect on market turnover and a positive effect on bid-ask spread is not always robust.

Table 6. The impact of the French STT on stock market liquidity (propensity score matching)

This table presents difference-in-difference econometric tests, where we rely on propensity score matching to match firms that were subject to the tax with firms in the control group that had the closest propensity to be subjected to the tax. Matching is performed on market capitalization and turnover. 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%. Time and firms dummies are included but not reported. Robust standard errors are clustered at the firm level and are presented in parentheses.

	Nearest neighbor matching	**Kernel matching**
ln(Volume$_{i,t}$)		
STT	–0.167***	–0.216***
(s.e.)	(0.053)	0.033
Nb. of obs.	21,970	61,557
adj. R^2	0.012	0.210
***Turnover$_{i,t}$ (%)* × 100**		
STT	0.028	–0.138***
(s.e.)	(0.07)	0.013
Nb. of obs.	21,847	61,537
adj. R^2	0.000	0.009
Bid-ask spread$_{i,t}$ (%)		
STT	–0.078	0.022*
(s.e.)	(0.060)	0.011
Nb. of obs.	21,774	60,006
adj. R^2	0.004	0.014
***Liquidity ratio$_{i,t}$* × 1,000**		
STT	–6.482	8.050
(s.e.)	(0.631)	4.160
Nb. of obs.	20,992	60,006
adj. R^2	0.000	0.014

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

Table 7. The impact of the French STT on stock market volatility (propensity score matching)

This table presents difference-in-difference econometric tests, where we rely on propensity score matching to match firms that were subject to the tax with firms in the control group that had the closest propensity to be subjected to the tax. Matching is performed on market capitalization and turnover. 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. Firm dummies are included but not reported. Robust standard errors are clustered at the firm level and are presented in parentheses.

	Nearest neighbor matching	**Kernel matching**
Squared return$_{i,t}$ (%)		
STT	0.222	–0.087
(s.e.)	(1.066)	0.445
Nb. of obs.	21,968	61,594
adj. R^2	0.000	0.002
Absolute return$_{i,t}$ (%)		
STT	0.009	–0.027
(s.e.)	(0.088)	0.037
Nb. of obs.	21,968	61,594
adj. R^2	0.000	0.017
Conditional variance$_{i,t}$		
STT	0.373	–0.107
(s.e.)	(0.979)	0.162
Nb. of obs.	22,352	61,722
adj. R^2	0.000	0.008
High-low range$_{i,t}$		
STT	–0.000	–0.000
(s.e.)	(0.0001)	0.000
Nb. of obs.	21,970	61,578
adj. R^2	0.000	0.005
Price amplitude$_{i,t}$ (%)		
STT	0.019	–0.017
(s.e.)	(0.125)	0.033
Nb. of obs.	21,970	61,578
adj. R^2	0.000	0.034

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

6. Conclusion

This paper analyzes 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. In contrast, the opponents argue that taxation of financial transactions will hurt market liquidity, thus, making markets even more volatile.

Since theoretical predictions on this subject are ambiguous, there is a need for an econometric analysis. Although a number of papers empirically examine the impact of STT, 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. As to volatility measures, the results are mostly insignificant. Our results are robust to a number of robustness tests that include different control groups, dynamic effects and propensity score matching.

To sum up, our investigation shows that STT is neither a panacea nor a “madness” for financial markets. Our results do not confirm expectations that STT decreases market volatility by curbing speculative activity, but at the same time, there is no significant effect on market volatility and even liquidity.

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Appendix

Table A. Average free float and market capitalization of the initial panels

	Stocks subject to the STT		Stocks not subject to the 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)[b], # 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)[c], # 30**		**Panel D (FR, no STT), # 49**		**Panel E (noFR, no STT)[d], # 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. [b] TNT Express, which experienced a takeover bid in 2012, is removed in the final sample. [c] CFAO, which experienced a takeover bid in 2012, is removed in the final sample. d) Degven, Dockwise, Mediq, and LBI International which experienced a takeover bid in 2012, is removed in the final sample. Espirito Santo Finl.GP. is also removed in the final sample due to infrequent trading.

