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THE IMPACT OF SECURITIES TRANSACTION TAX ON MARKET QUALITY: EVIDENCE FROM FRANCE AND ITALY

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Abstract:

This paper analyzes two recent securities transaction tax (STT) implementations in France and Italy in order to identify the effects of STT on market quality. The effects are observed on panel data in four periods utilizing several trading activity and market quality measures. Difference-in-Differences are estimated using several control groups including German and Spanish equities. The results suggest significant decrease in trading activity and liquidity in French taxed stocks following the STT levy. The effect of STT on volatility is statistically insignificant across different control groups and estimation periods. The need to account for seasonal effects is also demonstrated. In Italian case, the results are inconclusive due to possible contamination by political events, but the evidence points to decrease in trading activity following the reform. The evidence regarding volatility and liquidity in Italian case is mixed.

Keywords:

Financial Transaction Tax, Market Quality, Volatility, Liquidity, Securities Transaction Tax

JEL Classification: G18, G12, G14

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1 Introduction

The idea of Financial Transaction Tax (FTT) has recently gained a renewed support from renowned economists[1] and wide public[2]. Most prominently 11 EU states are in talks to introduce FTT as soon as 2017 (Reuters, 2015). Besides revenue-raising FTTs are meant to discourage financial transactions that do not enhance efficiency of financial market and as a consequence to curb excess volatility observed in financial markets[3]. Hence FTTs should function as Pigouvian taxes.

The objective of this paper is to extend previous empirical evidence and verify the effects of FTT imposed in securities market, or Securities Transaction Tax (STT)[4], on market quality measures, most notably volatility, in France and Italy. Especially Italian case has garnered limited attention.

To analyze the effects Difference-in-Differences (DiD) as well as triple DiD are estimated using individual stock panel data. The estimations are performed using several control groups including German and Spanish stocks observing STT's effects on volume, several measures of liquidity and volatility. Current paper adds to the literature by analyzing impacts of STT on liquidity and volatility using several measures of each market quality measure for both France and Italy. Main contribution of this paper is detailed analysis of Italian reform extending the evidence provided by Coelho (2014).

The results of this paper confirm previous evidence evaluating French and Italian policy changes. It is shown that trading activity significantly decreases in France and suggestive evidence is provided showing an increase in transaction costs measured as relative bid-ask spread. In Italy the results seem to be heavily influenced by general election as I don't detect any significant change in trading activity in most estimations. The effects of STT on volatility were largely inconclusive in both countries supporting previous empirical evidence and undermining major argument in favor of the tax. For both countries the results are strengthened by presenting seasonally adjusted results.

The paper is divided as follows. Following section presents review of theoretical debate on the matter. Third section consists of a review of previous evidence regarding STT effects on market quality. In fourth section estimation approach and data is discussed, while fifth section presents the results of the paper.

[1]Stiglitz (1989), Paul Krugman (2009) , Jeffrey Sachs (2010), Dani Rodrik (2009) and more than 200 economists, who signed an open letter published by Center for Economic Policy Research (CEPR). Furthermore The Guardian published their list of 1000 notable FTT supporters, which can be accessed here:http://www.theguardian.com/business/interactive/2011/apr/13/robin-hood-tax-economists?guni=Article:in%20body%20link

[2] For example, in the UK, petition in favor of FTT reached nearly million signatures. According to Eurobarometer survey from 2012 (77.2), 66% of respondents from EU were in favor of FTT.

[3] I don't aim to review the literature on excess volatility in this paper. Readers should refer to e.g. Shiller (2003), who provides some brief evidence on excess volatility.

[4] Securities transaction tax (STT) according to the FTT categorization provided by Matheson (2012).

2 Literature review

Discussion about STTs

Some of the first arguments in favor of securities transaction tax were laid down by Keynes (1936), who argued that speculation based on psychology drives market prices rendering them unable to allocate capital efficiently. These arguments were later also used by Tobin (1984), who originally proposed the idea of FTT on foreign exchange markets. Summers and Summers (1989) and Stiglitz (1989) argue that markets suffer from excess volatility and STT levy would drive speculators[5] (noise traders) out of the market while not significantly affecting long-term fundamental traders[6], who play pivotal role in capital allocation. Further, Summers and Summers (1989) and Stiglitz (1989) assert that STT would eradicate rent-seeking represented by the unnecessary costs expended on short-term speculation. However, these arguments ignore signalling function of prices in the short-term as the STT imposition will widen the *"no-trade zone"* created by transaction costs, in which prices won't reflect new information[7] or react to arbitrage opportunities[8]. Indeed Stiglitz (1989) argues that stock prices don't have significant informational role in the economy[9], which can be easily disputed not only by anecdotal evidence, but also by recent empirical evidence by Campello and Graham (2013). Still one has to give merit to this argument as high-frequency traders' (HFT) investments to gain advantage in terms of milliseconds are quite sizeable as shown by Budish et al. (2015). Recent STT proposals rely on the very same arguments, e.g. Schulmeister (2010) or Pollin et al. (2003).

On the other side of the debate Schwert and Seguin (1993) argue that STT increases capital costs depressing investment and consequently hindering economic growth. Schwert and Seguin (1993) highlight the effects on market makers, who are induced to increase bid-ask spreads[10] following STT introduction. As a result of higher transaction costs, volatility may as well increase according to Schwert and Seguin (1993) or Habermeier and Kirilenko (2003). Even Pollin et al. (2003) acknowledge that STT is incapable of curbing volatility caused by positive feedback trading triggered during market slump as liquidity dries up even more in the presence of STT. Furthermore Habermeier and Kirilenko (2003) criticize the loss of volume as it has informational value, which is disputed by Summers and Summers (1989) and Stiglitz (1989) as they assume that the lost volume is represented by noise trades, hence lacking any informational value. Another argument against the STT points to creation of distortions, which proponents are aware of and therefore both Stiglitz (1989) and Summers and Summers (1989) propose a tax with a wide base and low rate in order to minimize them.

Additionally one should consider arguments of Rogoff (2011) and Matheson (2011), who highlight the violation of Diamond-Mirrlees Production Efficiency Theorem

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[5] Summers and Summers (1989) define them as positive feedback traders.

[6] Matheson (2011) shows formal support for the argument.

[7] Because it wouldn't be profitable to exploit such information due to transaction costs.

[8] Integration of the market with other markets would be negatively affected. This issue is highlighted in today's capital markets as new competition enhancing rules such as MiFiD in Europe gave rise to market fragmentation.

[9] Stiglitz (1989) in the first part of his article argues that investment decisions are not based on stock prices, however in the following he argues that higher volatility may in case of overvaluation lead to overinvestment by companies.

[10] The bid-ask spread wouldn't be only directly affected by the change in transaction costs, but also possibly by decrease in volume and increase in adverse selection as the probability of market maker facing an informed trader increases according to Schwert and Seguin (1993).

(DMPET), which implies that intermediate goods shouldn't be taxed. Although, the assumptions of DMPET usually don't hold in practice and Jacobs (2015) shows that it might be optimal to tax intermediated goods (to distort production) if production technologies differ across individuals. Still for example value-added tax design conforms to DMPET as discussed by Mankiw et al. (2009).

Finally one of the main motivations for STT is revenue raising as FTTs in general are cheap to administer as Matheson (2011) shows. However from welfare perspective non-distortionary lump-sum taxes are optimal to raise revenue. Hence, motivation to levy distortionary tax, such as STT, should lie in efficiency reasons (Pigouvian tax or Corlett-Hague motive) or redistributional reasons. If we levy non-linear income tax, then distorting the production for redistributional reasons would be only optimal if we could improve the redistribution (following the narrative of Jacobs (2015) if the comparative advantages would provide additional information about ability). Recently STT literature has paid attention to welfare consequences of the tax, for example Subrahmanyam (1998), Dow and Rahi (2000) and most importantly Davila (2014).

Empirical Literature Review

Roll (1989) in one of the first empirical assessments analyzes relationship between price volatility in the stock market and transaction taxes[11] using cross-country regressions finding statistically insignificant effects of STT on volatility. However Roll's (1989) cross-section analysis is not only limited due to possible omitted variable bias, but primarily due to possible presence of endogeneity in his model as higher volatility may, e.g. induce law makers to impose an STT. Hence it's impossible to causally interpret results using Roll's (1989) methodology. Thus due to methodological reasons more attention has been paid to changes in tax policies. A comprehensive, but brief overview of empirical literature assessing STT and transaction cost changes on stock markets[12] is provided below and in Table 1.

Volume and Liquidity

Volume predominantly decreases with rise in STT rate as shown by Pomeranets and Weaver (2013) for USA, Baltagi et al. (2006), Su and Zheng (2011) and Wang and Li (2012) for China, Liu (2007) for Japan, Umlauf (1993) for Sweden and Becchetti et al. (2014), Capelle-Blancard and Havrylchyk (2014), Meyer et al. (2013), Colliard and Hoffmann (2015) and Coelho (2014) for the French implementation analyzed in this paper. Absence of an effect of STT on volume traded is documented by Hu (1998), who assesses STT changes for several countries in Asia, but he doesn't utilize control groups as he analyzes the changes using equality tests, hence the method is unable of identifying causal effects. Lack of STT's effect on volume was also documented in case

[11] Roll (1989) also incorporates in his model variables for price limits and margin requirements as he tries to explore, how these different regulatory measures affect volatility.
[12] I don't include reviews of FTT effects on FX markets or futures markets.

Table 2: Empirical literature review

Author (Year)	Country	Event	Obs. Period	Estimated relationships			
				Volatility	Liquidity	Volume	Returns
Roll (1989)	Cross-country	STT	up to 20 days	no effect	-	-	-
Jones and Seguin (1997)	USA	Commission dereg.	2 years	positive	-	-	-
Pomeranets and Weaver (2013)	USA	STT	2 years	positive/no effect*	negative	negative	-
Hu (1998)	Taiwan, Hong Kong, S. Korea, Japan	STT	80 weeks	no effect	no effect	no effect	negative
Baltagi et al. (2006)	China	STT	1 year	positive	no effect**	negative	-
Su and Zheng (2011)	China	STT	up to 120 days	mixed	-	negative	-
Wang and Li (2012)	China	STT	up to 6 months	mixed	-	negative	-
Liu (2007)	Japan	STT	4 years	-	-	negative	negative
Liu and Zhu (2009)	Japan	Commission dereg.	2 years	negative	-	-	-
Umlauf (1993)	Sweden	STT	-	positive/no effect	-	negative	negative
Saporta and Kan (1997)	United Kingdom	STT	-	no effect	-	-	negative
Bond et al. (2005)	United Kingdom	STT	-	-	-	-	negative
Phylaktis and Aristidou (2007)	Greece	STT	6 years	mixed	-	-	no effect
Hau (2006)	France	Tick-size change	up to 5 years	positive	negative	-	-
Becchetti et al. (2014)	France	STT	Up to 180 days	negative	mixed	negative/no effect***	-
Capelle-Blancard and Havrylchyk (2014)	France	STT	1 year	no effect	no effect****	negative	-
Meyer et al. (2013)	France	STT	4 months	-	negative	negative	-
Colliard and Hoffmann (2015)	France	STT	5 months	no effect	negative	negative	-
Haferkorn and Zimmermann (2013)	France	STT	up to 80 days	no effect	negative	negative/no effect	-
Coelho (2014)	France and Italy	STT	up to 4 months	no effect	no effect	negative in France/ no effect in Italy	negative
Rühl and Stein (2014)	Italy	STT	120 days	positive	negative	no effect	-

*-for individual stocks and portfolio estimates respectively, **- based on anecdotal evidence, ***- the effect is negative in DiD, but in RD is only statistically significant in the slope implying that STT's effect on volume is more negative for larger cap stocks, ****- depends on control group

of Italy by Coelho (2014) and Rühl and Stein (2014), which are only two papers to my knowledge that study the case of Italian STT. Haferkorn and Zimmermann (2013) find no effect of French STT on volume traded using DAX30 stocks as control group, but they assess the STT effect only on CAC40 constituents, which might drive this result.

