Dodging Robin Hood: Responses to France and Italy's Financial Transaction Taxes

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Abstract

I look at the effect of the introduction of financial transaction taxes in equity markets in France and Italy in 2012 and 2013, respectively, on asset returns, trading volume and market volatility. Using two natural experiments in a difference-in-differences design, I identify bounds on elasticity estimates for three categories of avoidance channels: real substitution away from taxed assets, retiming (anticipation of transaction realizations and portfolio lock-in), and tax arbitrage (cross-platform and financial instrument shifting). I find very large responses on all margins, and am able to account for as much as 60% of the reported revenue shortfalls. By far the strongest behavioral response comes from high-frequency trading lock-in on regulated exchanges, with an extraordinarily high tax elasticity in the order of -9. The results shed light on previously neglected features of optimal FTT design.

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The impact of financial sector taxation on financial market activity, corporate investment and aggregate growth is still poorly understood by the public and financial economics literature. Yet, it is an increasingly important area of research from a macroeconomic and fiscal policy standpoint. Recent policy reports estimate the introduction of comprehensive financial transaction taxes could induce at least a 0.53% decline in long-run GDP (Commission (2012)), and as much as 20% of

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corporate income tax in the European Union is collected from financial institutions, which suggests the presence of sizable fiscal externalities when considering tax reforms aimed at this sector.

One of the most commonly proposed forms of financial sector taxation, and the object of the present research, is a financial transactions tax (FTT). While prima facie the revenue potential from such an instrument may seem large given the targeted tax base, the magnitude of the behavioral response is critical. Yet, there is no consensus in the empirical literature as to the estimated elasticities of financial transactions with respect to transaction costs in general or transaction taxes in particular – most studies referenced by Matheson (2011) in this regard tend to focus on individual country-specific events of tax reform and very few take into account the responses of different asset markets. More importantly, one should expect FTTs to be especially conducive to diversion of financial activity across borders as long as tax measures are not globally implemented, given the exceptionally mobile nature of financial services. The focus of this paper is on identifying and measuring the magnitude of these responses.

Furthermore, the effect of FTTs on asset valuation and financial market efficiency is ambiguous. Theoretical models generally predict that higher transaction costs are associated with lower asset prices, since they increase the liquidity premium required by investors to hold them, beyond the capitalization of the costs themselves. The lock-in effect induced reduces overall market liquidity and is likely to reduce efficiency in price discovery, which in turn may increase the price impact of trades, heightening short-term price volatility. This is contrary to the policy incentives of reducing short-term (and often coined "speculative") fluctuations in asset prices by increasing transaction costs. Furthermore, a large lock-in effect could dramatically reduce the fiscal revenues obtained through such a measure. Avoidance opportunities also abound for this type of taxes, the most notorious of which are contracts for differences, which bypass the need for direct asset trading by cash settling net capital gains.

The present paper aims in a first stage at getting closer to answering two fundamental questions related to the academic and policy debate just described: (i) to what extent are FTTs an optimal tool for raising government revenue (whatever the reasons may be for that revenue, as highlighted in the discussion above) and in particular, whether the elasticities of asset prices and market volume are sufficiently low to grant that argument; and (ii) what impact (if any) do FTTs have on capital market short and long-term volatility and by association market welfare. I then turn to a discussion of how these results can inform future tax policy design choices. This paper abstracts from the question of how FTTs affect price informativeness and capital market efficiency in allocating financial resources to the most fundamentally productive firms in the economy; this issue, as well as the effect on corporate cost of capital and firms' financing decisions, is the object of a separate forthcoming paper.

There is an established literature evaluating the response of asset holders to reforms in capital gains taxes (Burman and Randolph (1994)) and dividend taxes (Chetty and Saez (2005)), in addition to the response of stock compensation realizations for executives following top income tax reforms (Goolsbee (2000)). Likewise, there is an emerging literature examining the response of the housing market to transaction taxes (Kleven and Best (2013); Fu et al. (2013)). This paper contributes to this broad strand of literature by adding to the scarce evaluation of behavioral responses to financial transaction taxes. In contrast with earlier empirical work on this question, for the first time in history we have clearly defined and parametrically rich natural experiments where the introduction of an FTT is done in fully electronic markets. Firstly, the response magnitudes of electronic markets to a transaction cost are orders of magnitude larger than those of conventional floor trading markets; all of the elasticity estimates support this claim, with most parameters larger than 3 in absolute value (whereas earlier measures of elasticities with respect to capital or financial transaction taxes are around 1 or less). Secondly, these reforms are unprecedented in that combined they give us enough variation for parametric identification of all the core substitution and avoidance channels involved in the most commonly estimated net aggregate response. Given the multiplicity of behavioral channels relevant for this type of taxation, earlier studies provide a very incomplete depiction of reality. To the best of my knowledge, this paper is the first attempt in the literature to quantify the relative magnitudes of different substitution, avoidance and evasion channels available to market participants.

I am aware of several recent working papers evaluating the introduction of the financial transaction tax in France in 2012 (Becchetti and Ferrari (2013); Colliard and Hoffmann (2013); Meyer et al. (2013); Haferkorn and Zimmermann (2013)). Becchetti and Ferrari (2013) use untaxed French publicly traded stocks (all of those under the market capitalization threshold) as a control group, while Meyer et al. (2013) and Haferkorn and Zimmermann (2013) use British and German blue chip stocks, respectively, as their control of choice. This paper is closest methodologically to Colliard and Hoffmann (2013), in that it uses for the French case, Dutch stocks as the primary control group in a difference in differences estimation design; similarly, I focus both on developments in registered exchanges and in over the counter trading platforms. Colliard and Hoffmann (2013) also go far in providing analysis of post-reform changes in low latency activity. However, from an empirical standpoint, I not only use additional sets of control groups (including foreign depositary receipts), but also analyze the introduction of a FTT on equities and equity derivatives in Italy in 2013. Furthermore, conceptually this paper differs substantially from Colliard and Hoffmann (2013), in that my focus is not on the response of low latency activity and efficiency, but rather on the non-algorithmic response margins, in line with the public finance literature on capital tax avoidance. The key contribution of this paper lies in the use of the cross-country variation in policy design to discern between alternative behavioral responses. In turn, as I will allude to in section 4, the distinction between behavioral responses is essential for optimal taxation design - in particular, to determine the marginal tax wedges across asset types and trading platforms necessary to maximize government revenues, while minimizing distortionary deadweight loss.