Table B. Number of observations

This table provides the number of observations (nb firms × nb days) for each sample and the percentage of the initial sample. 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. The initial sample includes all stocks included in the Euronext 100 and Next 150 indexes. The final sample excludes all companies that experienced a takeover bid over the period (#6) or securities infrequently traded (#1). The robustness sample excludes companies for which we lack observations at the beginning of the period (#2) and all observations that meet the following criteria: stock price below €2 at least one day over the period or total volume over the period below k€60,000.

Panel	Initial sample	Final sample	Robustness sample
Euronext 100			
FR, STT	14,986	14,986 (100%)	14,724 (98%)
noFR, noSTT	10,414	10,160 (98%)	9,386 (90%)
Next 150			
FR, STT	7,620	7,366 (97%)	7,105 (93%)
FR, noSTT	12,446	12,446 (100%)	9,070 (73%)
noFR, noSTT	18,034	16,764 (93%)	11,643 (65%)
Total	***63,500***	***61,722 (97%)***	***51,928 (82%)***

Table C. Correlation Matrix

This table provides pairwise correlation coefficients for the liquidity measures and the volatility measures. 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. $ln(Volume_{i,t})$ = 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*. $Turnover_{i,t}$ = 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. $Bid\text{-}ask\ spread_{i,t} = 2*(PA_{i,t}–PB_{i,t})/(PA_{i,t}+PB_{i,t})$ 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 $R_{i,t} = \log(P_{i,t} / P_{i,t-1})$. $Squared\ Return_{i,t}$, $SR_{i,t} = (R_{i,t})^2$ 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.

	Liquidity measures				
	$ln(Volume_{i,t})$	$Turnover_{i,t}$	$Bid\text{-}ask\ spread_{i,t}$	$Liquidity\ Ratio_{i,t}$	
$ln(Volume_{i,t})$	1.0000				
$Turnover_{i,t}$	0.2573*	1.0000			
$Bid\text{-}ask\ spread_{i,t}$	–0.3989*	–0.0262*	1.0000		
$Liquidity\ Ratio_{i,t}$	0.2164*	0.0030	–0.0717*	1.0000	
	Volatility measures				
	$Abs.\ Return_{i,t}$	$Sq.\ Return_{i,t}$	$GARCH_{i,t}$	$HLR_{i,t}$	$Price\ amplitude_{i,t}$
$Abs.\ Return_{i,t}$	1.0000				
$Sq.\ Return_{i,t}$	0.7175*	1.0000			
$GARCH_{i,t}$	0.3059*	0.2579*	1.0000		
$HLR_{i,t}$	0.5846*	0.6828*	0.4979*	1.0000	
$Price\ amplitude_{i,t}$	0.7391*	0.5372*	0.5190*	0.7866*	1.0000

* indicates a correlation statistically different from zero at the 5% level.

Table D. The impact of the French STT on stock market liquidity (Robustness sample)

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 $V_{i,t-1}*\text{sign}(R_{i,t-1})$. Time and firms dummies are included but not reported. Robust standard errors are clustered at the firm level and are presented in parentheses. We exclude companies for which we lack observations at the beginning of the period (#2) and all observations that meet the following criteria: stock price below €2 at least one day over the period or total volume over the period below k€60,000.