Liquidity was also shown to be negatively affected by STT in most cases. Pomeranets and Weaver (2013) find positive relationship between Holden measure and STT rate, while Hau (2006) finds positive relationship between tick size and effective spread[13]. Haferkorn and Zimmermann (2013) find negative impact of French STT on order book volume, but their results also point to relative increase in bid-ask spreads. Meyer et al. (2013) and Colliard and Hoffmann (2015) on the other hand find no effect of French STT introduction on spreads, but confirm negative effect of STT on order book volume. Rühl and Stein (2014) provide evidence of quoted bid-ask spread increase following Italian STT implementation. Liquidity wasn't affected by STT according to evidence from Asia by Hu (1998), whose methodology, however, could be questioned, and also Baltagi et al. (2006), who provide only anecdotal evidence. For French STT implementation, Capelle-Blancard and Havrylchyk (2014) show that liquidity (measured as bid-ask spread) wasn't impacted by STT using Dutch control group, but utilization of German control group suggests negative impact of STT on liquidity. Similarly Coelho (2014) finds absent impact of STT on both bid-ask spread and price impact in French and also in Italian case.

Volatility

As can be seen from Table 1, volatility was found to decrease with STT rate increases only in two cases as other evidence usually suggests either mixed or absent effect of STT on volatility. Jones and Seguin (1997) find evidence supportive of increases in volatility subsequent to STT rate increase, while Baltagi et al. (2006) find the relationship of this direction for Chinese market, Hau (2006) for tick size change in France and Rühl and Stein (2014) for Italian STT evaluated in September 2013[14]. Phylaktis and Aristidou, (2007) test the possibility of asymmetrical impact of STT on volatility in bear and bull market periods and show that in bull market periods STT rate hike increases volatility, while the relationship between the variables in bear market periods depends on the utilized sample. The effect of STT on volatility is also absent in all of the papers assessing French STT reform except for Becchetti et al. (2014), who find significant decrease in volatility (measured as Parkinson's H-L price range[15]) following STT introduction.

The evidence of STTs impact on returns is relatively straightforward as seen from Table 1. Both Saporta and Kan (1997) and Bond et al. (2005) find negative relationship between UK's Stamp Duty rate and stock returns, which was also confirmed for French and Italian STT introduction by Coelho (2014).

[13] Although as Hau (2006) warns tick size change is not fully equivalent to STT change due to different supply side effects.
[14] As they test the effect of derivatives falling within the scope of taxation, which is discussed in next section.
[15] This measure is discussed in following sections.

3 Methodology and data

Overview of implementations

France

The STT in France was introduced in Article 5 of Supplementary Budget Act of 2012[16]. The law introduced three taxes[17]: tax on acquisition of equity securities and other related instruments[18], HFT tax, and tax on purchases of Credit Default Swaps on sovereign debt. This paper assesses the first two measures. The tax on acquisition of securities applies to purchase[19] of equities or similar instruments[20] issued by a company legally registered in France[21], whose market capitalization is higher than € 1 billion on 1st December of the year preceding the year of taxation and admitted to trading on foreign or domestic regulated markets[22]. The tax doesn't apply to debt securities, which could potentially exacerbate the existing debt bias discussed by Fatica, Hammelgam and Nicodeme (2012). Moreover, as Bijlsma and Zwart (2013) show, France has a sizeable corporate bond market, hence it doesn't seem optimal to confine the tax to equity markets only. From revenue perspective exclusion of derivatives[23] from scope of the tax is a much more significant omission as it offers relatively cheap means to evade the tax. The tax of 0,2% is paid on acquisition of the security and applies to net position on given day[24]. The tax design includes important exemptions[25], most notably on primary transactions and transactions associated with market making in order to minimize the impact of STT on capital costs and on liquidity. Hedging activities associated with market making are also exempted from the tax. Thus we can see that the design tries to limit potentially negative impact of STT on liquidity by taxing only the most liquid stocks, taxing net positions and exempting transactions associated with market making.

The HFT tax is applied when the rate of cancellation or order modification within one day exceeds a given threshold. The tax rate is 0,01% on the amount of cancelled or modified orders that exceed the threshold. The tax is applied only to transactions of companies operating in French market and was simultaneously introduced with the tax on equities, which poses an identification problem. Coelho (2014) simply assumes that the tax affects mutually exclusive groups, because HFTs trade mostly intraday with zero net positions at the end of the day, hence are not affected by the STT. But one still

[16] The English version of the document can be found here: http://www.impots.gouv.fr/portal/deploiement/p1/fichedescriptive_7432/fichedescriptive_7432.pdf

[17] Note that before implementation of French FTT, France had a registration tax on shares, but this tax wasn't applicable to transfers of publicly traded shares (as long as the transfer wasn't recorded by deed), see Leclerc (2012). More details on the changes in this tax is and its replacement by current schedule is provided by Leclerc (2012).

[18] Similar instruments include all instruments that could provide capital or voting rights to taxed securities, such as ADRs, even if they were emitted by an entity registered outside of France, but represent taxed securities.

[19] Or more precisely as law states: *"applies to every acquisition for valuable consideration" (p.3)*

[20] Similar instruments include all that could provide

[21] Thus for example Airbus Group NV is headquartered in Toulouse, France, but legally registered in the Netherlands, hence its equities are not taxed.

[22] The list of companies, whose shares are subjected to STT was annually published by French Ministry of Finance. In 2012, the list consisted of 109, in 2013 of 113 and in 2014 of 114 companies.

[23] Following the introduction of the tax spike in Contract-for-Difference (CFD) trading was reported by Bloomberg (2013) and Reuters (2013) suggesting relatively intensive STT evasion.

[24] Therefore intraday traders with nearly zero net holdings at the end of the day are not affected by the tax.

[25] The list of exemptions: 1. Acquisitions on primary market, 2. Acquisitions of clearing houses and central depositories except for transactions that are unrelated to clearing/deposition, 3. Acquisitions in market making activities, 4. Acquisitions resulting from liquidity agreements, 5. Restructuring and intra-group acquisitions, 6. Temporary acquisitions, such as repurchase agreements, 7. Acquisitions by employee savings scheme, 8. Acquisitions of bonds exchangeable or convertible into stock.

cannot infer causal interpretation of the results, because changes in volatility or liquidity may have been caused by change in HFT activity resulting from HFT tax introduction. Meyer et al. (2013) argue that most of the estimated effects may be credited to STT as the HFT tax rate is much lower. Colliard and Hoffmann (2015) devise a simple approach to isolate the effects of the two taxes, which is also used in this paper. Both taxes were introduced on 1.8.2012 while ADRs came under scope of the tax later on 1.12.2012.

Italy

Italian STT[26] came into effect 8 months after the introduction of French STT. The Italian tax design is very similar to French tax, but it offers fewer opportunities for tax evasion. Italy introduced two taxes: tax on transfers of equities and HFT tax. Similarly to France the tax on equities is applicable to transfers of equities and similar instruments issued by companies legally registered in Italy or equivalent instruments issued by other entities regardless of their legal residence. Equities of companies with market capitalization below € 500 million[27] are exempted from the tax[28]. The tax rate in Italy is 0,1% on transactions in regulated markets and multilateral trading facilities (MTF), but 0,2% otherwise – on OTC markets, thus discriminating against OTC markets possibly to prevent further fragmentation of the market. The rate was temporarily higher in 2013 by 0,02 percentage points in both market categories. Similarly to French case, the tax applies to net positions at the end of the day.

The most significant difference between the implementations is the inclusion of derivatives, whose value is primarily tied with taxed securities within the scope of the tax. Hence, the CFD loophole is nonexistent in Italian case making evasion more problematic i.e. more costly. Derivatives transactions are subject to fixed amount of tax, which is determined depending on contract type and its value while transactions on regulated markets and MTFs are subject to lower tax. The exemptions are similar to those in French case[29].

The HFT tax introduced in Italy also follows French implementation, but the threshold of modified and cancelled orders as well as tax rate differ. The HFT tax and tax on equities has been effective since 1st March 2013, while derivative transactions came within the scope of the tax in September 2013.

Estimation approach

In order to identify the effect of the tax event on market quality I utilize difference-in-differences approach following previous literature assessing the reforms. The design of the events presents a good opportunity to explore causal effects of the tax on market quality as several control groups can be constructed. Due to common trend assumption

[26] To my knowledge official English translation of Italian bill doesn't exist, hence in this section I rely on unofficial translation provided by PriceWaterhouseCoopers (2013).
[27] The threshold market capitalization is calculated as average market capitalization during November of preceding year. Thus the categorization is more precise and less prone to short-term shocks to valuations than in French case.
[28] The list of these companies is annually published by Italian Ministry of Finance. The most recent list can be found here: http://www.mef.gov.it/inevidenza/article_0065.html
[29] In Italy the tax doesn't apply to transactions associated with market making, which is defined in similar manner as in French case (PriceWaterhouseCoopers, 2013). Issuance and redemption of shares is also exempted from the tax. Further liquidity enhancement transactions on behalf of issuer, social security institutions and pension schemes, transactions between companies with control ties and transactions for purposes deemed ethical or socially responsible are exempted (PriceWaterhouseCoopers, 2013).

under DiD, the quality of control group is crucial for the estimation. The utilized control groups are explored in next section.

As shown by Angrist and Pischke (2008) inclusion of time-invariant control variables into DiD estimation doesn't affect consistency or unbiasedness of the results, but incorporation of these variables increases the precision of the estimates. Hence I include fixed-effects in the model allowing for firm-level variation of intercepts capturing all unobservable (and in this case also observable, but not gathered in dataset) time-invariant firm characteristics. The propriety of this approach was also tested using Hausman test on French data[30], which supports fixed-effects as more appropriate than pooling and random effects models. The preference for fixed-effects rather than random effects is also straightforward from the nature of the data used as the fixed effects estimator allows for correlation between explanatory variables and unobserved time-invariant factors (see Wooldridge, 2002). It is obvious that dummy for STT treatment will be correlated with time-invariant factors such as ROE and other variables systematically related to company size, thus random-effects is clearly inappropriate even from theoretical standpoint.

Further, in sake of estimate precision, one has to take into account the possibility of market quality measure fluctuations across all stocks due to events such as ECB's policy announcements. The different seasonal, calendar and day-of-the-week effects in volatility and volume were documented by Kiymaz and Berument (2003) among others. To account for potential common shocks in volume, liquidity and volatility I include time dummies in the model similarly to Capelle-Blancard and Havrylchyk (2014). However, time dummies don't address the issue of differential seasonal and time effects across treatment and control groups, which were also reported by Kiymaz and Berument (2003). These are addressed in alternative specification using Difference-in-Difference-in-Differences (DiDiD)[31] approach following Imbens and Wooldridge (2007).

The baseline model has the following form:

$$(1) \quad Y_{i,t} = \eta_i + \beta_1 Day_t + \delta STT_{i,t} + X_{i,t} + \varepsilon_{i,t},$$

where η_i represents the fixed effect of *i*-th company, Day_t represents the day dummy and $STT_{i,t}$ represents the dummy variable, which is one for taxed stocks in the period after the tax went into effect or simply the DiD. This is effectively a two-ways fixed effects model as described by Baltagi (2010). Additionally control variables, $X_{i,t}$, for market capitalization, *logMC,* and average price, *logaprice*, are included in the model in alternative specification, which yields similar results and hence is not reported in the paper[32]. This specifications partly follows Meyer et al. (2013). Capelle-Blancard and Havrylchyk (2014) and Coelho (2014) don't incorporate any control variables in their models[33]. The simple specification without any control variables obviously assumes that

[30] More precisely with dependent variable volume expressed in €, and for 60 day estimation window.
[31] Also often denoted as Triple DiD.
[32] The results are available on request. If the results with controls differ significantly, then they are discussed in results.
[33] Pomeranets and Weaver (2013) due to interdependence between market quality measures include average price, average volume and effective bid-ask spread as control variables into their volatility model, because they don't utilize

there aren't any time-varying variables causing omitted variable bias. In short-term estimations, current specification seems appropriate, because most of the firm specific factors affecting volatility and liquidity (explored by e.g. Pastor and Veronesi (2003) or Schwert (1990)) are in most cases fixed, for example ROE or dividend per share in case of volatility, although obviously they are not fixed per se, but cannot be usually observed in shorter time intervals than quarters[34]. In longer horizons, such variables could be industry, management quality or transparency of company.