Following a background review of the two case studies I am focusing on for empirical estimation in section 1, the remaining of the paper focuses on the response of cash equity markets to the introduction of a transaction tax. Each section briefly reviews the existing literature and conceptual framework, describes the empirical results, and looks at potentially useful ways of summarizing the responses observed in the data in terms of policy and welfare-relevant parameters of interest. Section 2 focuses extensively on prices and turnover, while section 3 more succinctly deals with volatility. The heart of the behavioral response identification is derived in section 2.4. I conclude by drawing some policy implications (section 4) and delineating open questions for future research beyond the reach of this paper (section 5).

1 Natural Experiments

1.1 French 2012 FTT reform

The French government imposed a unilateral financial transactions tax on August 1st, 2012, (announced on February 29th) which consists of a 0.2%[1] levy on the purchase of shares of companies headquartered in France that have a market cap of at least €1bn, irrespective of trading location. 109 firms fell into this category during 2012 and they were clearly identified at the beginning of the year[2]. The tax is calculated based on the traded price of a share and must be paid on the first day of the next month by the entity that initiated the transaction. The primary market is exempt, so changes on the capital structure of companies, although a worthwhile subject of subsequent research, should be of second order for the moment. The rate of 0.2% is about average of the range of proposed FTT rates for equity transactions in policy discussions, and is based on the notion that the tax should be of the order of existing bid-ask spreads (amounting to about 0.24% of share prices for high-market cap equity transactions in France) in order to minimize behavioral disruptions[3]. EU sovereign credit default swaps not acquired for hedging purposes have also become subject to a 0.01% tax based on the notional value of a transaction. Finally, high-frequency trading (program trading with amended or canceled orders exceeding two-thirds of transmitted orders) became subject to a 0.01% tax if trading is carried out in France. The measure is part of a comprehensive fiscal devaluation[4], which involves the raising of VAT and financial income taxes, as well as a cut in

[1]The initial rate announced was 0.1%, increased by the new government to 0.2% on July 4th via the 2nd Amended Finance Law of 2012).

[2]Every January 1st of each year a new revised list is made public.

[3]Another way of thinking about this rule of thumb is that transactions requiring similar resources should be taxed at the same rate (with the tax not exceeding those resources), so that if derivatives are a typically less expensive way of obtaining exposure to the underlying asset, the former should be taxed at a lower rate. Effectively, this is often the case in proposals encompassing taxation of both equity and derivative markets (see Commission (2013) for a recent example).

[4]FTTs are frequently perceived as taxes on consumption of financial services, especially since the latter are typically exempt from invoice-based VAT. The conceptual question of whether financial services should be taxed

payroll taxes aimed at making French firms more competitive by lowering labor costs.

For the purposes of the analysis below, it will be useful to keep in mind the following chronology of events: on January 12th, 2012, brokerages suspended orders for cross-book swaps[5]of French stock into ADRs[6] due to rumors of share transfer duties being extended to sales outside of France; on February 7th the first articles in Les Echos, Le Monde and WSJ detailing the legislative bill to be presented to Council of Ministers were published; on February 27th the National Assembly released a report on the ongoing debate of the bill and Presidential candidate Hollande publicly announced support for the measure, which was ultimately approved by Parliament two days later. On July 4th the FTT rate was increased to 0.2% (2nd Amended Finance Law 2012), coming into effect on August 1st. ADRs came under the scope of the tax only on December 1st. Figure C.1 depicts the timeline of relevant events.

1.2 Italian 2013 FTT reform

Starting on March 1st, 2013, transactions of shares issued by Italian resident companies with a capitalization equal or higher than €500 million are to be taxed at a 0.1% base rate if executed on-exchange[7], and 0.2% if over-the-counter (OTC)[8]. Securities representing these shares (ADRs, GDRs[9], etc) are also under the scope of the tax. The tax is due by the buying party and as in the French case, dues are calculated based on net transfer of ownership position at the end of each day. The list of *exempted* companies for 2013 was published by the Italian Ministry of Finance on February 1st, 2013. For 2014 and onwards, it will be published by December 20th of each year. As in France, a high-frequency trading tax at a 0.02% rate was also introduced for algorithmic trading based transactions with a cancellation to completion rate greater than 60%; however, as supported by other empirical evidence (Colliard and Hoffmann (2013)), I contend that the high-frequency tax should be infra-marginal to market participants affected by the cash equities tax, since high-

as final consumption goods at all (instead of being considered intermediate inputs) is dealt with by Auerbach and Gordon (2002).

[5] One can either source new ADRs by depositing the corresponding domestic shares of the company with the depositary bank that administers the ADR program or, instead, one can obtain existing ADRs in the secondary market. The latter can be achieved either by purchasing the ADRs on a US stock exchange or via purchasing the underlying domestic shares of the company on their primary exchange and then swapping them for ADRs (crossbook swaps). Often these swaps account for the bulk of ADR secondary trading.

[6] American Depositary Receipts, described in further detail in section 2.3.

[7]Formally defined as cash equity transactions concluded in a Regulated Market or Multilateral Trading Facility (MTF).

[8]Both rates were exceptionally set at 0.12% and 0.22% respectively, for 2013 only.

[9]Global Depositary Receipts.

frequency/algorithmic traders typically take advantage of intraday arbitrage opportunities, closing the day flat on the asset - in other words, they do not typically carry overnight changes in stock ownership. Nonetheless, a reduction in high-frequency trading due to this specific smaller marginal tax rate would also impact the evaluation of changes in total turnover, and will thus need to be taken into consideration when disentangling the effect of each tax.