Model	**(1)**	**(2)**	**(3)**
Sample	**Euronext 100**	**Next 150**	
Nb. of firms	**FR STT (59) no FR, no STT (40)**	**FR STT (29) FR, no STT (49)**	**FR STT (29) no FR, no STT (66)**
ln(Volume$_{i,t}$)			
STT	–0.2037***	–0.3479***	–0.2908***
(s.e.)	(0.0409)	(0.0867)	(0.0814)
Nb. of obs.	24,106	16,166	18,748
adj. R^2	0.907	0.818	0.838
***Turnover$_{i,t}$ (%)* × 100**			
STT	–0.1144***	–0.2346***	–0.1948**
(s.e.)	(0.0237)	(0.0875)	(0.0780)
Nb. of obs.	24,106	16,166	18,748
adj. R^2	0.503	0.335	0.532
Bid-ask spread$_{i,t}$ (%)			
STT	0.0163***	0.0542*	0.0317*
(s.e.)	(0.0051)	(0.0288)	(0.0186)
Nb. of obs.	23,930	16,130	18,681
adj. R^2	0.281	0.375	0.415
***Liquidity ratio$_{i,t}$* × 1,000**			
STT	–1.8140	–3.5594	–5.4367**
(s.e.)	(10.8028)	(2.5064)	(2.6067)
Nb. of obs.	23,907	15,758	18,394
adj. R^2	0.098	0.053	0.052
Price reversal (dependent variable: $R_{i,t}$)			
$R_{i,t-1}$	–0.0003	–0.0211**	–0.0164
(s.e.)	(0.0079)	(0.0088)	(0.0112)
$V_{i,t-1}*\text{sign}(R_{i,t-1})$	–0.0000	0.0000	0.0000
(s.e.)	(0.0000)	(0.0000)	(0.0000)
$V_{i,t-1}*\text{sign}(R_{i,t-1})*\text{STT}$	–0.0000	0.0000	–0.0000
(s.e.)	(0.0000)	(0.0000)	(0.0000)
Nb. of obs.	24,106	16,166	19,009
adj. R^2	0.385	0.287	0.307

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

Table E. The impact of the French STT on stock market volatility (Robustness sample)

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. Robust standard errors are clustered at the firm level and are presented in parentheses. We exclude companies for which we lack observations at the beginning of the period (#2) and all observations that meet the following criteria: stock price below €2 at least one day over the period or total volume over the period below k€60,000.

Model	**(1)**	**(2)**	**(3)**
Sample	**Euronext 100**	**Next 150**	
Nb. of firms	**FR STT (59)** **no FR, no STT (40)**	**FR STT (29)** **FR, no STT (49)**	**FR STT (29)** **no FR, no STT (66)**
Squared return*$_{i,t}$ *(%)			
STT	–0.1105	–0.3972	–0.2016
(s.e.)	(0.3805)	(0.4325)	(0.3700)
Nb. of obs.	24,110	16,175	18,748
adj. R^2	0.248	0.162	0.177
Absolute return*$_{i,t}$ *(%)			
STT	–0.0304	–0.1346	–0.0262
(s.e.)	(0.0790)	(0.0890)	(0.0839)
Nb. of obs.	24,110	16,175	18,748
adj. R^2	0.312	0.215	0.247
***Conditional variance*$_{i,t}$**			
STT	0.1272	–1.2108**	0.2846
(s.e.)	(0.4842)	(0.4962)	(0.5397)
Nb. of obs.	24,110	16,175	18,748
adj. R^2	0.592	0.232	0.326
***High-low range*$_{i,t}$**			
STT	–0.0000	–0.0000	0.0000
(s.e.)	(0.0000)	(0.0000)	(0.0000)
Nb. of obs.	24,106	16,166	18,748
adj. R^2	0.300	0.200	0.215
Price amplitude*$_{i,t}$ *(%)			
STT	–0.0070	–0.0948	–0.0198
(s.e.)	(0.1018)	(0.1066)	(0.0999)
Nb. of obs.	24,106	16,166	18,748
adj. R^2	0.449	0.365	0.373

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

Table F. The impact of the French STT over 6 months

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.