The unbiasedness of fixed-effects estimator is further ensured by strict exogeneity assumption, which should be met in this case. More concerning is the consistency of the estimator as heteroscedasticity and autocorrelation are expected to be present. Therefore following the discussion in Bertrand et al. (2004), Hansen (2007), but mainly Petersen (2009) and Thompson (2011) I use double-clustered standard errors following Thompson's (2011) equation:

$$(2) \quad \hat{V}(\hat{\beta}) = \hat{V}_{firm} + \hat{V}_{time,0} - \hat{V}_{white,0},$$

where $\hat{V}(\hat{\beta})$ is the estimated variance of the estimator $\hat{\beta}$, $\hat{V}_{firm}$ and $\hat{V}_{time,0}$ are variance matrices clustered on firm and error and $\hat{V}_{white,0}$ is White's heteroskedasticity-consistent variance matrix[35].

The effects of STT on market quality measures are estimated in four time windows around the implementation: 30 days, 60 days, 6 months and 12 months.

In order to account for seasonal effects I also estimate triple DiD as in Imbens and Wooldridge (2007) and follow similar approach to that of Coelho (2014) and Colliard and Hoffmann, (2015). This approach exploits full length of my dataset to eliminate the seasonal effect with the highest precision possible given the obtained data. The effect of the STT itself is only estimated for August 2012 in French case and March 2013 in Italian case. The specification with full set of dummies following Imbens and Wooldridge (2007) is:

$$(3) \quad \begin{aligned} Y_{i,t} &= \eta_i + \beta_1 Month + \beta_2 Year + \beta_2 Month*Year + \beta_3 Country*Month + \beta_4 Country*Year + \\ &+ \delta STT_{i,t} + \varepsilon_{i,t} \end{aligned}$$

$$\text{and } STT_{i,t} = FRA*Month_{August}*Year_{2012},$$

where η_i represents fixed effect of *i-th* company, *Month/Year* represents a dummy variable for month/year, *Country* represents dummy variable, which is one for treatment high market capitalization stocks[36] and zero for control high market capitalization stocks and *STT* represents the treatment effect, where *FRA* is dummy, which is one for French (treated) companies. However, the inclusion of full set of dummies may lead to

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any control group. However, incorporation of these variables to DiD model would be counterproductive and would present a bad control variable.

[34] Although one could observe various signals of different reliability from e.g. supply chain and other sources.

[35] The zeros in indexes denote zero lag. I employ the HC1 robust errors, which are consistent with Stata's estimation of robust clustered errors as stated by Hausman and Palmer (2012).

[36] Note that this estimation is not applied to small control groups, in such case instead of country dummy I would have a dummy indicating of the stock is over or below the market capitalization threshold.

overspecification, therefore I also estimate the reduced form used by Colliard and Hoffmann (2015). The reduced specification is:

$$(4)\quad \begin{aligned} Y_{i,t} = \eta_i + \beta_1 Month_{August} + \beta_2 Month_{August} * Year_{2012} + \beta_3 FRA * Month_{August} + \\ + \beta_4 FRA * Year_{2012} + \delta STT_{i,t} + \varepsilon_{i,t} \end{aligned},$$

where only dummy for August and for year 2012 (for French implementation) are incorporated in the model, hence I am comparing the market quality measures in August with all other months in the year and similarly year 2012 with all the other years.

Control groups

As already noted the common trend assumption implies that one would like to compare groups of stocks as homogenous as possible. The tax design offers me a natural control group of French and Italian stocks below € 1 billion and € 500 million respectively. This control group is relatively heterogeneous, hence following Coelho (2014) I also employ control group of French and Italian stocks below the taxation threshold, but over € 500 million in French case and € 250 million in Italian case. In order to choose an appropriate control group of comparable stocks from other European markets I look at correlations in returns of blue chip indices across Europe[37]. The returns of large market capitalization French stocks (CAC40) have highest correlation coefficients with Dutch (AEX) and German (DAX30) stocks. German rather than Dutch stocks were chosen as the dividends are in many cases paid out on quarterly basis in the Netherlands while in France are paid out on annual basis. This poses a possible problem for my analysis as the data isn't dividend adjusted, which is discussed below. Another problem is the proximity of general election in the Netherlands[38]. Using German stocks as control group has, however, one downside, because the market microstructure differs on Euronext Paris from the one on Deutsche Börse. The stock return correlations with Italian blue chip index FTSE MIB are relatively lower across all European markets. Highest correlation coefficient is achieved with Spanish (IBEX 35) stocks, hence I use Spanish stocks as a control group for Italian stocks.

Market quality measures

Volatility

The volatility measures in this paper are limited by the daily frequency of the data described in following section. This paper assesses only daily volatility. The first measure of volatility is the "classical" estimator: close-to-close squared return. But this measure is expected to be quite noisy following Andersen and Bollerslev (1998)[39]. Squared return is calculated as:

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[37] The results are not reported here, but can provided at request.

[38] The election in the Netherlands took place on 12.9.2012 positing a possible contamination threat in longer time horizons.

[39] Jones and Seguin (1997) and Pomeranets and Weaver (2013) multiply the squared return by a constant, $\frac{\pi}{2}$, in order to achieve unbiasedness of squared return. However, this transformation is not used in this paper as the bias is assumed to be small and in the same direction in all markets, hence it shouldn't bias DiD estimations.

$$(5) \quad CVOL_{i,t} = \left[\ln\left(\frac{P_{i,t}}{P_{i,t-1}} \right) \right]^2 = (R_{i,t})^2 ,$$

where $P_{i,t}$, $P_{i,t-1}$ are closing prices on day *t* and *t-1*. $R_{i,t}$ is logarithmic daily return.

But due to noisiness and the possibility of bias in classical estimator, because of bid-ask bounce, alternative measures of volatility based on price ranges are also utilized. Alizadeh et al. (2002) argue that efficiency of range based estimators is comparable to efficiency of realized volatility calculated from 3-6 hour data[40]. The high-low price range of Parkinson (1980) provides more efficient[41] estimation of volatility than classical estimator if assumptions hold as shown by Parkinson (1980), Garman and Klass (1980) or Beckers (1983). Parkinson's measure utilized here is calculated as:

$$(6) \quad VOLPar_{i,t} = \frac{\left[\ln(Ph_{i,t}) - \ln(Pl_{i,t}) \right]^2}{4\ln(2)} ,$$

where $Ph_{i,t}$ is the highest price of stock *i* on day *t* and $Pl_{i,t}$ the lowest. The empirical assessment of price range volatility estimators[42] was performed by Shu and Zhang (2006), who show that most efficient estimator is Garman and Klass estimator while estimator with lowest bias is Yang and Zhang estimator, which isn't used in this paper as described in footnote 53. In general, according to Shu and Zhang (2006) and Alizadeh et al. (2002), price range measures are robust to market microstructure noise and as Alizadeh et al. (2002) show are less sensitive to bid-ask bounce as the upward bias will be cancelled out with the downward bias of the price range measures documented by Garman and Klass (1980). Based on this discussion I also use Garman and Klass estimator given by following equation:

$$(7) \quad VOLGK = 0,511(h-l)^2 - 0,019\left[c(h+l) - 2hl \right] - 0,383c^2 ,$$

where $h = \ln(\frac{Ph_{i,t}}{Po_{i,t}})$, $l = \ln(\frac{Pl_{i,t}}{Po_{i,t}})$, $c = \ln(\frac{P_{i,t}}{Po_{i,t}})$. $Ph_{i,t}$, $Pl_{i,t}$, $Po_{i,t}$, $P_{i,t}$ are high, low, opening and closing prices of *i*-th stock on day *t.*

Liquidity

[40] Hence the absence of intraday data shouldn't significantly affect the quality of analysis in this paper.

[41] The efficiency of estimators is assessed based on relative efficiency to squared return estimator and following Garman and Klass (1980) is calculated as: $Eff(Y) = \frac{\text{var}(CVOL)}{\text{var}(Y)}$, where $CVOL$ is classical estimator and Y is the given volatility measure for which we are trying to estimate efficiency.

[42] Following Parkinson (1980) price range estimates were developed by e.g. Garman and Klass (1980), Ball and Torous (1984), Rogers and Satchell (1991) and Yang and Zhang (2000). Yang and Zhang (2000) construct their own price range estimator, which incorporates presence of drift and opening jumps, and is a range-based estimator with the lowest bias, but is not used here as it cannot be used to estimate daily volatility.

Liquidity cannot be described by a single "right" measure as the concept of liquidity is multidimensional in its characteristics[43]. Hence STT's impact on liquidity is assessed using three different measures, which capture different properties of liquidity.

The first utilized measure of liquidity quoted bid-ask spread in relative form. Ideally one would wish to work with effective spreads as they effectively capture the real transaction costs of trading as Bessembinder and Venkataraman (2010) argue, but due to data constraints quoted bid-ask spread is employed. Hereby used measure is based on closing spread, which may be potentially biased due to window dressing by market makers at the close based on evidence by Jang and Lee (1995). However, the market microstructure on hereby analyzed markets differs significantly from the NYSE in 1990s assessed by Jang and Lee (1995), thus more relevant evidence on the behavior of bid-ask spread in today's markets is provided by Wyart et al. (2008). Despite being unable to calculate effective spreads, quoted spreads at close should represent a good estimate of bid-ask spreads as Hasbrouck (2005) argues that the measures exert correlation of 95%[44]. Fong et al. (2014) assess liquidity measures in global perspective and conclude that relative closing quoted spread is the best proxy for effective spread and other high-frequency spread measures. The formula for closing bid-ask spread following Chung and Zhang (2014) is:

$$(8) \quad CQSpread_{i,t} = \frac{(Ask_{i,t} - Bid_{i,t})}{(Ask_{i,t} + Bid_{i,t})/2},$$

where $Ask_{i,t}$ and $Bid_{i,t}$ correspond to closing ask and bid prices for *i*-th company at day *t*.

Besides volume, the effects of STT are also estimated for turnover ratio, which is a volume normalized by outstanding shares of the company. In the short-term, when shares outstanding are fixed, one could expect the effects of STT to be equivalent for both measures. Following Gabrielsen et al. (2011) the measure is calculated as:

$$(9) \quad TR_{i,t} = \frac{TurnShares_{i,t}}{SharesOut_{i,t}},$$

where $TurnShares_{i,t}$ is the number of shares traded of stock *i* on day *t* and $SharesOut_{i,t}$ is the number of outstanding shares. Both variables in my dataset are in thousands.

Finally to assess price impact, I utilize Amihud's (2002) illiquidity ratio, which is calculated as follows:

$$(10) \quad ILLIQ_{i,t} = \frac{|R_{i,t}|}{VOLUME_{i,t}},$$

here $R_{i,t}$ is the daily stock return of *i*-th stock on day t and $VOLUME_{i,t}$ is the daily value traded (volume in euros) for the respective stock *i.* I have to note that this is

[43] See for example Lybek and Sarr (2002) for overview.
[44] Although Hasbrouck (2005) doesn't report the results in the paper.

representation for daily liquidity estimation. The daily stock return is calculated as $\ln(\frac{P_{i,t}}{P_{i,t-1}})$, where $P_{i,t}$, $P_{i,t-1}$ are closing prices. Amihud (2002) multiplies the illiquidity ratio by 10^6 while Becchetti et al. (2014) by 10^5. I follow Becchetti et al. (2014) and multiply the illiquidity ratio by 10^2 as the denominator (volume[45]) was already divided by 10^3.