The Italian Financial Transaction Tax law was approved on December 24th, 2012, and published in the Italian Official Gazette on December 29th, but articles about the voting of the law were published on December 21st[10]. Details on payments and reporting rules were published in a decree of the Ministry of Economy and Finance on February 1st, 2013. Since the first major series of press articles covering the legislative proposal in detail were published on October 10th-12th (Ore (2012a,c,b)), 2012, I use that as a second announcement date, in a similar fashion to the event identification strategy used for the French case.

In contrast to the French legislation, the Italian tax policy included a very narrow market maker exemption and ensured equity derivatives were included. Although the tax on derivatives was originally not supposed to come into effect until July 1, 2013 (eventually postponed to September 1), the loophole of trading swaps and contracts for differences (CFDs) was severely restricted from then on. Exacerbating the cross-platform design for cash equities, contracts executed OTC were subjected to a base rate five times higher than those executed on-exchange. The tax on derivatives is a flat tax ranging from €0.025 to €200 depending on the relevant instruments and with stepwise increases dependent on its notional value. Exemptions to the tax are much more limited under this framework - European pension funds being the main one. Figure C.2 depicts the timeline of relevant events.

2 FTTs as optimal taxes and revenue raising tools

2.1 Conceptual framework

Official government estimates of expected additional revenue accruing from the introduction of a FTT are non-negligible, all the more the broader the range of instruments included under the scope of the tax. With the introduction of the new tax regime, €500 million (0.2% of total government revenue) was expected for 2013 alone in France, and €1 billion for the second half of 2013 in Italy. Yet, most estimates rely on static estimations of tax bases, assuming no behavioral response of financial market participants (avoidance, evasion, participation decline, etc). In addition, there have been few empirical studies in the past that have been able to provide us with well identified elasticity estimates to the introduction of a FTT. High asset valuation and turnover elasticities

[10] I hence use December 21st as one of the announcement dates for Italy.

would undermine the optimality of these types of taxes for revenue purposes.

To the best of my knowledge, there is at best a thin literature analyzing the welfare impacts of financial transaction taxes (and consequently, their optimality in general) (see Subrahmanyam (1998); Dow and Rahi (2000)). Most recently, Davila (2013) studies the welfare impact of introducing a linear FTT under a model of trading with belief disagreement. Under his baseline model, trading is motivated by either different hedging needs, risk aversion, initial asset holdings (fundamental trading), or beliefs (non-fundamental, suboptimal trading). Assuming there is no redistribution objective and that optimists are mostly buyers and pessimists mostly sellers, Davila obtains a closed formula for the optimal tax where the reduction in distortion induced by belief disagreement is traded off against the loss in fundamental trading arising from the introduction of the tax. Although a valuable contribution to our theoretical understanding of the welfare implications of an FTT, the formulas for the optimal linear tax presented in that paper are limited in two main fronts from a social welfare perspective: (i) maximizing aggregate welfare involves only the utility of traders, and not that of non-market participants (such as ultimate investors, corporations, savers), and (ii) the only objective of the tax under Davila's framework is to serve as a corrective tax for excessive trading caused by divergent beliefs about asset returns - there is no consideration of the need for covering existing VAT loopholes or targeting financial sector rents (Philippon and Reshef (2009)), for example[11].

Furthermore, the only two allowed response margins are lock-in (represented by an inactivity region post-tax for those with relatively small benefits of portfolio adjustment) and changes in asset prices. As I discuss in more detail in the following sections, in practice the set of underlying response margins affecting the choice of optimal transaction tax rates resembles Piketty et al. (2011)'s study of optimal top income marginal tax rates - a "tale of three elasticities"[12] . As in Slemrod and Yitzhaki (2002), the first (extensive) margin of response is "real" *substitution* away from taxed assets; given the short-run fixed supply of outstanding floating shares, I contend that this kind of response is fully capitalized into asset values, whose change in response to the introduction of FTTs I measure below. In addition, there are two major intensive response margins I focus on. There is substantial evidence in support of *retiming* responses in transaction realizations - first temporarily, by anticipating realizations from immediately after the time of introduction of the tax to immedi-

[11]Also omitted are the potential double-dividends of such a tax (the use of Pigouvian tax revenues to lower existing distortionary taxes), assuming financial market participants are given a relatively low weight in the social welfare function (which is plausible in multiple European contexts). However, this argument is often called for on the erroneous basis that Pigouvian taxes do not create any deadweight losses of their own; the net effect depends on the social weight of those asymmetrically benefited by other lower taxes relative to the weight of those most directly affected by the FTT.

[12]"Real" labor supply elasticity can be thought of in the current context as substitution towards untaxed assets, income shifting as equivalent to avoidance through instrument and platform shifting, and bargaining effects comparable to reduction in trading due to retiming.

ately before; and second permanently by deferring realizations, thus minimizing the frequency of transaction tax liability (lock-in effect). Finally, there can be *tax arbitrage* in the form of income shifting across trading platforms and economically equivalent financial instruments.Slemrod (2001) generalizes a labor-leisure choice under a linear income tax model by allowing individuals to change both their labor supply and avoidance effort in response to tax changes. He shows that the net income and substitution effects of taxes depend both on preferences and the avoidance technology, and econometric analysis cannot usually identify the two forces separately, unless avoidance costs are known. The literature reveals cases of striking avoidance by shifting the timing of capital gains and stock-options realizations (Burman et al. (1994); Goolsbee (2000)), suggesting a very low cost of avoidance in the financial sector. Yet, to the best of my knowledge there has been no study to date of income shifting within the sector (in other words, shifting income classification such as through the use of economically equivalent derivatives, as opposed to re-timing of transactions).[13] Empirically, absent individual portfolio data on asset holdings and contracts entered into, substitution and different types of avoidance forces have been indistinguishable. This paper fills that gap, by proposing a method of disentangling the weight of each behavioral response using the variation in policy design in the two natural experiments herein analyzed.