Model	**(1)**	**(2)**	**(3)**
Sample	**Euronext 100**	**Next 150**	
Nb. of firms	**FR STT (59) no FR, no STT (40)**	**FR STT (29) FR, no STT (49)**	**FR STT (29) no FR, no STT (66)**
ln(Volume$_{i,t}$)			
STT × August 2012	–0.3138***	–0.2602***	–0.3632***
(s.e.)	(0.0550)	(0.0812)	(0.0689)
STT × September 2012	–0.1799***	–0.1608	–0.2766***
(s.e.)	(0.0496)	(0.1043)	(0.0938)
STT × October 2012	–0.1372**	–0.2085*	–0.3457***
(s.e.)	(0.0547)	(0.1110)	(0.1194)
STT × November 2012	–0.1691***	–0.2527**	–0.3181***
(s.e.)	(0.0578)	(0.1198)	(0.1120)
STT × December 2012	–0.2412***	–0.3417***	–0.2950***
(s.e.)	(0.0602)	(0.1072)	(0.1099)
STT × January 2013	–0.2550***	–0.3891***	–0.4211***
(s.e.)	(0.0620)	(0.1009)	(0.1263)
Nb. of obs.	25,016	19,802	24,125
adj. R^2	0.897	0.827	0.835
***Turnover$_{i,t}$ (%)* × 100**			
STT × August 2012	–0.1339***	–0.2093	–0.2260**
(s.e.)	(0.0254)	(0.1264)	(0.0880)
STT × September 2012	–0.1041***	–0.0019	–0.1375**
(s.e.)	(0.0299)	(0.1249)	(0.0682)
STT × October 2012	–0.0964***	–0.0935	–0.1483
(s.e.)	(0.0293)	(0.1515)	(0.0933)
STT × November 2012	–0.1264***	–0.1998	–0.1432
(s.e.)	(0.0374)	(0.1659)	(0.0998)
STT × December 2012	–0.1601***	–0.1368	–0.2257**
(s.e.)	(0.0405)	(0.1288)	(0.0995)
STT × January 2013	–0.1502***	–0.2190**	–0.2670***
(s.e.)	(0.0344)	(0.0860)	(0.0931)
Nb. of obs.	24,975	19,802	24,126
adj. R^2	0.448	0.279	0.256
Bid-ask spread$_{i,t}$ (%)			
STT × August 2012	0.0183***	0.0360	–0.0063
(s.e.)	(0.0068)	(0.0368)	(0.0267)
STT × September 2012	0.0201***	0.0211	0.0216
(s.e.)	(0.0068)	(0.0294)	(0.0335)
STT × October 2012	0.0294***	0.0509*	0.0666*
(s.e.)	(0.0094)	(0.0302)	(0.0376)
STT × November 2012	0.0157*	0.0101	–0.0241
(s.e.)	(0.0086)	(0.0337)	(0.0660)
STT × December 2012	0.0246***	0.0969***	–0.0168
(s.e.)	(0.0093)	(0.0268)	(0.1224)
STT × January 2013	0.0314***	0.1107***	–0.1532
(s.e.)	(0.0102)	(0.0311)	(0.2742)
Nb. of obs.	24,838	19,762	24,040
adj. R^2	0.272	0.498	0.540

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

Table F. The impact of the French STT over 6 months (continued)

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. *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%. *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*$_{i,t} = |R_{i,t}| \sqrt{\pi}/2$.