Data

The data was collected from Thomson Reuters Datastream[46]. Previous papers assessing the two policy changes relied mainly on stocks constituting indices. Similarly to Becchetti et al. (2014) data were collected for all stocks traded at that particular market. In case of France the original sample consists of all stocks constituting the CAC All Shares index[47], which includes all stocks listed on Euronext Paris provided that Euronext Paris is their primary listing exchange[48]. For Italy constituents lists for All Shares indices couldn't be obtained, hence the data is obtained for all stocks traded on Borsa Italiana. The choice to work with as wide datasets as possible is problematic, because many of the stocks are relatively illiquid[49]. The illiquid stocks were omitted if they weren't traded for at least one day in most of the observed weeks[50]. Obviously this problem is mostly present in low capitalization stocks, which weren't traded. Hence the possible concerns about the propriety of this exclusion (or wide dataset) are addressed by using control groups of large capitalization German and Spanish stocks. Regarding German stocks, the data was obtained for all constituents of CDAX index that trade on Xetra. The obtained dataset also includes companies with lower market capitalization than the taxation threshold, which are used to isolate the effect of HFT tax. The German dataset has one drawback: the value traded was not available for German stocks, hence the data is imputed by multiplying the volume in shares by average price.

Regarding Spanish control group, data was obtained for blue chip, IBEX35, and mid-cap, IBEX MID CAP, indices, which generally include companies with market capitalization over the Italian taxation threshold, while only few IBEX MID CAP constituents have market capitalization below the taxation threshold. Hence, due to data limitations I didn't obtain data for low capitalization companies in Spain making it impossible to verify the effect of HFT tax. In all cases shares of collective investment

[45] Volume was obtained in thousands and wasn't rescaled as it doesn't impact regression results, see Wooldridge (2002).

[46] The quality of Thomson Reuters Datastream data was assessed by Ince and Porter (2004), who conclude that the data is of high quality after screening. Similarly German equity data from Datastream are evaluated by Brückner (2013).

[47] Additional information about the index can be found here: https://indices.euronext.com/sites/indices.euronext.com/files/all_share_and_sector-family_rules_version_14-01.pdf

[48] According to Euronext (2014) stocks, whose primary listing is not on Euronext Paris are included, if their annual velocity (the ratio of shares traded and shares listed) is less than 3%.

[49] This is often also a reason, why these stocks are not included in the indices besides requirements such as market capitalization or free float (the proportion of equity available to public trading)

[50] The requirement is relatively mild as for example Colliard and Hoffmann (2015) exclude all stocks that weren't traded at least 20 times a day. However, others such as Becchetti et al. (2014) or Capelle-Blancard and Havrylchyk (2014) don't provide clear approach to illiquid stock omission.

vehicles were excluded as they were exempt from the tax in both countries. Additionally preference shares were excluded as the paper focuses on effects on common shares.

The obtained sample spans 5 years from the beginning of 2010 till the end of 2014. This allows me to account for seasonal effects in the estimates. The treatment is assigned based on the list of companies published by French Ministry of Finance[51] and Italian Ministry of Finance. Besides omission of illiquid stocks I also excluded stocks of companies, which had initial public offerings (IPOs) and stock splits in the observed period. Stock splits were shown to increase volatility of stock returns (e.g. Sheikh (1989), Dubofsky (1991), Koski (1998)) and mixed effects were also found on volume (Koski, 1998) and other measures of liquidity (Easley et al., 2001). Thus, even though the data is adjusted for capital events stocks experiencing splits during the observed period were excluded from the dataset[52]. Stocks of companies with recent IPOs were shown by Schwert (1998, 1990) to be more volatile initially after IPO[53] with gradual decrease in volatility over time. Similarly stocks of companies, which delisted from various reasons[54] during the observed period were excluded from the dataset. Although, the number of taxed companies has increased since 2012 and anecdotal evidence doesn't point to companies going private or changing the place of their legal registration after the implementation of the tax. Further the data was screened for possible mistakes in capital events possibly present in Datastream data following advice of Ince and Porter (2004) and Brückner (2013).

The data was obtained for adjusted closing prices, opening and closing price, high and low price at given trading day, ask and bid price quoted at the close of the market, turnover by value, turnover by volume and the number of common shares outstanding. Possible problem is represented by the absence of adjustment for dividends in Datastream data. Umlauf (1993) also works with dividend unadjusted data and argues that the omission is not driving his results. However, it is fairly plausible to assume that following the STT imposition contributions of dividend yield to volatility of stock returns remains unchanged. Moreover, price range volatility measures by Parkinson (1980) and Garman and Klass (1980) utilize non-adjusted prices, thus the analysis shouldn't be significantly affected by the omission.

Descriptive statistics

Several other restrictions had to be made to the dataset as the bid-ask spread was in numerous cases negative. Dataset was restricted to observations with bid-ask spread lower than 50%, which can be considered as a very benevolent restriction, but one has to keep in mind that there are still quite illiquid companies among the small capitalization

[51] The list for year 2012 is available in the decree here: http://legifrance.gouv.fr/eli/arrete/2012/7/12/EFIE1227995A/jo/texte ; List for 2013: http://www.legifrance.gouv.fr/affichTexte.do;jsessionid=CE5E8FB7F6253110B263AE91521F88CE.tpdjo07v_1?cidTexte=JORFTEXT000026951702&categorieLien=id ; List for 2014: http://legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000028408375&categorieLien=id

[52] If stock splits would predominantly take place in pre or post-reform in one of the control groups, then it could potentially drive the results.

[53] An obvious reason for this phenomenon may be a novel industry or simply the age of the company.

[54] Due to bankruptcies or capital changes such as takeover of Silic SA or squeeze out of APRR SA.

stocks. I also restricted Amihud ratio (multiplied by 10^5) to maximum value of 10, which is again a relatively liberal restriction[55]. The tables 2 and 3 include summary statistics for the datasets including low and high market capitalization stocks from France, Italy, Germany and high market capitalization stocks for Spain for one year horizon.

Table 2: Descriptive statistics for all French and German companies

Variable	Mean	Std. Dev.	Minimum	Maximum
FTT	0,096	0,294	0,000	1,000
Volume Traded	528,023	2603,453	0,000	178104,400
Value Traded	10853,275	35565,091	0,000	1198364,809
Turnover Ratio	0,002	0,005	0,000	0,389
Amihud Illiquidity r.	0,093	0,462	0,000	9,959
Relative Bid-Ask Spread	0,011	0,019	0,000	0,414
VOL: Squared Return	0,001	0,004	0,000	0,912
VOL: Parkinson	0,000	0,002	0,000	0,363
VOL: Garman-Klass	0,000	0,002	-0,001	0,144
log Return	0,000	0,024	-0,955	0,607
Market Capitalization	3780323,933	10569008,174	279,699	97548379,200
Common Shares	147742,161	415954,130	73,000	4432658,000
Closing Price	29,528	47,865	0,020	876,950
Opening Price	29,519	47,852	0,020	884,400
High Price	29,824	48,363	0,030	884,400
Low Price	29,198	47,329	0,020	855,000
Ask price	29,622	48,090	0,030	876,950
Bid Price	29,423	47,667	0,020	864,000
N=128413, 554 cross-sectional units				

Volume measures and market capitalization are in thousands. Amihud Illiquidity ratio was multiplied by 100000. All prices are in EUR.

[55] Becchetti et al. (2014) record a maximum value of roughly 4 for Amihud ratio in their sample.

Table 3: Descriptive statistics for all Italian and Spanish companies

Variable	Mean	Std. Dev.	Minimum	Maximum
FTT	0,141	0,348	0,000	1,000
Volume Traded	3474,006	17341,519	0,000	418296,900
Value Traded	10173,335	43087,455	0,100	1115955,000
Turnover Ratio	0,002	0,005	0,000	0,229
Amihud Illiquidity r.	0,105	0,495	0,000	9,818
Relative Bid-Ask Spread	0,011	0,014	0,000	0,400
VOL: Squared Return	0,000	0,002	0,000	0,176
VOL: Parkinson	0,000	0,001	0,000	0,033
VOL: Garman-Klass	0,000	0,001	0,000	0,030
log Return	0,001	0,022	-0,420	0,375
Market Capitalization	2245475,753	7238069,503	1657,760	70572085,560
Common Shares	615307,577	2014128,326	1132,000	19280948,000
Closing Price	8,391	25,948	0,024	396,000
Opening Price	8,387	25,966	0,024	395,000
High Price	8,489	26,213	0,024	397,000
Low Price	8,280	25,660	0,024	390,250
Ask price	8,434	26,161	0,024	397,500
Bid Price	8,334	25,722	0,024	392,000
N=50244, 210 cross-sectional units				

Volume measures and market capitalization are in thousands. Amihud Illiquidity ratio was multiplied by 100000. All prices are in EUR.

Note that the panels are unbalanced as even for some very liquid companies, such as Total S.A. one can find a missing value[56] in Datastream data. Therefore the baseline model was also estimated on 12 month balanced panel with small stock control groups in both French and Italian case. The estimated models are not reported in the paper, but can be provided at request. The estimated effects from balanced panels are qualitatively similar to the results obtained from unbalanced panels. As the discussed 12 month panels were the most heavily unbalanced, one could assume that the results extend to shorter, more balanced panels. Therefore only results from unbalanced panels will be discussed[57] below.

Interestingly Garman-Klass volatility measure has negative minimum, which is indeed possible as argued by Molnár (2012) and doesn’t represent an error in the data. The tables A and B in Appendix clearly indicate the, even surprising, homogeneity of French and German large capitalization stocks with respect to market quality measures. The homogeneity of taxed Italian and comparable Spanish stocks is considerably smaller as seen from tables C and D in Appendix.

[56] The data seem to be missing randomly.
[57] Note that in short estimation periods the panels were much more balanced and in some cases, as in Italian case with Spanish control group, the panel was balanced in 30 day and 60 day estimation window.

4 Results

Volume and Liquidity

France

Control group: French stocks with capitalization below € 1bn

The estimation results in Table 4 point to decrease in volume traded expressed in both number of shares and monetary units following the STT imposition in treatment group relative to control group. The STT coefficient in 30 day estimation window implies statistically significant decrease of volume traded of approximately 34%[58]. The coefficient decreases as the estimation period increases implying possible presence of temporary effect or seasonal effect. Still, even in one year estimation window, the coefficient suggests a decrease of approximately 27% in volume expressed in shares. However, the STT coefficient in the regression with volume expressed in € as dependent variable decreases faster as the coefficient implies a decrease of approximately 18,7% in treatment group relative to control group after STT introduction in 12 month estimation window. Inclusion of additional control variables also results in relatively significant change in estimated coefficient as it suggests a 24,6% decrease in value traded. The model is not reported here[59] as earlier discussed. The difference in longer estimation horizon across trading volume measures is most certainly caused by the effect of changing price level, which is implicitly included in value traded. Hence the more moderate decrease in value traded had to be caused by relative increase in stock prices in treatment relative to control or by relative decrease in valuation in control group. This explanation is also supported by the sensitivity of STT coefficient to incorporation of control variables for log of average prices or log of market capitalization. The estimated results translate into elasticity of volume (in shares traded) with respect to transaction costs change of -1,275 for 30 day estimation window and elasticity of -1,0125 for 12 month estimation window if one follows Coelho's (2014) transaction cost estimate of 0,75%[60]. The estimated elasticities are slightly higher than those of Coelho (2014) and Baltagi et al. (2006), who find elasticities of -0,9 and -1 respectively. However, the estimated elasticities rely on Coelho's (2014) trading cost estimates, which might be too conservative as Munck (2005) estimates the total trading costs on Euronext in 2004 at 60 basis points[61]. Keeping in mind the findings from note 72 and decreasing trend in trading costs I also estimate elasticities using two-way trading costs

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58 The coefficient is -0,4152, hence as the model is log-linear the estimated coefficient implies an increase in outcome variable by $e^{\hat{\beta}}$.