2.2 Empirical Literature Review

Perhaps the most widely cited empirical study that attempts to estimate price and turnover elasticities to a FTT is the analysis by Umlauf (1993) of the introduction of a 1% tax on equity trades in Sweden in 1986. Using an event study framework, Umlauf describes a 60% fall in trading in the Stockholm exchange following the reform, with trading activity in the affected companies shifting to London. Furthermore, he finds a 5.3% decline in market value subsequent to the announcement of the tax. Other studies (Hu (1998); Schwert and Seguin (1993); Bond et al. (2004); Oxera (2007)) empirically estimate a range of turnover elasticities between -0.5 and -1.7 and asset value elasticities in the order of -0.15 and -0.4 (calculated relative to total transaction costs[14]). In addition, other papers note the existence of liquidity clienteles (Amihud et al. (2005)), which suggest that FTTs are capitalized more heavily into the prices of assets with high turnover.

[13] In particular, entering into economically equivalent derivative contracts instead of executing true transfers of asset ownership ensures the same payoff to the holding agent while circumventing tax obligations if the former are exempt or subject to lower effective rates.

[14] Transaction costs are defined as the sum of bid-ask spreads, brokerage fees and security transaction taxes, equaling approximately 3% of the security value. Other studies (Hawkins and McCrae (2002)) use similar figures for average cash equity transaction costs on exchange.

2.3 Empirical Estimation

I am using the unilateral French reform in 2012 and the Italian reform in 2013 as natural experiments to test several theoretical predictions mentioned above. In particular, I use a difference-in-differences augmented event study based on CAPM to estimate the value and turnover elasticity (subsequently split into four behavioral elasticities) of stocks to the tax rate as an increase in proportional transaction costs. I am exploiting within-asset market cross-border variation by choosing comparable high-market cap companies. I use daily (and for some volatility measures intra-day) data from Bloomberg. The core regression of interest for asset prices is the following:

$$r_{igt} = \alpha_{ig} + \beta_{ig} r_{mt} + \gamma_{igt} D_{st} + \eta_g + \delta_t + \epsilon_{igt}$$

where r_{igt} is the price return on security i of group g on date t, r_{mt} is the market return, and γ_{igt} measures the abnormal return caused by the event s for asset i (treatment effect of event). Including additional standard control variables for company size and book-to-market ratio (Fama and French (1993)) to this specification would not alter the results, since the latter variables would have been captured by the fixed effects terms given the very narrow event study windows I estimate the above specification within[15].

I use a homologous specification for the triple difference in differences analysis of turnover[16] elasticities (the differencing across years is necessary to extract seasonality effects), where I first difference the last three weeks of the implementation month and pre-implementation month (August versus July, and March versus February, respectively), then the implementation year versus the previous year (2012 versus 2011, and 2013 versus 2012, respectively) and finally treatment versus control groups:

$$\begin{aligned} ln\ t_{igt} &= a_{ig} + \eta_g + \delta_0 Month + \delta_1 Year + \beta_0 Month \cdot Group \\ &+ \beta_1 Month{\cdot}Year + \beta_2 Year{\cdot}Group + \beta_3 Month{\cdot}Year{\cdot}Group + \epsilon_{igt} \end{aligned}$$

The identifying restrictions for the validity of the specifications above are twofold. Firstly, conditional on covariates, the average values for treated and controls would have followed parallel paths in the absence of treatment. This is arguably a realistic restriction within the horizon of

[15]For robustness I also re-estimate the same specifications using the return of blue-chip market indexes in Europe and France as the market benchmark instead (in particular, FTSEurofirst 300 and SBF250). Insofar as we can think of these indexes as "risk-free", the firm-specific daily differential should then correspond to the conventional definition of excess return. These results can be provided upon request.

[16]Turnover is defined as total daily transaction volumes (number of shares traded) over the total number of shares outstanding excluding insider ownership.

event study for daily data, but it is less clear when looking at long-run turnover effects. Secondly, it is critical that no other significant news affected the spreads of interest on selected event days; special care is warranted here for example for earnings announcements causing outliers which can bias the estimates.

The treatment groups are stocks traded on the Paris and Milan stock exchanges, respectively. I implicitly abstract from trading on non-domestic exchanges, as well as multilateral trading facilities. However, according to studies covering MTFs under the French event study (Haferkorn and Zimmermann (2013)), I do not expect this omission to qualitatively alter the results. All data are taken from Bloomberg.

The first control group used are French and Italian (respectively) publicly listed companies just below the threshold of eligibility (between €500m and €1bn and between €250 and €500m, respectively). This is possibly the control group of lowest credibility, since growth companies under the threshold may be perceived as potentially included under the tax in future years, which would affect the present value of their returns as well as that of companies already taxed. In addition, at 35 (52 for Italy) total companies (since the treatment groups are those within the interval of eligibility threshold +€500m, to mitigate heterogeneity in firm characteristics in the two groups), the around-threshold available sample is extremely small, often lacking statistical power to be informative about any effects[17]. Table 5 summarizes the valuation and turnover results for this control group.

The second control group used in the empirical analysis so far are American Depositary Receipts for the same shares being affected by the treatment in France and Italy. Each ADR represents a given number/fraction of shares of a foreign company, but are denominated and trade in US$. They trade only in the US, mostly over-the-counter. Mechanically, underlying shares are converted into ADRs by being deposited in a custodian bank and having the corresponding ADRs then issued by a domestic depositary bank[18]. From a firm standpoint, ADRs broaden their potential investor base without having to comply with the reporting requirements of listed companies. From an investor standpoint, these securities enable exposure to the same returns as holding the underlying foreign shares, while avoiding currency exchange and cross-border investment costs. For the purposes of

[17] Further research using alternative summary statistics and specifications might be worthwhile conducting to discern any discontinuous effect on the two groups.