Model	**(1)**	**(2)**	**(3)**
Sample	**Euronext 100**	**Next 150**	
Nb. of firms	**FR STT (59) no FR, no STT (40)**	**FR STT (29) FR, no STT (49)**	**FR STT (29) no FR, no STT (66)**
***Liquidity Ratio*$_{i,t}$ × 1,000**			
STT × August 2012	1.7395	–9.3796***	–9.6862***
(s.e.)	(11.8820)	(2.8844)	(3.0003)
STT × September 2012	13.4854	–6.1486**	–7.2443***
(s.e.)	(20.3060)	(2.5593)	(2.6489)
STT × October 2012	–35.3316**	–2.9625	–4.1000
(s.e.)	(16.9529)	(3.1749)	(3.2777)
STT × November 2012	2.9558	–4.6392***	–5.0050***
(s.e.)	(16.8945)	(1.6051)	(1.8079)
STT × December 2012	24.8907	0.9695	–3.2557
(s.e.)	(20.5469)	(3.9938)	(4.2277)
STT × January 2013	–7.8184	0.8194	–1.9540
(s.e.)	(22.5805)	(3.6792)	(3.7642)
Nb. of obs.	24,800	19,118	23,351
adj. R^2	0.099	0.059	0.057
***Squared Return*$_{i,t}$ (%)**			
STT × August 2012	0.2459	0.0649	–0.4466
(s.e.)	(0.3456)	(1.9181)	(0.7240)
STT × September 2012	0.0923	2.6262*	–0.0226
(s.e.)	(0.4282)	(1.4974)	(1.0709)
STT × October 2012	–0.0094	0.6105	0.1292
(s.e.)	(0.4298)	(1.6609)	(0.8151)
STT × November 2012	–0.5121	–0.6549	–0.0589
(s.e.)	(0.5384)	(2.2769)	(1.0855)
STT × December 2012	–0.7063	1.4453	–1.9732
(s.e.)	(0.7058)	(1.6857)	(2.1452)
STT × January 2013	–0.3093	1.3892	–4.7039
(s.e.)	(0.5336)	(1.3548)	(3.6550)
Nb. of obs.	25,018	19,812	24,130
adj. R^2	0.165	0.034	0.063
***Absolute Return*$_{i,t}$ (%)**			
STT × August 2012	–0.0208	–0.1123	–0.2153**
(s.e.)	(0.0742)	(0.1504)	(0.0978)
STT × September 2012	0.0852	0.2711*	0.0583
(s.e.)	(0.0795)	(0.1543)	(0.1391)
STT × October 2012	0.0453	–0.0556	–0.0284
(s.e.)	(0.0882)	(0.1682)	(0.1282)
STT × November 2012	–0.0948	–0.1092	–0.0037
(s.e.)	(0.1028)	(0.1866)	(0.1357)
STT × December 2012	–0.1710	–0.1468	–0.1695
(s.e.)	(0.1250)	(0.1966)	(0.1799)
STT × January 2013	–0.0733	–0.1081	–0.2377
(s.e.)	(0.1150)	(0.1538)	(0.2072)
Nb. of obs.	25,018	19,812	24,130
adj. R^2	0.296	0.168	0.190

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

Table G. The impact of the French STT on stock market liquidity, Control group: DAX and MDAX

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 $V_{i,t-1}*\text{sign}(R_{i,t-1})$. Time and firms dummies are included but not reported. Robust standard errors are clustered at the firm level and are presented in parentheses.

Model	**(1)**	**(2)**
Sample	**Euronext 100 & DAX**	**Next 150 & MDAX**
Nb. of firms	**FR STT (59)** **DAX (30)**	**FR STT (29)** **MDAX (49)**
ln(Volume$_{i,t}$)		
STT	–0.1406***	–0.2538***
(s.e.)	(0.0328)	(0.0843)
Nb. of obs.	22606	19641
adj. R^2	0.925	0.765
***Turnover$_{i,t}$ (%)* × 100**		
STT	–0.0631***	–0.0961
(s.e.)	(0.0208)	(0.0785)
Nb. of obs.	22606	19635
adj. R^2	0.533	0.437
Bid-ask spread$_{i,t}$ (%)		
STT	0.0331***	0.0390***
(s.e.)	(0.0034)	(0.0134)
Nb. of obs.	22491	19613
adj. R^2	0.329	0.284
***Liquidity ratio$_{i,t}$* × 1,000**		
STT	–4.6205	–2.7125
(s.e.)	(13.8093)	(2.8530)
Nb. of obs.	22452	19399
adj. R^2	0.104	0.054
Price reversal (dependent variable: $R_{i,t}$)		
$R_{i,t-1}$	–0.0047	0.0032
(s.e.)	(0.0091)	(0.0123)
$V_{i,t-1}*\text{sign}(R_{i,t-1})$	–0.0000	–0.0000
(s.e.)	(0.0000)	(0.0000)
$V_{i,t-1}*\text{sign}(R_{i,t-1})*$STT	–0.0000***	0.0000
(s.e.)	(0.0000)	(0.0000)
Nb. of obs.	22606	19640
adj. R^2	0.425	0.326

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

Table H. The impact of the French STT on stock market volatility, Control group: DAX and MDAX

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. Robust standard errors are clustered at the firm level and are presented in parentheses.