59 But complete results can be provided at request.

60 The calculation of transaction cost elasticity is: $\varepsilon_{V,tc} = \frac{\frac{\partial V}{V}}{\frac{\partial tc}{tc}} = \frac{\%\Delta V}{\%\Delta tc} = \frac{-34\%}{\frac{0,2\%}{0,75\%}} = -1,275$, where *V* denotes volume and *tc* denotes transaction costs.

61 Munck (2005) bases his estimates on Elkins/McSherry data, which provide one-way trading cost estimates, hence two-way trading costs are calculated as double of one-way trading costs. In both French and Italian case one has to calculate the elasticity based on two-way trading costs as the tax is paid only on acquisition of securities. Recently Pollin and Heintz (2011) compile total two-way trading costs for US market, which range from 25 to 50 basis-points depending on the source of the data. According to Pollin and Heintz (2011) Elkins/McSherry estimates are generally lower than ITG estimates. Baker and Kiymaz (2013) report one-way trading costs of 57 basis points in 2009 for European markets based on ITG data.

of 50 basis points. The resulting elasticities for 30 days and 12 months are then -0,85 and -0,675 respectively.

Table 4: Results for Volume and Liquidity, France

Control Group: French Stocks below 1B	*Dependent variable*				
	Vol. in shares	Vol. in €	Turnover r.	Spread	Amihud
±15 days					
STT	-0,4152***	-0,3804***	-0,0012***	0,0023***	0,1233***
(S.E.)	(0,0695)	(0,0725)	(0,000300)	(0,000600)	(0,044700)
F-test, p-value	0,000000	0,000000	0,000000	0,000000	0,035282
Adj. R squared	0,026500	0,010700	0,014700	0,002700	0,000500
±30 days					
STT	-0,4024***	-0,3452***	-0,0011***	0,0022***	0,1024
(S.E.)	(0,053800)	(0,059500)	(0,000200)	(0,000500)	(0,062500)
F-test, p-value	0,000000	0,000000	0,000000	0,000000	0,186230
Adj. R squared	0,022900	0,008200	0,009700	0,002400	0,000100
±3 months					
STT	-0,3625***	-0,3006***	-0,00104***	0,0032***	0,0943***
(S.E.)	(0,044100)	(0,051500)	(0,000200)	(0,000600)	(0,031200)
F-test, p-value	0,000000	0,000000	0,000000	0,000000	0,022609
Adj. R squared	0,017600	0,006000	0,005900	0,002400	0,000100
±6 months					
STT	-0,3162***	-0,2065***	-0,0007***	0,0019***	0,0128
(S.E.)	(0,047400)	(0,055800)	(0,000200)	(0,000500)	(0,023700)
F-test, p-value	0,000000	0,000000	0,000000	0,000000	0,711790
Adj. R squared	0,012600	0,002800	0,001200	0,001000	0,012800

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance; Standard errors are provided in parentheses.
Num. of obs.= 15D/9292, 30D/18663, 3M/40538, 6M/72491

Turnover ratio regressions confirm previous results. However, following Capelle-Blancard and Havrylchyk (2014), turnover ratio is not log-transformed, which allows direct comparison with estimates of Capelle-Blancard and Havrylchyk (2014), who obtain very similar coefficients. Still in light of latter results presented in this paper it is advisable to use logarithmic transformation of turnover ratio as dependent variable.

The results for bid-ask spread as a dependent variable confirm the narrative provided by volume-based measures. The bid-ask spread is negatively affected in all estimation periods rising in treatment group relative to control group by 0,19 to 0,32 percentage points[62] depending on observation period.

[62] Note that corresponding coefficients are 0,0019 and 0,0032, because I don't work with relative spread in percentage form, hence the resulting coefficient has to be multiplied by 100 to get interpretation in percentage points.

The results regarding price impact, which is assessed using Amihud ratio, are mixed as seen from Table 4. Although, all STT coefficients are positive suggesting an increase in price impact and confirming previously presented results of negative effect of STT on liquidity.

Table 5: Results for Volume and Liquidity, France

Control Group: French Shares over 500M below 1B	*Dependent variable*				
	Vol. in shares	Vol. in €	Turnover r.	Spread	Amihud
±15 days					
STT	-0,17291***	-0,078086*	-0,000718***	0,000986***	-0,008871
(S.E.)	(0,031380)	(0,044192)	(0,000130)	(0,000356)	(0,008748)
F-test, p-value	0,000000	0,077319	0,000000	0,005648	0,310630
Adj. R squared	0,007985	0,000827	0,008013	0,002029	0,000273
±30 days					
STT	-0,1581***	-0,0622*	-0,000713***	0,000082	-0,008833*
(S.E.)	(0,023132)	(0,031738)	(0,000085)	(0,000291)	(0,005092)
F-test, p-value	0,000000	0,050056	0,000000	0,777570	0,082818
Adj. R squared	0,006144	0,000508	0,009236	0,000011	0,000398
±3 months					
STT	-0,11023**	-0,049384	-0,00062***	0,000411	0,012608
(S.E.)	(0,054340)	(0,067940)	(0,000165)	(0,000518)	(0,010179)
F-test, p-value	0,000000	0,026918	0,000000	0,039129	0,016987
Adj. R squared	0,002772	0,000298	0,005579	0,000259	0,000346
±6 months					
STT	-0,149556**	-0,097731	-0,000534**	-0,000179	0,015057
(S.E.)	(0,061608)	(0,070200)	(0,000230)	(0,000483)	(0,010720)
F-test, p-value	0,000000	0,000000	0,000000	0,203060	0,002978
Adj. R squared	0,004558	0,001086	0,003440	0,000056	0,000302

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance; Standard errors are provided in parentheses.
Num. of obs.= 15D/3771, 30D/7556, 3M/16443, 6M/291665

Control group: French stocks with capitalization between € 500m and € 1bn

As could be seen from the detailed descriptive statistics in Tables A and B in Appendix, taxed stocks differ significantly from untaxed French stocks, which could be problematic as previous empirical research has shown[63]. In order to mitigate the heterogeneity between the groups, the small cap sample is restricted to companies with market capitalization over € 500 million. Still this control group isn't flawless, as already noted by Coelho (2014), due to possible spillover effects.

The results, in Table 5, for volume expressed in number of shares confirm the adverse effect of STT on trading activity, however, the coefficient is of smaller magnitude

[63] For example Chordia et al. (2004) document the differences in development of liquidity of large cap and small cap stocks as well as different variability of spreads among the two groups.

implying a relative decrease in volume of 15,9% and 13,9% in 30 days and 12 months window respectively. Thus the respective implied elasticities are -0,596 (30 days) and -0,521 (12 months) assuming trading costs of 75 basis points[64]. Interestingly these results don't extend to volume expressed in € as the STT coefficients are statistically insignificant or significant only at 10% level. This is in contrary to the expected direction of possible spillover effects as STT introduction could initiate substitution from taxed assets to non-taxed assets below the threshold. Turnover ratio supports the findings for traded volume in shares as expected.

The results from bid-ask spread regressions suggest a temporary increase in spreads following STT introduction with much smaller magnitude than in previously discussed results. The Amihud ratio points to statistically insignificant change while the models are mostly jointly insignificant as seen from F-tests.

Control group: German stocks

The results are presented in Table 6. The volume traded expressed in shares decreased in treatment group relative to control group approximately by 24,5% in 30 day horizon, but the estimated effects of STT introduction are significantly lower in longer estimation windows. In 12 month window the STT coefficient is statistically significant only at 10% level and suggests approximately 6,6% decrease in volume traded. Thus the estimated effect of STT on volume fades out much faster than with previous control groups. The implied elasticities of volume with respect to transaction costs are -0,919 for 30 day window and -0,356 in 6 month[65] window assuming costs of 75 basis points[66]. The STT coefficients are markedly similar in regressions with volume expressed in currency units. Models with turnover ratio as dependent variable confirm the results, however, it seems that linear model fits worse than log-linear model utilized with other volume measures supporting the discussion above.

The estimated coefficients in bid-ask spread regressions confirm the findings using the French small cap control group. The coefficients imply an increase in relative bid-ask spreads by 0,07 percentage points (coefficient 0,0007) in treatment group relative to control group after STT went into effect. The coefficients are also relatively stable across estimation periods with the exception of coefficient in 6 month regression, which is statistically insignificant.

[64] With trading costs of 50 basis points the elasticities would be -0,3975 (30 days) and -0,3475 (12 months).
[65] The elasticity for 12 month window is not calculated as the coefficient is significant only at 10% level.
[66] The elasticities are -0,6125 for 30 days and -0,2375 for 6 month period assuming total trading costs of 50 basis points.

Table 6: Results for Volume and Liquidity, France

Control Group: German Stocks over 1B	Dependent variable				
	Vol. in shares	Vol. in €	Turnover r.	Spread	Amihud
±15 days					
STT	-0,281***	-0,2705***	-0,00064***	0,00067**	-0,0026
(S.E.)	(0,0571)	(0,0609)	(0,0002)	(0,0002)	(0,0015)
F-test, p-value	0,000000	0,000000	0,000000	0,016782	0,289970
Adj. R squared	0,029769	0,021564	0,007338	0,001175	0,000230
±30 days					
STT	-0,2258***	-0,2227***	-0,0004**	0,0007**	-0,0002
(S.E.)	(0,0461)	(0,0506)	(0,0002)	(0,0003)	(0,0006)
F-test, p-value	0,000000	0,000000	0,000013	0,000010	0,893130
Adj. R squared	0,018776	0,014229	0,001954	0,002001	0,000002
±3 months					
STT	-0,1135***	-0,09963**	-0,0002	0,0004	0,001
(S.E.)	(0,0379)	(0,0443)	(0,0002)	(0,0003)	(0,003)
F-test, p-value	0,000000	0,000000	0,000677	0,000007	0,393200
Adj. R squared	0,004596	0,002726	0,000548	0,000956	0,000035
±6 months					
STT	-0,068784*	-0,060813	-0,000061	0,000362**	0,001522
(S.E.)	(0,0371)	(0,0448)	(0,0001)	(0,0002)	(0,0019)
F-test, p-value	0,000000	0,000000	0,180900	0,000000	0,045747
Adj. R squared	0,001523	0,000910	0,000043	0,000769	0,000096

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance; Standard errors are provided in parentheses.
Num. of obs.= 15D/4867, 30D/9753, 3M/21079, 6M/41454

Italy

Control group: Italian stocks with capitalization below € 500m

As already noted Coelho (2014) finds insignificant changes in volume traded in Italy following the reform, which she ascribes to general election happening nearly simultaneously with reform implementation. As Table 7 shows I confirm these results. The STT coefficients are statistically insignificant across specifications and their direction is mixed. The same holds for turnover ratio. Coelho’s (2014) explanation rests on the fact that election spurred trading, consequently compensating the decrease in volume traded caused by STT and claims that probable effect of tax on volume was negative. Such proposition would, however, assume that election results affected trading activity in control group differently, namely that trading activity in control group stocks increased relatively less. However, my control group consists of Italian stocks with smaller market capitalization, which are probable to have less internationally diversified business implying larger sensitivity to domestic political events. On the other hand, treatment group may be overrepresented with financial institutions holding Italian sovereign debt to large extent consequently reflecting into higher sensitivity of these stocks to political events[67]. Another supportive argument for Coelho's (2014) explanation may lie in lower sensitivity of small cap stocks to news events due to their

[67] Moreover the election would decide if austerity measures would continue, hence the stronger reaction of financial stocks would be expected.

lower liquidity. However, if such effects were driving the results, then common trend assumption is violated and control group is inappropriate.