[18] When the ADR holder sells, it can either be sold to another U.S. investor or it can be canceled and the underlying shares can be sold to a non-U.S. investor. In the latter case, the ADR certificate would be surrendered, and the shares held with the local custodian bank would be released back into the home market and sold to a broker there. Additionally, the ADR holder would always be able to request delivery of the actual shares.

this study, ADRs are considered a tax-exempt control group since they only came under the scope of the tax four months later in France and enforcement is highly questionable as they are traded exclusively outside of Europe. In addition, I include Italian companies with liquid ADRs as a placebo, since in the latter case ADRs were never tax-exempt, so that we should not expect a similar differential effect a priori. By virtue of trading over-the-counter, data on the outstanding number of securities and the unit correspondence between ADRs and the underlying stock is not publicly available, so I use the log of absolute trading volume as my measure of turnover here. [19]

While there was an initial decline in valuation on announcement of the tax (February 7th), it was not as large as for other comparable assets. The February 27th positive coefficient on domestic ordinary shares is possibly reflective of an arbitrage correction. Most puzzling is the sharp devaluation of ordinary shares on December 1st, albeit no relative volume change. This could reflect the cancellation of ADRs, which would translate into a dumping of shares into the domestic market, and a reduced supply in the ADR market. Finally, some event dates lose their significance once currency exchange fluctuations are included as a control variable.

While all French high-market cap stocks seem to rebound in September towards pre-reform levels similar to the control group, stocks of companies with actively traded ADRs show a second decline in domestic share trading volume a couple of months after the introduction of the FTT in France (see Figure C.3) - not seen in the broader sample. This may be the result of lagged broker adaptation to the discrepancy in treatment between the two securities, or more likely, the larger (albeit lagged) impact of the tax on more liquid shares, since stocks with ADRs tend to be amongst those with highest turnover in the domestic French equity market. Note that although I replicated the same tests controlling for currency exchange fluctuations, the results presented in Table 6 do not include these controls - hence, the difference in direction between fixed effect coefficients in some of the regressions, which should have a priori been very similar in every column.

The third control group are Dutch and Belgian (Spanish in Italy's case) high-market cap companies. Like their French counterparts, Dutch and Belgian stocks are also traded on Euronext, hence a priori having a similar group of financial customers and traders involved. The control group alone in this case amounts to 59 companies, against 109 in the treatment group[20]. Belgium has had a transaction tax in place for most of the 20th century, in the order of 0.17%. However, since

[19] Yet another important caveat regarding the usefulness of ADRs for answering the questions at hand is that if ADRs were delisted between the event date and the time of writing of this paper, we may omit the liquidity and price effects on those assets, since we only have access to securities currently active. I further drop companies whose ADRs have an average daily trading volume of less than 2.5 units; that leaves us with 40/25 companies for the volume estimates in France/Italy.

[20] Due to data availability, effectively we have 57 and 108 companies in each group, respectively.

I am conducting a DiD analysis in what follows, what matters is that the control group sees no treatment during the period considered empirically - in other words, that only French stocks were subject to a change in transaction taxes. Using only Dutch stocks (which have no FTT in place) does not qualitatively change the results, and the magnitude impact on coefficients of interest is only marginal[21]. For Italy, the control group of choice are high-market cap Spanish companies. The two groups share similar macroeconomic shocks over this period and are broadly comparable in terms of sectoral distribution. Appendix A includes summary statistics about the market capitalization and turnover distribution of each set of treatment and control groups. These quantiles correspond to those used to restrict subsamples in Table 8. Table 7 below summarizes the results for changes in asset returns, which can be seen visually in the adjoining figures.

The implied price elasticity is -0.3 (a 1% decline in relative returns with an expected tax increase of 0.1% on announcement dates). This estimate is orders of magnitude smaller than the decline of asset values implied by a mechanical partial equilibrium model[22]. Cumulative abnormal return regressions yield similar results. Furthermore, the results are robust to estimating abnormal return using beyond-sample market indexes as a benchmark (such as the FTSEurofirst 300 and SBF250). I also constructed a placebo test for the change in turnover using the same control and treatment groups for 2005-2006 instead of 2011-2012, with no turnover effect found on the placebo period, which corroborates the robustness of the results above[23]. Early announcement dates for Italy (October 2012) show no significant price effect. A plausible explanation is the high count of articles being circulated simultaneously in those days about the EU-11 agreement to go ahead with a Eurozone-wide Tobin tax in 2014 (Ore (2012d)), which would suppress the differential (if any) between Italian and Spanish stock returns. However, estimates of price elasticity are very sensitive to the choice of event date, and I am thus cautious about taking these results at face value. In contrast, the turnover estimates described below are much more robust to choice of estimation windows and are patent even from simple plotting of non-transformed data.

Table 8 summarizes the overall turnover effect results using the core control groups. Q1-Q5 refer to the 1st through the 5th quintiles for market capitalization within the French and Dutch/Belgian sample, while T1-T5 correspond to the turnover quintiles for the same companies. Similar cross-sectional patterns are found in the Italian case, which I omit for brevity. The -0.27% coefficient for turnover in France is equivalent to a 24% decline (or a -3.6 elasticity with respect to an increase in transaction costs). Colliard and Hoffmann (2013) highlight that when looking at a longer two month horizon, the actual drop in relative turnover is closer to 10%, much smaller than that

[21] Results available upon request.

[22] Appendix A.1 characterizes the implications for asset valuation of a transaction tax under a basic partial equilibrium model à la Matheson (2011).

[23] Available upon request.

estimated for the first month after the reform. Several plausible reasons, including time-shifting of realizations and changes in reference point perceptions of excessive transaction costs could be behind this phenomenon. Notwithstanding, for most stocks in the upper liquidity quintiles, volumes persist at historically low relative levels after a temporary rebound in September seen in Figure C.4.

I also present estimates by quintile of market capitalization and liquidity (defined as average annual turnover). In line with Amihud et al. (2005), the evidence suggests the measured average decline in turnover is concentrated almost entirely in the lowest two quintiles of market capitalization and in the most liquid stocks. Finally, in Table 9 I attempt to discern between the two types of retiming avoidance effect (anticipation shifting of transactions around the implementation date and lock-in/deferral effects persisting after implementation). In particular, I define temporary anticipation responses as the difference between the measured change in turnover immediately around implementation[24] and the change over more distant months[25], which represent a change of a more permanent character, that I refer to here as the permanent lock-in effect. This definition thus captures a purely transitory change in turnover around implementation, without relying on assumptions about pre-treatment trends. The estimates for the latter are presented in the second column under each case in Table 9. In the third and last column under Italy I measure the magnitude of a permanent (lock-in) second round of turnover drop around June 1st, 2013, which I argue in section 2.4.6 may help us identify some response of cash equity trading with respect to expectations of derivative taxation.