Model	**(1)**	**(2)**
Sample	**Euronext 100 & DAX**	**Next 150 & MDAX**
Nb. of firms	**FR STT (59)** **DAX (30)**	**FR STT (29)** **MDAX (49)**
Squared return*$_{i,t}$ *(%)		
STT	–0.3259	–0.5056
(s.e.)	(0.2873)	(0.4113)
Nb. of obs.	22,606	19,641
adj. R^2	0.198	0.058
Absolute return*$_{i,t}$ *(%)		
STT	–0.0185	–0.1057
(s.e.)	(0.0664)	(0.0742)
Nb. of obs.	22,606	19,641
adj. R^2	0.334	0.226
***Conditional variance*$_{i,t}$**		
STT	0.0987	0.1184
(s.e.)	(0.4591)	(0.4754)
Nb. of obs.	22,606	19,641
adj. R^2	0.492	0.214
***High-low range*$_{i,t}$**		
STT	0.0000	–0.0000
(s.e.)	(0.0000)	(0.0000)
Nb. of obs.	22,606	19,641
adj. R^2	0.335	0.189
Price amplitude*$_{i,t}$ *(%)		
STT	0.0012	–0.1302
(s.e.)	(0.0725)	(0.0916)
Nb. of obs.	22,606	19,641
adj. R^2	0.478	0.361

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

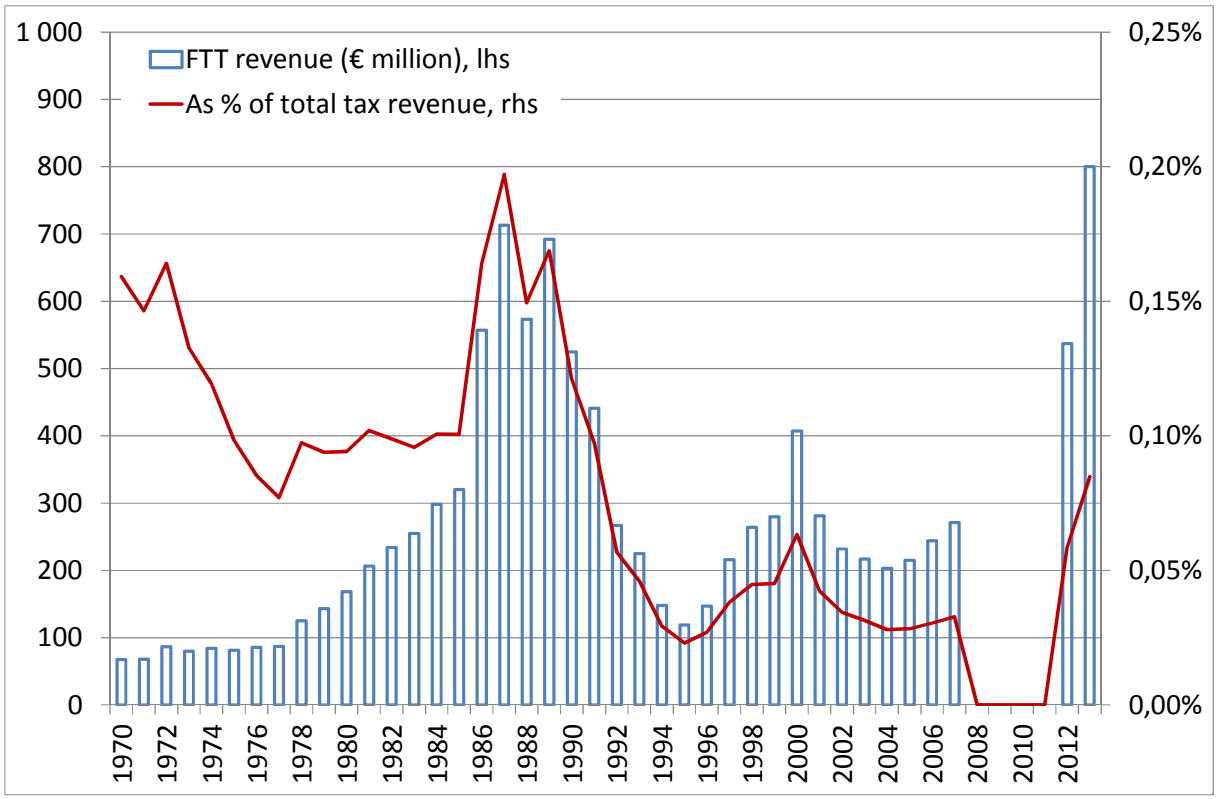
Table I. Results of the Probit models for the propensity score matching