Table 7: Results for Volume and Liquidity, Italy

Control Group: Italian Stocks below 500M	Dependent variable				
	Vol. in shares	Vol. in €	Turnover r.	Spread	Amihud
±15 days					
STT	-0,026911	-0,040980	-0,000624	-0,001536**	-0,012618
(S.E.)	(0,093562)	(0,093828)	(0,000601)	(0,000756)	(0,064872)
F-test, p-value	0,582230	0,419330	0,006650	0,001205	0,890870
Adj. R squared	0,000056	0,000121	0,001363	0,002019	0,000003
±30 days					
STT	0,158905*	0,14974*	-0,000552	-0,002132***	-0,076383**
(S.E.)	(0,086391)	(0,089490)	(0,000498)	(0,000559)	0.035954
F-test, p-value	0,000003	0,000027	0,003894	0,000000	0,140360
Adj. R squared	0,001988	0,001628	0,000770	0,004128	0,000202
±3 months					
STT	0,057096	0,081882	-0,000424	-0,000225	-0,024897
(S.E.)	(0,074986)	(0,797940)	(0,000408)	(0,000434)	(0,028147)
F-test, p-value	0,019704	0,001347	0,001582	0,440100	0,500380
Adj. R squared	0,000239	0,000453	0,000439	0,000026	0,000020
±6 months					
STT	0,034864	0,109496	-0,000133	-0,000019	-0,028710
(S.E.)	(0,072679)	(0,082272)	(0,000134)	(0,000448)	(0,023049)
F-test, p-value	0,054251	0,000000	0,137380	0,932300	0,283090
Adj. R squared	0,000083	0,000745	0,000050	0,000000	0,000026

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance; Standard errors are provided in parentheses.
Num. of obs.= 15D/5402, 30D/10824, 3M/22706, 6M/44409

Another possible explanation to distinctively different reaction to STT implementation or its absence in Italy compared to France is different tax design offering fewer opportunities to tax evasion as derivatives came under scope of the tax later in 2013 and ADRs were subject to tax from the initial date of the implementation. Additionally the tax rate is lower on regulated markets in Italian case, which could have routed some volume back onto Milan stock exchange, but I wouldn't expect this effect to be the main driver of the estimated coefficients as trades on MTFs are also subject to lower tax rate. Hence, even in the absence of contamination one would expect a lower impact of Italian STT on volume traded due to different tax design.

The findings from bid-ask spread regressions show relative decrease in bid-ask spreads in treatment group pointing to increase in liquidity. The effects are, however, statistically significant only for two shortest estimation periods as the coefficients for 6 month and 12 month window are nearly zero. The surprising direction of the effect in the short-horizon may be again driven by the election and violation of common trend assumption.

Control group: Italian stocks with capitalization between € 250m and € 500m

Similarly to French exercise the effects are also estimated relatively narrow[68] control group using companies with stock market capitalization higher than € 250m, but lower than €500m. The estimated coefficients in Table 8 are qualitatively similar to estimates from previous section. Although in this case both measures of volume imply a statistically significant (at 5% level) decrease in trading activity in one year estimation horizon. The measured decrease is higher for volume expressed in € implying a possible decrease in prices in treatment group relative to control group (or increase in control group prices). The decrease of 21,8% in case of volume expressed in shares reflects into elasticity of volume in shares with respect to transaction costs of -1,3625 assuming that costs are 75 basis points[69]. The elasticity estimates are higher than in case of France, which is opposite to what one would expect as Italian tax design doesn't offer as much opportunities to evade the tax[70].

Table 8: Results for Volume and Liquidity, Italy

Control Group: Italian Stocks over 250M below 500M	*Dependent variable*				
	Vol. in shares	Vol. in €	Turnover r.	Spread	Amihud
±15 days					
STT	-0,23654*	-0,25596*	-0,00077	-0,001584**	0,004615
(S.E.)	(0,128280)	(0,138010)	(0,000498)	(0,000738)	(0,003218)
F-test, p-value	0,000015	0,000007	0,019153	0,000002	0,322300
Adj. R squared	0,007858	0,008914	0,002313	0,009454	0,000413
±30 days					
STT	-0,092008	-0,12380	-0,000854*	-0,001337**	-0,015980
(S.E.)	(0,142849)	(0,160680)	(0,000503)	(0,000611)	(0,021681)
F-test, p-value	0,019319	0,002677	0,009070	0,000000	0,145000
Adj. R squared	0,001151	0,001896	0,001432	0,006963	0,000447
±3 months					
STT	-0,17544	-0,22383*	-0,000837*	-0,000851	0,000459
(S.E.)	(0,108270)	(0,126960)	(0,000427)	(0,000581)	(0,011675)
F-test, p-value	0,000000	0,000000	0,000044	0,000000	0,936400
Adj. R squared	0,003971	0,005840	0,001668	0,003177	0,000001
±6 months					
STT	-0,246021**	-0,30051**	-0,000619	-0,000651	0,015236**
(S.E.)	(0,119440)	(0,147720)	(0,000383)	(0,000626)	(0,007409)
F-test, p-value	0,000000	0,000000	0,000001	0,000000	0,001046
Adj. R squared	0,006970	0,009201	0,001202	0,001625	0,000544

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance; Standard errors are provided in parentheses.
Num. of obs.= 15D/2370, 30D/4751, 3M/9998, 6M/19753

[68] The estimation results of this control group may be also negatively affected by the relatively small number of control group companies due to relatively narrow market capitalization interval (only € 250m).
[69] If one assumes costs of 50 basis points the elasticity is -0,908. Also note that in Italian case the tax on acquisition was 0,12% in 2013 on regulated markets including Borsa Italiana.
[70] However, there is a possibility of significant difference between transaction costs on Euronext and Borsa Italiana.

The coefficient estimates from bid-ask spread regressions again point to increase in liquidity in 30 and 60 days windows. Models with Amihud ratio provide mixed evidence regarding price impact with the estimates of STT coefficient being mostly statistically insignificant with the exception of 12 month window.

Control group: Spanish stocks

The estimates, in Table 9, using comparable Spanish stocks as control group confirm previous findings regarding volume as both volume expressed in shares and € significantly decrease following STT introduction only in 12 month horizon. The decrease is relatively pronounced as both coefficients imply approximately 31,5% decrease in volume traded, hence the elasticity amounts to -1,96875 working with transaction costs of 75 basis points[71].

Table 9: Results for Volume and Liquidity, Italy

Control Group: Spanish stocks over 500M	*Dependent variable* Vol. in shares	Vol. in €	Turnover r.	Spread	Amihud
±15 days					
STT	-0,038525	-0,068080	-0,000556	0,001417	-0,000296
(S.E.)	(0,090983)	(0,094819)	(0,000477)	(0,001377)	(0,000473)
F-test, p-value	0,370250	0,118520	0,069218	0,016656	0,041930
Adj. R squared	0,000327	0,000990	0,001342	0,002328	0,001682
±30 days					
STT	-0,047697	-0,064483	-0,000837*	-0,003004**	-0,000533
(S.E.)	(0,094923)	(0,102750)	(0,000477)	(0,001450)	(0,000803)
F-test, p-value	0,133320	0,046302	0,005963	0,000000	0,000170
Adj. R squared	0,000458	0,000807	0,001536	0,009669	0,002869
±3 months					
STT	-0,109999	-0,089609	-0,000773*	-0,000934	0,001472
(S.E.)	(0,073057)	(0,078990)	(0,000395)	(0,001032)	(0,001064)
F-test, p-value	0,000002	0,000169	0,000045	0,002298	0,127750
Adj. R squared	0,002164	0,001362	0,001602	0,000895	0,000224
±6 months					
STT	-0,377923***	-0,375764***	-0,001225***	0,001016	0,001530
(S.E.)	(0,073741)	(0,077934)	(0,000331)	(0,000785)	(0,000984)
F-test, p-value	0,000000	0,000000	0,000000	0,000004	0,002143
Adj. R squared	0,022756	0,020964	0,005461	0,001034	0,000462

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance; Standard errors are provided in parentheses.
Num. of obs.= 15D/2460, 30D/4920, 3M/10381, 6M/20410

This result is also supported by statistically significant decrease in turnover ratio. The spread estimates are mixed with only 60 day estimation suggesting a slight decrease in bid-ask spread, but estimates as a whole indicate no change in bid-ask spread. The Amihud ratio is statistically insignificant for all estimation periods.

[71] Transaction costs of 50 basis points would yield elasticity of -1,3125.

Volatility

France

Control group: French stocks with capitalization below € 1bn

From Table 10 can be seen that squared return[72] wasn't relatively impacted in the treatment group following the STT introduction. Still the coefficients are negative, which is in line with estimates using Parkinson's and Garman-Klass price range measures. Both price range measures suggest statistically significant decrease in volatility in treatment in 60 days and 6 month estimation windows. But again the effects may be driven by the control group.

Table 10: Results for Volatility, France

Control Group: French Stocks below 1B	*Dependent variable*		
	Squared Return	Parkinson's HL	Garman-Klass HL
±15 days			
STT	-0,00009	-0,00005	-0,00009*
(S.E.)	(0,00013)	(0,00006)	(0,00005)
F-test, p-value	0,417270	0,364640	0,201680
Adj. R squared	0,00007	0,00009	0,00018
±30 days			
STT	-0,00011	-0,00008**	-0,00013***
(S.E.)	(0,00009)	(0,00004)	(0,00004)
F-test, p-value	0,194420	0,061863	0,018441
Adj. R squared	0,00009	0,000187	0,000298
±3 months			
STT	-0,00004	-0,00008***	-0,00013***
(S.E.)	(0,00009)	(0,00003)	(0,00005)
F-test, p-value	0,565590	0,014738	0,002019
Adj. R squared	0,000008	0,00015	0,00024
±6 months			
STT	-0,00004	-0,00007*	-0,00007*
(S.E.)	(0,00006)	(0,00003)	(0,00004)
F-test, p-value	0,469540	0,005855	0,006159
Adj. R squared	0,000007	0,000100	0,000100

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance; Standard errors are provided in parentheses.
Num. of obs.= 15D/9292, 30D/18663, 3M/40538, 6M/72491

Control group: French stocks with capitalization between € 500m and € 1bn

Estimations using narrower control group in Table 11 suggest that previous results regarding volatility may have been largely driven by the heterogeneity of control groups

[72] Potentially one could calculate returns using the middle of the spread, which would mitigate the bias caused by bid-ask bounce, but this paper rather utilizes price range measures, which should also deal with the potentially low efficiency of squared return.

represented either by a single individual shock or recurring seasonal effect. All estimations are statistically insignificant with nearly zero coefficients of mixed direction.

Control group: German stocks

Estimations from squared return regressions using German stocks as control group in Table 12 indicate relative decrease in volatility following STT reform. However, this is not supported by the results using price range measures. The coefficients are also negative, but statistically insignificant. Minding the tax design one could expect the price range measures to be relatively unaffected by the tax as activities of intraday traders

Table 11: Results for Volatility, France

Control Group: French Shares over 500M below 1B	*Dependent variable*		
	Squared Return	Parkinson's HL	Garman-Klass HL
±15 days			
STT	-0,000034	0,000025	0,000041
(S.E.)	(0,000094)	(0,000031)	(0,000029)
F-test, p-value	0,714210	0,423470	0,151210
Adj. R squared	0,000036	0,000170	0,000546
±30 days			
STT	-0,000008	0,000018	0,000011
(S.E.)	(0,000055)	(0,000021)	(0,000020)
F-test, p-value	0,886650	0,383240	0,590320
Adj. R squared	0,000003	0,000101	0,000038
±3 months			
STT	0,000030	0,000018	0,000012
(S.E.)	(0,000058)	(0,000036)	(0,000034)
F-test, p-value	0,394350	0,215880	0,419300
Adj. R squared	0,000044	0,000093	0,000040
±6 months			
STT	-0,000032	-0,000019	-0,000014
(S.E.)	(0,000057)	(0,000037)	(0,000034)
F-test, p-value	0,232200	0,092485	0,209960
Adj. R squared	0,000049	0,000097	0,000054

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance;
Standard errors are provided in parentheses.
Num. of obs.= 15D/3771, 30D/7556, 3M/16443, 6M/29165

shouldn't be affected by the tax[73]. These results will be explored in more detail in triple DiD analysis in order to capture possible recurring seasonal effect in volatility. One has to keep in mind the possibility of slightly different market microstructure driving the results.