As seen both in the last column of Table 8 and on Figure C.5, we find no such reduction in trading for Italian stocks following the reform. In section 2.4 I explain that this is likely a result of the more complex combination of tax wedges used in the Italian version of the FTT design, which offset much of the otherwise expected decline of on-exchange trading. Contentious general elections in Italy at the end of February could be raised as a concern for the identification of the specification above, since other confounding factors could be at play. However, concerns over political stability in Italy would, if anything, have *spurred* trading in Italian securities (albeit due to pessimistic valuation changes), thus implying that any turnover reduction impact estimates are a *lower bound* of their true value absent the elections.

A note is due at this point regarding the potential use of exchange-traded funds (ETFs) or other types of investment funds as tax-exempt avoidance opportunities for investors. Since trades executed by these funds would still be reflected in the data used in the estimations above, it is important to understand how such avoidance could affect the results, if at all. While the acquisition

[24]From the prior month to the first month the new tax enters into force.

[25]From the second to last month before implementation (t-2 months) to the second month of implementation (t+2).

of ETF units using a share transfer is considered to be a "contribution" and not a "purchase" of stocks, the fund itself is still liable for the transaction tax as an institutional buyer as it manages its portfolio. Hence, assuming there were a synthetic fund that perfectly replicated the exposure to returns of all shares under the scope of the tax, we should still expect to see an effect of the tax on share prices and turnover, as long as the fund management mirrors the optimal portfolio management of individual investors who before had their cash invested directly in the said stocks. Furthermore, any additional costs incurred by the fund in transacting those shares would most likely be shifted forward to fund contributors (in the form of increased fees for example). Thus, I claim that a decline in observed turnover and asset values cannot be explained by a shift towards collective investment funds - leaving shifting and deferral responses as the most plausible channels explaining the observed effects. However, this reasoning assumes investors have the same optimal portfolio allocation strategy before and after the tax, as well as before and after shifting to an ETF; if the tax for some reason were to make individual investors more averse towards active portfolio management, for instance, and ETFs were typically less active, then an ETF-oriented shift could produce at least part of the observed decline in trading volumes, and the perceived reduced liquidity would place further downward pressure on prices.

In addition to being the single most important determinant of the tax base at hand, trading volume can also be informative about the impact of the reform on capital market efficiency, discussed more at length in section 3. Transmission of information about the value of underlying assets is one of the key roles of the financial sector as an intermediary between investors and entrepreneurs/firms. One way of thinking about the amount of information available in the market is closely linked to liquidity – if in expectation, beliefs in the entire economy about the true value of an asset are correct, then a priori, markets with a greater number of participants ought to be more informative about fundamental values. The assumption that the sample of participants is somehow representative of the true distribution of beliefs in the economy is a critical caveat here – if an asset market has a greater ratio of speculators to value investors than the economy-wide distribution, an increase in market participants alone will not translate into increased price informativeness – on the contrary.

Using this rationale, I estimate the homologous relative differential between treatment and control groups for the number of trades executed each day, rather than simply the volume or turnover in the stock. I am using the number of trades as a proxy for the number of participants in the market. Following an increase in transaction costs, the decline in trading volume could be either due to the same people transacting much smaller amounts with the same frequency, or some participants choosing to transact less frequently, but for similar order sizes as before. The intuition behind this exercise is that in the latter case, the amount of information being aggregated by the price system is reduced. This could imply lower capacity of true price discovery and inefficient resource misallocation.

Indeed, when compared to the estimates in the first part of this section, I find that close to 80%

of the decline in stock turnover as a result of the FTT can be attributed to a decline in the number of trades executed (Table 10). Hence, the magnitude of individual portfolio adjustment remains relatively stable, but participation frequency declines sharply. In other words, market breadth declined, while market depth remained unaffected by the increase in participation costs.

2.3.1 Over-the-counter

Over-the-counter markets encompasses inter-dealer trading outside of formal exchange platforms[26]. As such, it does not use centralized trading mechanisms (such as auctions or limit-order books) to aggregate bids and offer trades; rather transaction terms are negotiated privately, with no immediate reporting requirements or supervisory authority - customization of transactions is thus more easily available, but the overall procedure is also more opaque relative to on-exchange trades. Dealers have an increased incentive to participate in OTC mechanisms, even for stocks listed on public exchanges that are highly liquid, given the higher profitability of intermediation in OTC. From a client standpoint, OTC provide a platform where large block trades in a stock can be executed while minimizing price impact. In Europe, firms are increasingly trading internally, against own accounts, and as of 2013 make up to 40% of all cash equity trading in Europe, on average[27]. Under the second round of MiFID[28], OTC transactions will be subject to reporting requirements similar to those of registered exchanges (albeit with a time delay) starting in 2015; anticipatory effects of this legislation could translate into an upward trend in OTC "reported" volumes, even if true trading levels had remained constant. In the analysis in Table 11, the time and group fixed effects should absorb any such variation; notwithstanding, such concerns would if anything mitigate the decline of OTC relative to lit markets, and hence reenforce the conclusions that OTC trading was substantially more negatively impacted in both countries by the tax than on-exchange trading.