This table presents Probit models that allow us to compute propensity scores to match firms that were subject to the tax with firms in the control group that had the closest propensity to be subjected to the tax. Models are estimated on the data averaged for 6 months before the introduction of the tax (Feb. 2012-July 2012, 127 days). *Market capitalization* = Total number of shares 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*. $Turnover_{i,t}$ = 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. *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.

Model	**(1)**	**(2)**	**(3)**
Market capitalization$_i$	0.00001*** (2.83)	0.00001*** (2.79)	0.00001*** (2.61)
Turnover$_i$	109.58*** (4.26)	118.69*** (4.43)	119.13*** (26.22)
Squared return$_i$	–0.13*** (-3.78)		
Conditional variance$_i$		–0.14*** (-3.88)	
High-low range$_i$			–2021.76*** (465.07)
Constant	–0.37** (-2.29)	–0.39** (-2.44)	–0.28* (0.16)
Nb. of obs.	249	249	249
Pseudo R^2	0.1206	0.1318	0.1426

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

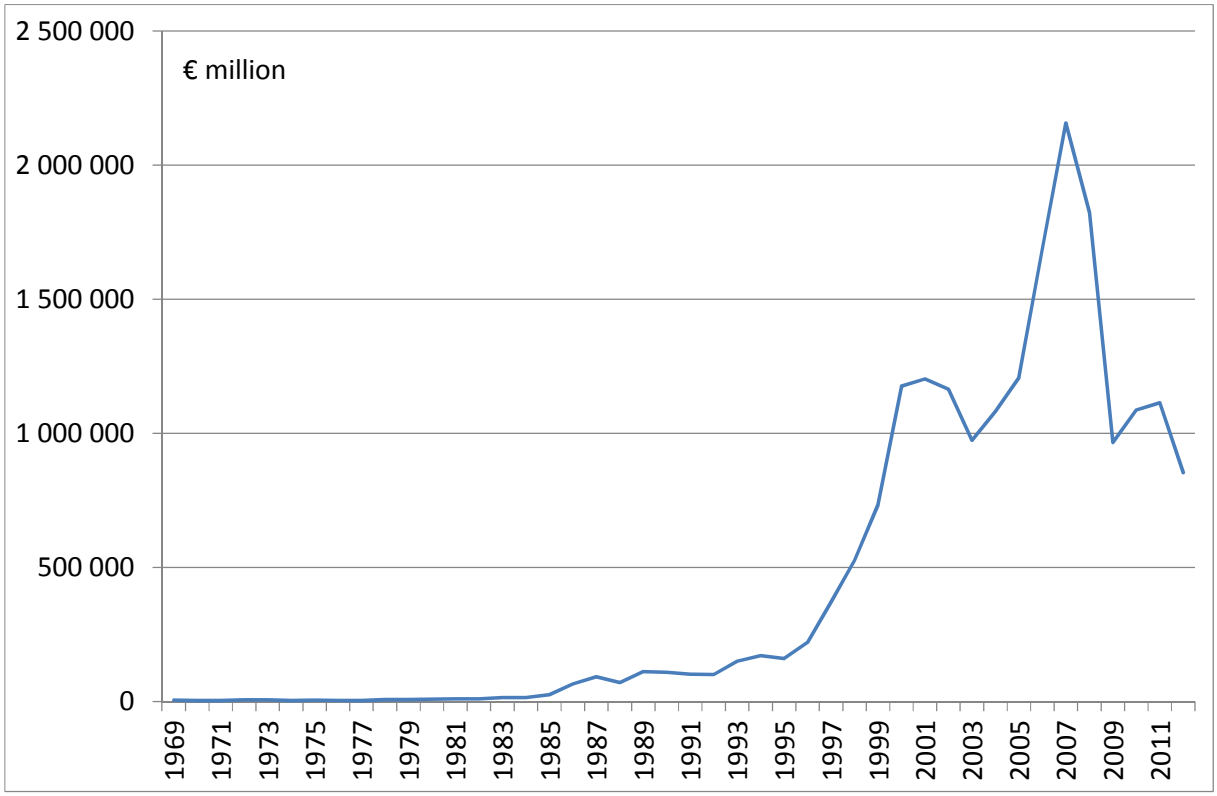
Figure A. Revenues from the French FTT



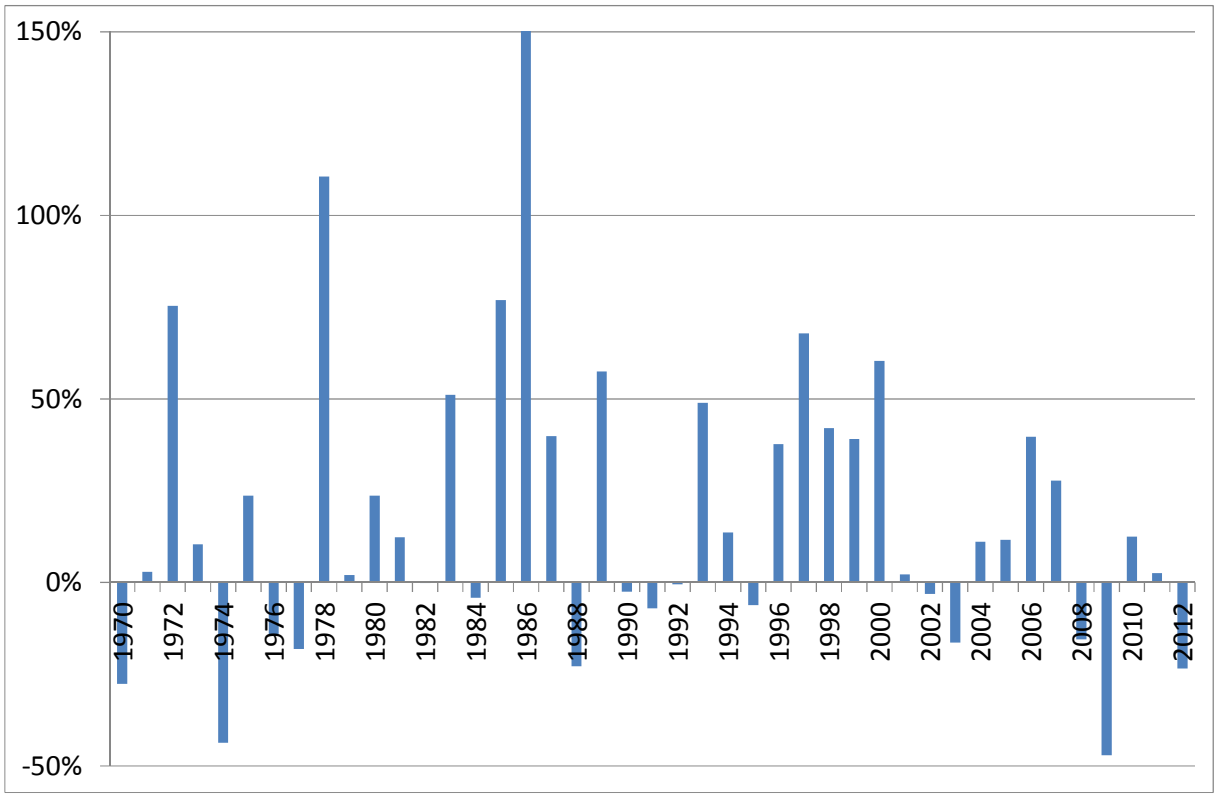
Source: OECD. 1970-2007: “Impôt de Bourse”; 2012-2013 (expected): “Taxe sur les transactions financières”

Figure B. Historical trading volume at the "Bourse de Paris"

Panel A. Annual turnover



Panel B. Annual variation



Source : Euronext.