Table 12: Results for Volatility, France

[73] Since intraday traders are assumed to have zero net positions at the end of the day, hence don't pay any tax.

Control Group: German Stocks over 1B	Dependent variable		
	Squared Return	Parkinson's HL	Garman-Klass HL
±15 days			
STT	-0,00015*	-0,00005	-0,00003
(S.E.)	(0,00007)	(0,00004)	(0,00004)
F-test, p-value	0,027667	0,041371	0,153260
Adj. R squared	0,000996	0,000855	0,000419
±30 days			
STT	-0,0001**	-0,00002	-0,00001
(S.E.)	(0,00005)	(0,00003)	(0,00003)
F-test, p-value	0,024456	0,353770	0,678690
Adj. R squared	0,000519	0,000088	0,000018
±3 months			
STT	-0,00009**	-0,00003	-0,00002
(S.E.)	(0,00004)	(0,00002)	(0,00002)
F-test, p-value	0,025454	0,011740	0,032987
Adj. R squared	0,000240	0,000301	0,000216
±6 months			
STT	-0,000056**	-0,00002	-0,00002
(S.E.)	(0,00003)	(0,00002)	(0,00002)
F-test, p-value	0,031551	0,001310	0,016558
Adj. R squared	0,000112	0,000249	0,000138

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance; Standard errors are provided in parentheses.
Num. of obs.= 15D/4867, 30D/9753, 3M/21079, 6M/41454

Italy

Control group: Italian stocks with capitalization below € 500m

The results for volatility in Italian case in Table 13 imply that volatility wasn't significantly affected by STT introduction in the shortest observation period. Squared return was significantly affected by the tax only in one year estimation window, while price range measures point to statistically significant increases of volatility in 60 day, 6 month and 12 month estimation windows. All except one coefficient suggest an increase in stock return volatility in taxed stocks relative to untaxed stocks following the reform. The magnitude of STT coefficient is the highest in 12 month period similarly to volume pointing to possibility that an individual shock to either treatment or control group is driving the results.

Control group: Italian stocks with capitalization between € 250m and € 500m

Decreasing the heterogeneity of control group yields qualitatively different results as previous estimation, which is evident from Table 14. The STT coefficients across volatility measures and estimation periods are statistically insignificant. Additionally the coefficients in most cases switch signs from previously found positive to negative. Thus it seems that results obtained using control group of small Italian stocks are driven by different volatility dynamics in treatment and control. However, the possibility of spillover effects affecting results using this control group cannot be excluded.

Table 13: Results for Volatility, Italy

Control Group: Italian Stocks below 500M	*Dependent variable*		
	Squared Return	Parkinson's HL	Garman-Klass HL
±15 days			
STT	0,000010	0,000025	-0,000005
(S.E.)	(0,000153)	(0,000063)	(0,000074)
F-test, p-value	0,935020	0,598590	0,909870
Adj. R squared	0,000001	0,000051	0,000002
±30 days			
STT	0,000008	0,000128**	0,000111**
(S.E.)	(0,000146)	(0,000051)	(0,000051)
F-test, p-value	0,938500	0,000273	0,001011
Adj. R squared	0,000006	0,001223	0,000998
±3 months			
STT	0,000136	0,000156***	0,000134***
(S.E.)	(0,000095)	(0,000045)	(0,000043)
F-test, p-value	0,051895	0,000000	0,000000
Adj. R squared	0,000166	0,001457	0,001311
±6 months			
STT	0,000197***	0,000182***	0,000173***
(S.E.)	(0,000058)	(0,000036)	(0,000034)
F-test, p-value	0,000048	0,000000	0,000000
Adj. R squared	0,000376	0,002058	0,002154

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance;
Standard errors are provided in parentheses.
Num. of obs.= 15D/5402, 30D/10824, 3M/22706, 6M/44409

Control group: Spanish stocks

Interestingly the estimates obtained from volatility regressions with comparable Spanish stocks as control group in Table 15 are relatively similar to those using small Italian stocks as control group. The coefficients for all three volatility measures are positive and statistically significant at acceptable levels in 12 month estimation period, while price range measures offer similar results also in 6 month period. These results indicate that spillovers may be present in estimations using control group of Italian stocks with market cap between € 250m and € 500m. To find out if the estimated effects aren't driven by recurring seasonal effects triple DiD is presented in the next section.

Table 14: Results for Volatility, Italy

Control Group: Italian Stocks over 250M below 500M	*Dependent variable*		
	Squared Return	Parkinson's HL	Garman-Klass HL
±15 days			
STT	-0,000410	-0,000157	-0,000149
(S.E.)	(0,000398)	(0,000138)	(0,000097)
F-test, p-value	0,040456	0,013987	0,003350
Adj. R squared	0,001770	0,002546	0,003625
±30 days			
STT	0,000283	-0,000050	-0,000039
(S.E.)	(0,000260)	(0,000107)	(0,000076)
F-test, p-value	0,155970	0,220800	0,270020
Adj. R squared	0,000424	0,000316	0,000264
±3 months			
STT	-0,000129	-0,000022	-0,000020
(S.E.)	(0,000121)	(0,000051)	(0,000041)
F-test, p-value	0,192830	0,345880	0,367980
Adj. R squared	0,000170	0,000089	0,000081
±6 months			
STT	-0,000037	0,000018	0,000026
(S.E.)	(0,000059)	(0,000035)	(0,000036)
F-test, p-value	0,542380	0,297470	0,119740
Adj. R squared	0,000019	0,000055	0,000123

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance;
Standard errors are provided in parentheses.
Num. of obs.= 15D/2370, 30D/4751, 3M/9998, 6M/19753

Difference-in-Difference-in-Differences

The devised placebo tests, which are not reported here[74] suggest a recurring seasonal effect in French taxed stocks in the direct vicinity of the taxation evet. The effect was found in both volume estimations with German control group in 30 and 60 day estimation periods[75], while there is no evidence of seasonal effect in case of bid-ask spread. The seasonal effect also extends to volatility. The seasonal effect is also documented by Colliard and Hoffmann (2015), who argue that the effect is caused by relatively more intensive holidays in France.

In Italian case, the placebo tests suggest a possible recurring effect in bid-ask spread. Note that triple DiD was estimated only using German control group in French case and Spanish control group in Italian case as these are considered as the most appropriate

[74] But can provided at request.

[75] The placebo estimates using French small cap control group also support the existence of seasonal effect, but the inappropriateness of the control group may be also behind the estimated effects.

control groups. As the results from model with full set of dummies are qualitatively similar to the results obtained from reduced model of Colliard and Hoffmann (2015) presented here are only the coefficients for treatment from the full model[76].

Table 15: Results for Volatility, Italy

Control Group: Spanish stocks over 500M	*Dependent variable*		
	Squared Return	Parkinson's HL	Garman-Klass HL
±15 days			
STT	0,000070	0,000094	0,000040
(S.E.)	(0,000169)	(0,000068)	(0,000067)
F-test, p-value	0,399960	0,031946	0,383890
Adj. R squared	0,000288	0,001870	0,000308
±30 days			
STT	0,000045	0,000102**	0,000066
(S.E.)	(0,000158)	(0,000048)	(0,000046)
F-test, p-value	0,785300	0,001419	0,040743
Adj. R squared	0,000015	0,002068	0,000851
±3 months			
STT	0,000114	0,000103***	0,000082***
(S.E.)	(0,000084)	(0,000031)	(0,000032)
F-test, p-value	0,193950	0,000005	0,000113
Adj. R squared	0,000163	0,001998	0,001436
±6 months			
STT	0,000101**	0,000096***	0,000088***
(S.E.)	(0,000044)	(0,000025)	(0,000025)
F-test, p-value	0,065882	0,000000	0,000000
Adj. R squared	0,000166	0,001967	0,001891

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance;
Standard errors are provided in parentheses.
Num. of obs.= 15D/2460, 30D/4920, 3M/10381, 6M/20410

France

The triple DiD results using German stocks as control group in Table 16 confirm the assertions from placebo tests indicating a significant seasonal effect around the implementation in French taxed stocks in volume in 30 and 60 day estimation intervals. The estimated coefficients point to decrease in volume expressed in shares of approximately 9% and volume expressed in € of 11,4% in August 2012. This is a decrease nearly 50% lower than that implied by seasonally unadjusted results. The coefficient reflects into elasticity of volume in shares with respect to trading costs of -0,3375 assuming costs of 75 basis points[77]. The seasonally adjusted STT effects are

[76] Whole estimates can be provided at request.
[77] And elasticity of -0,255 assuming that two-way trading costs equal to 50 basis points.

very similar in magnitude to the "permanent" effect of STT on volume estimated by Colliard and Hoffmann (2013, 2015) of around 10%.

The STT coefficient in bid-ask spread regression confirms the results from placebo tests and from Colliard and Hoffmann (2015) showing absence of seasonal effects in spreads as the seasonally adjusted coefficient (0,0007) is nearly identical to seasonally unadjusted coefficient (0,0006). The model confirms decrease in liquidity in treatment group relative to control in short horizon. Seasonally adjusted estimates of STT coefficients from Turnover ratio and Amihud regressions are statistically insignificant.

Table 16: Results for Volume and Liquidity, DiDiD France

Control Group: German Stocks over 1B	*Dependent variable*				
	Vol. in shares	Vol. in €	Turnover r.	Spread	Amihud
August					
STT	-0,094839**	-0,1215***	0,000074	0,000732***	-0,000621
(S.E.)	(0,044536)	(0,046795)	(0,000202)	(0,000273)	(0,001182)
F-test, p-value	0,000000	0,000000	0,000000	0,000000	0,000000
Adj. R squared	0,125280	0,073936	0,063274	0,013561	0,001420

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance; Standard errors are provided in parentheses. Num. of obs.=194843

Table 17: Results for Volatility, DiDiD France

Control Group: German Stocks over 1B	*Dependent variable*		
	Squared Return	Parkinson's HL	Garman-Klass HL
August			
STT	0,000012	0,000037	0,000054
(S.E.)	(0,000042)	(0,000034)	(0,000038)
F-test, p-value	0,000000	0,000000	0,000000
Adj. R squared	0,038120	0,137500	0,145850

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance;
Standard errors are provided in parentheses.
Num. of obs.=194843

Similarly seasonally adjusted volatility regressions in Table 17 yield statistically insignificant coefficients for STT variable. Coefficients for all three variables have positive sign contradicting the negative sign of seasonally unadjusted coefficients. The estimates are also in line with the evidence from placebo tests of probable seasonal effect in volatility in taxed stocks in August, which is also in line with findings of Colliard and Hoffmann (2015).

Italy

Seasonally adjusted estimates in Table 18 of both measures of volume yield statistically insignificant results as in previously presented estimates confirming the absence of a recurring seasonal effect. Same conclusions extend to turnover ratio.

Despite finding evidence suggesting presence of seasonal effect in bid-ask spreads, seasonally adjusted estimates provide similar results to unadjusted estimates suggesting a decrease in bid-ask spread during March 2013. This puzzling result may be still a result of individual treatment or control specific shock or, in other words, violation of common trend assumption.

The seasonally adjusted estimates for volatility in Table 19 confirm absence of statistically significant effects of STT on volatility in Italian case for all three volatility measures. However, as placebo estimates produced statistically significant effects in both placebo periods, but of different signs one has to question the reliability of these estimates. Overall there doesn't seem to be evidence of decrease in volatility following STT introduction in Italy.