Over-the-counter prices track on-exchange prices virtually all the time (as expected, since if that were not the case, there would be large unexploited arbitrage opportunities on the table), so I refrain from including OTC asset valuation estimates in this section, which would be equivalent to the results presented above. Therefore, I focus the analysis of OTC activity on trading volume and subsequently, volatility measures akin to those used for lit markets. The data I use covers OTC transactions reported to Markit BOAT, a trade reporting platform that covers approximately 25% of all cash equity reported activity in Europe (including lit markets). The drop in OTC trading is much more pronounced in Italy than in France in great part due to the tax wedge created by the legislation in Italy, which taxed OTC transactions at double the rate on lit platforms. Effectively, the turnover effect in OTC in Italy is in the order of a 85% drop relative to the Spanish control

[26]In what follows, the terms "on-exchange" and "lit markets" are used interchangeably, and I refer to both registered exchanges and multilateral trading facilities combined.
[27]Thomson Reuters - European Market Share Reports
[28]Directive on Markets in Financial Derivatives

group; in France, the drop rounded to 26% of pre-reform OTC trading volumes. More importantly for the identification of behavioral responses in the next section, virtually all of the response in French OTC turnover was temporary, vanishing by September 2012. In contrast, the massive drop in Italian OTC was sustained several months after the introduction of the tax wedge (Figures C.6 and C.7).

2.4 Identification of behavioral responses

Combining the variation in policy design in both natural experiments analyzed in the preceding sections, I derive a range of estimates for each different elasticity that, as previously contended, I expect to play a role in explaining the underlying behavioral response to the tax. In particular, I aim at identifying elasticity ranges for realization anticipation, deferral/lock-in, avoidance through mechanism/platform shifting (from OTC to Lit), and instrument shifting (towards economically equivalent derivative contracts). Furthermore, I propose a strategy to identify the lock-in effect of high-frequency transaction taxes, separately from the lock-in effect induced by financial transaction taxes applied based on end of day ownership transfers of stock.

2.4.1 Evasion

Firstly, in order to deal with potential evasion responses being erroneously taken for avoidance behavior, I assume that Italy and France have similar evasion costs and elasticities. Furthermore, I contend it is unlikely that significant evasion exists in financial transactions of focus in this study given counterparty reporting and the inherent digital trail. Most non-domestic trading of French and Italian equities is done in so-called "white exchanges" thanks to the introduction of MiFiD in 2007, which have standing agreements to not only provide information on trades executed by non-resident agents, but also to enforce applicable obligations they may be subject to in their domiciles; against this background, significant geographic evasion seems implausible. Moreover, the ADR exercises above show no credible evidence supporting an evasion story[29], which may attest to expected US compliance with European tax enforcement demands. I am hence ruling out significant evasion opportunities and focus instead in what follows on modeling avoidance.

2.4.2 Market-making exemptions

Colliard and Hoffmann (2013) suggest that even under a uniform tax rate in both OTC and on-exchange (such as the French case), we could expect a shift of transactions from OTC to lit markets due to the exemption of transactions resulting from market-making activities from the scope of

[29] Under geographic evasion, we should expect a significant drop in trading volume of domestic stocks relative to their ADR counterparts - especially in France's case, where they were de facto temporarily exempt. The empirical analysis does not support this hypothesis.

the tax. A market maker (MM) is "a person who holds himself out on the financial markets on a continuous basis as being willing to deal on own account by buying and selling financial instruments against his proprietary capital at prices defined by him" (article 4.1(8) MiFID, Parliament and Council (2004)). They are designated by or registered as such on registered exchanges. However, OTC traders also benefit from the exemption under the French legislation, as long as they operate in a similarly liquidity-providing function to that of registered exchanges' market makers. [30]

Since the set of broker institutions considered systematic internalizers OTC overlaps to a great extent with that of market makers on investment exchanges (in other words, the exempt institutions are almost identical), I argue that this must not in fact have been a dominant dynamic in France[31]. Moreover, the lack of a significant permanent lock-in effect on turnover OTC in France supports this contention, in that no shifting *outside* of OTC seems to have occurred as a result of the FTT in France, where there were no cross-platform tax arbitrage opportunities. In Italy, however, systematic internalizers were not exempt from FTT, implying indeed an incentive to shift trades to regulated exchanges if able to claim them under market-making purposes. According to a study by the Association of Financial Markets in Europe, about 40% of all reported OTC trading (which in itself accounts for an average of 40% of total reported trading volume in equities in Europe) corresponds to trades executed by systematic internalizers and crossing processes/network trades[32]. Equivalently, at most 40% of all OTC trading in Europe corresponds to trading by systematic internalizers. I take this ratio as a proxy for the proportion of OTC that may have been open to shifting from OTC to on-exchange platforms due to greater market-making exemptions in the latter. In other words, with an average of 30% of pre-FTT equity volume in Italy being traded OTC, I allocate an upper bound of $40\% \cdot 30\% = 12\%$ of total pre-FTT volume as having shifted platforms towards lit markets. This leaves a minimum of $85\% - 40\% = 45\%$ of pre-FTT OTC volume which shifted to lit markets due to the tax rate differential between OTC (0.2%) and regulated markets (0.1%). In reality, this is likely to have been the determinant factor explaining the bulk of the decline in trading volume OTC in Italy, as it was invariably the justification highlighted in press commentaries and reviews of the impact of the law by practitioners. The lack of a sizable

[30] These are also known as systematic internalizers (SI), defined as "an investment firm which on an organized, frequent and systematic basis, deals on own account by executing client orders outside a regulated market or an MTF" (article 4(7) MiFID,2004). Effectively, the core difference between the two types of brokers is that a SI does not have to be designated by an exchange, and is free to create its own trading rules, including acting as a SI across multiple jurisdictions without needing further exchange approval.

[31] In addition, I implicitly assume the corresponding share of market-makers and systematic internalizers to total on-exchange and OTC participants, respectively, must have been comparable. Otherwise, we should expect a bigger overall lock-in effect in the platform with the smallest fraction of exempt counterparties.

[32] These are defined as internal electronic matching systems, operated by investment firms, which execute client orders against other client orders or house account orders.

anticipation shifting response in the Italian OTC market (in contrast to the one observed in France) can be justified by the alternative avoidance opportunity of shifting towards lit markets, which likely involved some fixed costs; as discussed below with respect to derivatives, those participants who chose to shift towards lit markets in Italy (almost everyone except exempt pension funds) would have done so once and completely at implementation, rather than combining mixed avoidance strategies within a short time window, since alternative sheltering options tend to be polarizing under the presence of fixed costs (Cowell (1990)).