Table 18: Results for Volume and Liquidity, DiDiD Italy

Control Group: Spanish Shares	*Dependent variable*				
	Vol. in shares	Vol. in €	Turnover r.	Spread	Amihud
March					
STT	0,107089	0,076198	0,000263	-0,006555***	-0,000781
(S.E.)	(0,089588)	(0,107540)	(0,000432)	(0,002498)	(0,000859)
F-test, p-value	0,000000	0,000000	0,000000	0,000000	0,000000
Adj. R squared	0,080797	0,144400	0,035902	0,271990	0,007719

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance; Standard errors are provided in parentheses. Num. of obs.=96658

Table 19: Results for Volatility, DiDiD Italy

Control Group: Spanish Shares	*Dependent variable*		
	Squared Return	Parkinson's HL	Garman-Klass HL
March			
STT	0,000056	0,000028	0,000004
(S.E.)	(0,000079)	(0,000057)	(0,000055)
F-test, p-value	0,000000	0,000000	0,000000
Adj. R squared	0,026245	0,082964	0,082077

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance;
Standard errors are provided in parentheses.
Num. of obs.=96658

Identification of HFT tax effect

Even after adjusting the results for seasonality one could question if the estimates isolate STT effect as the tax was enacted simultaneously with HFT tax. Following the approach of Colliard and Hoffmann (2015) the effects can be isolated exploiting the fact that French/Italian stocks below the threshold were not taxed, hence one can compare the development of market quality measures in untaxed French/Italian stocks with control group of comparable German/Spanish companies below the market capitalization threshold[78].

Table 20: Results for Volume and Liquidity, French HFT tax effect

Control Group: German Stocks below 1B	*Dependent variable*				
	Vol. in shares	Vol. in €	Turnover r.	Spread	Amihud
±15 days					
STT	-0,032821	-0,020446	0,000221***	-0,001616***	-0,7252**
(S.E.)	(0,028531)	(0,036046)	(0,000086)	(0,000468)	(0,324570)
F-test, p-value	0,247020	0,570580	0,009909	0,000565	0,025482
Adj. R squared	0,000139	0,000032	0,000661	0,001182	0,000496
±30 days					
STT	-0,028888	-0,022413	0,00019*	-0,000360	-1,0133
(S.E.)	(0,052391)	(0,062415)	(0,000115)	(0,000711)	(0,716780)
F-test, p-value	0,166400	0,396950	0,008629	0,279910	0,186610
Adj. R squared	0,000095	0,000036	0,000342	0,000058	0,000087
±3 months					
STT	0,067237	0,095055*	0,000278*	-0,001504**	-0,21471
(S.E.)	(0,044746)	(0,054278)	(0,000144)	(0,000676)	(0,342820)
F-test, p-value	0,000004	0,000000	0,000003	0,000001	0,566030
Adj. R squared	0,000489	0,000613	0,000493	0,000557	0,000008
±6 months					
STT	0,029035	0,140133	-0,000093	0,001740	0,3415**
(S.E.)	(0,119267)	(0,156930)	(0,000211)	(0,000053)	(0,128740)
F-test, p-value	0,676200	0,108790	0,827020	0,204540	0,807080
Adj. R squared	0,000002	0,000029	0,000001	0,000018	0,000001

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance; Standard errors are provided in parentheses.
Num. of obs.= 15D/4865, 30D/9744, 3M/21163, 6M/42146

[78] In Italian case this approach is unfeasible due to absence of sufficient number of Spanish companies with market capitalization below € 500 million in my dataset. Despite this one wouldn't expect the tax to have large effects[78] as Borsa Italiana had already employed restrictions on HFT trading at the request of Consob according to Grant and Sanderson (2012).

The estimated results for French case are presented in Table 20 for liquidity. The estimates for both measures of volume are statistically insignificant across estimation periods. STT coefficients in turnover ratio regressions have surprisingly positive signs, which contradicts the estimates for volume measures. Bid-ask spread regressions produce significant STT estimates in two estimation periods, in 30 day and 6 month period. In both cases coefficient of interest is negative, which could imply that the previously estimated increase in bid-ask spread could be even bigger. However, it would be expected that HFT tax would increase bid-ask spread in treatment. The volatility estimates, seen in Table 21 , are statistically insignificant across measures and estimation periods. Based on these results one could argue that effects of HFT tax are weak at most if not even completely absent. It has to be noted that this approach has possible disadvantages as Zhang's (2010) evidence suggests that HFTs are more active in highly liquid stocks, which are usually stocks with larger market capitalizations, hence also Colliard and Hoffmann (2013) argue that HFT tax may have much more

Table 21: Results for Volatility, French HFT tax effect

	Dependent variable		
Control Group: German Stocks below 1B	Squared Return	Parkinson's HL	Garman-Klass HL
±15 days			
STT	-0,000063	-0,000007	0,000016
(S.E.)	(0,000126)	(0,000071)	(0,000080)
F-test, p-value	0,617110	0,925150	0,844190
Adj. R squared	0,000025	0,000001	0,000004
±30 days			
STT	0,000047	0,000048	0,000078
(S.E.)	(0,000118)	(0,000089)	(0,000093)
F-test, p-value	0,610300	0,348550	0,190160
Adj. R squared	0,000013	0,000044	0,000085
±3 months			
STT	-0,000075	-0,000019	0,000051
(S.E.)	(0,000153)	(0,000071)	(0,000069)
F-test, p-value	0,518340	0,715950	0,249570
Adj. R squared	0,000010	0,000003	0,000030
±6 months			
STT	0,000145	0,000073	0,000037
(S.E.)	(0,009)	(0,000053)	(0,000049)
F-test, p-value	0,769390	0,720580	0,842370
Adj. R squared	0,000001	0,000001	0,000000

*- 10% level of significance, **- 5% level of significance, ***- 1% level of significance;
Standard errors are provided in parentheses.
Num. of obs.= 15D/4865, 30D/9744, 3M/21163, 6M/42146

pronounced effects on liquid stocks, but the estimates[79], not reported here, suggest that this effect might be a smaller problem than it seems.

5 Conclusion

The objective of this paper was to verify the impact of recent financial transaction tax implementations in France and Italy and extend previous evidence by conducting more detailed analysis of Italian case. The presented findings confirm previous evidence from France regarding trading activity, which significantly decreased following the STT introduction. The need to account for seasonality is also highlighted as some previous papers neglected these effects possibly overestimating the impact of the tax. The evidence regarding liquidity measured using relative quoted bid-ask spread contradicts most of the previous papers as for example Meyer et al. (2013) find mixed evidence regarding spread change using German stocks as control group. Thus, the estimates of present paper probably highlight the problem already indicated by Capelle-Blancard and Havrylchyk (2014), who reach similar conclusions to this paper using German stocks as control group, but find no effect of STT on spreads using Dutch stocks. Therefore, one has to be cautious in interpreting these estimates. For Italy this paper confirms previous evidence by Coelho (2014), who finds no impact of STT on trading activity as probably political events prevent identification of the STT effects in short-term. 12 month estimations imply a relatively large decrease in trading activity following STT introduction. This result could be driven by derivatives being included into scope of the tax in September 2013, as Rühl and Stein (2014) show significant decreases in trading activity following the inclusion. Hence, the muted response of volume to STT introduction in Italian case may be driven not only by political events, but also by temporary evasion using the transitory derivatives loophole.

Previous evidence is also confirmed regarding STT's effects on stock return volatility as, in both French and Italian case, results suggest absence of STT's impact on volatility. Therefore the desirability of securities transaction tax can be questioned as the tax doesn't seem to fulfill its purpose of being corrective, Pigouvian tax, while negatively affecting trading activity and possibly liquidity. However, such strong conclusion assumes that estimated effects have causal interpretation, which can be questioned as one is constrained by available control groups[80]. Additionally more insight should be provided by future literature regarding possible redistributional effects of the tax in order to fully assess its desirability.

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[79] To verify this I also estimated model using stocks with market capitalization between € 500m and € 1bn in 12 month horizon. The STT coefficients were statistically insignificant for both liquidity and volatility measures. The results can be provided at request.

[80] The causal interpretation also cannot be ensured by using regression discontinuity (RD) design or matching as one is constrained by data. Additionally Capelle-Blancard and Havrylchyk (2014) show that estimated effects using matching are qualitatively similar to DiD estimates albeit coefficients are slightly lower, while RD doesn't seem to be appropriate estimation method. Meyer et al. (2013) also utilize matching and conclude that matching error is relatively high.

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Appendix

Table A: Means of liquidity/volatility measures for 1 year window in French dataset

Group	Volume in Shares			Turnover Ratio		
	Before	After	Diff.	Before	After	Diff.
French Treated	1778,934	1458,541	-320,3926	0,003171	0,002314	-0,000857009
French Small	107,3106	90,22828	-17,08229	0,00149	0,001419	-7,09553E-05
German over 1B	1384,461	1135,515	-248,9457	0,00357	0,002787	-0,00078313
German Small	58,63662	51,53008	-7,106539	0,001688	0,001416	-0,000272203
Group	**Bid-Ask Spread**			**Amihud**		
	Before	After	Diff.	Before	After	Diff.
French Treated	0,002482	0,002628	0,000146	0,003985	0,003455	-0,000529667
French Small	0,015072	0,013315	-0,001757	0,344612	0,214336	-0,130276348
German over 1B	0,00231	0,002185	-0,000125	0,00516	0,004258	-0,000901319
German Small	0,018625	0,016958	-0,001666	0,748535	0,545456	-0,20307878

Table B: Means of volatility measures for 1 year window in French dataset

Group	Squared return			Volatility Parkinson		
	Before	After	Diff.	Before	After	Diff.
French Treated	0,000462	0,000253	-0,000209	0,000338	0,000206	-0,000132614
French Small	0,000728	0,000573	-0,000155	0,000574	0,000493	-8,09309E-05
German over 1B	0,000403	0,000255	-0,000148	0,000297	0,000189	-0,000107352
German Small	0,000921	0,000798	-0,000124	0,000636	0,00059	-4,63279E-05
Group	**Volatility GK**					
	Before	After	Diff.			
French Treated	0,00033	0,000203	-0,000127			
French Small	0,000543	0,000478	-6,5E-05			
German over 1B	0,000294	0,000187	-0,000108			
German Small	0,00059	0,000547	-4,33E-05			

Table C: Means of liquidity measures for 1 year window in Italian dataset

Group	Volume in Shares			Turnover Ratio		
	Before	After	Diff.	Before	After	Diff.
Italian Treated	11342,95	10757,28	-585,671	0,00482	0,004235	-0,00059
Italian Small	499,9987	325,3524	-174,646	0,001703	0,001256	-0,00045
Spanish over 500M	886,0192	1025,941	139,9221	0,002177	0,002826	0,000649
Group	**Bid-Ask Spread**			**Amihud**		
	Before	After	Diff.	Before	After	Diff.
Italian Treated	0,001626	0,002672	0,001046	0,000792	0,000784	-8,4E-06
Italian Small	0,013406	0,014292	0,000886	0,251444	0,270116	0,018672
Spanish over 500M	0,022535	0,022506	-2,9E-05	0,002754	0,001221	-0,00153

Table D: Means of volatility measures for 1 year window in Italian dataset

Group	Squared return			Volatility Parkinson		
	Before	After	Diff.	Before	After	Diff.
Italian Treated	0,000426	0,000454	2,81E-05	0,000346	0,000389	4,27E-05
Italian Small	0,000613	0,000442	-0,00017	0,000628	0,000483	-0,00014
Spanish over 500M	0,000485	0,000393	-9,2E-05	0,000426	0,000367	-5,9E-05

Group	Volatility GK		
	Before	After	Diff.
Italian Treated	0,000355	0,000389	3,36E-05
Italian Small	0,000634	0,00049	-0,00014
Spanish over 500M	0,000422	0,000363	-5,9E-05