2.4.3 Identification premises

My pivotal assumptions are common retiming (anticipation and lock-in, OTC and lit), platform and derivative shifting elasticities across the two case studies. I have no reason to expect the retiming response to be different in the two countries (controlling for the respective applicable rates). In addition, I allow retiming to vary between OTC and lit markets, since OTC participants might represent more long-term asset holders, less affected by FTT, such as certain types of pension funds (in Italy most non-exempt parties can switch to lit markets given the tax wedge between platforms, with those agents remaining likely to be pension funds, for example), or have access to different avoidance technologies.

Furthermore, I non-trivially assume that the HFT and the main FTT of 0.2% affect mutually exclusive groups of traders, since algorithmic (high-frequency) trading typically takes advantage of intraday misalignments in quotes, ending the day with unchanged net positions, which are the base of the FTT. Moreover, I use survey estimates from the Committee of European Securities Regulators that up to 40% of all equity volume on registered exchanges corresponds to high-frequency trading (2010). Although this was an upper bound in 2010, the increasing trend of HFT likely makes this a conservative estimate for 2012-13. I require the relative composition of market participants by type to be unchanged after the introduction of the tax.

Therefore, I posit that any discrepancies between observed figures in the empirical estimations in section 2.3 arise due to different avoidance opportunities through the two channels aforementioned (platform and derivative shifting), as well as different tax rates on high-frequency trading. I exploit the cross-country variation in tax arbitrage opportunities and survey proxies for the share of market-maker-like participants in OTC and high-frequency traders in exchanges to separately identify the magnitude of each behavioral response. Diagram C.8 summarizes the responses identified in this section. All elasticities are calculated with respect to a change in marginal tax rates (MRT) relative to transaction costs, whose estimates average 0.75% of asset values, except for high-frequency trading costs, estimated at 0.2%[33]. Calculating elasticities directly with respect to the marginal

[33]The rationale for using transaction costs rather than the full notional value of the asset as a base for elasticity

tax rate change (similar to what is commonly done in the capital gains tax or VAT literature) would give us astronomically large elasticities ranging from -30 to -4500.

2.4.4 Over-the-counter

We restrict our focus to platform shifting for the moment (the first part of the diagram above). Out of the observed 26% OTC drop in France, I estimated its entirety to be due to reshifting of transaction realizations around implementation (in other words, temporary anticipation). This implies that the permanent lock-in effect OTC was null following the introduction of the 0.2% FTT. This may be in part due to the generous market-making exemptions given by the French law, but also to the more flexible features of OTC contracts which may aid in curtailing the need for deferral. The results are therefore not consistent with the hypothesis that transactions shifted from OTC to lit markets in France due to more generous market-making exemptions in the latter.

By assumption, the over-the-counter lock-in elasticity is the same in both countries ($\sim 0\%$, per the previous paragraph), while the market-making shift from OTC to lit can range from 0% up to 40% in Italy, due to the stricter market making restrictions in the Italian FTT design. Hence, the remaining difference between the observed OTC permanent decline percentages ($[-45\%, -85\%]$ and 0% for Italy and France, respectively), can be attributable to the differential tax treatment of the two platforms in Italy. This result enables us to compute lower and upper bounds on the *platform shifting elasticity* due to changes in relative tax rates:

$$\epsilon_{platform} = \frac{\%\Delta\text{OTC drop attributable to platform shifting}}{\%\Delta\text{MTR wedge between OTC and lit/ATC}} = \frac{[-45\%, -85\%]}{[(0.22\% - 0.12\%)\,/0.75\%]} = [-3.375, -6.375]$$

We can furthermore impose a confidence interval around this range of elasticities by using the standard errors of the estimated decline in observed OTC - precisely,

$$\text{Var}\left(\epsilon_{platform}\right) = \left(\frac{1}{13.3\%}\right)^2 \cdot \text{Var}\left(\hat{\beta}_3^{OTC_{IT}}\right)$$

Moreover, absent alternative dominant avoidance strategies, we can also derive an estimate for the *anticipation response elasticity over-the-counter*,

$$\epsilon^{OTC}_{anticipation} = \frac{\%\Delta\text{OTC anticipation drop}}{\%\Delta\text{MTR increase OTC/ATC}} = \frac{-26\%}{(0.2\%/0.75\%)} = -0.975$$

computations is that rather than accruing to the overall value or cost of the asset per se, transaction taxes increase the resources needed to enter into any transaction. Transaction taxes represent a marginal cash cost that cannot be offset against any stock borrowing or netting of asset purchases with a given counterparty. In other words, as a trader I care how many more resources I will have to invest as transaction costs *in proportion* to what I used to, conditional on any trade notional value.

with corresponding variance[34]

$$\text{Var}\left(\epsilon^{OTC}_{anticipation}\right) = \left(\frac{1}{26.6\%}\right)^2 \cdot \left\{\text{Var}\left(\hat{\beta}_3^{OTC_{FR}}\right) + \text{Var}\left(\hat{\beta}_3^{Lock-in\_OTC_{FR}}\right)\right\}$$

In fact, because of the informational asymmetry inherent to OTC trading, spreads (a fundamental component of non-tax transaction costs) are typically higher than on exchanges, implying a larger initial share of transaction costs to notional value than 0.75% (Matheson (2011)). This entails the elasticity estimates just computed could be underestimating the true magnitude of the response OTC.

2.4.5 Registered exchanges - lit markets

While the total estimated decline in lit turnover in France was in the order of 24%, 18% was captured by a long-term lock-in effect, leaving only 6% as possible temporary anticipation response. To the extent that there is a subset of investors with fixed portfolio reallocation dates which may not correspond to the tax reform months, the 6% figure may underestimate the true magnitude of anticipatory behavior[35]. Thus, we have

$$\epsilon^{FTT}_{anticipation} = \frac{\%\Delta\text{lit anticipation drop}}{\%\Delta\text{MTR increase lit/ATC}} = \frac{-6\%}{(0.2\%/0.75\%)} = -0.225$$

with variance

$$\text{Var}\left(\epsilon^{FTT}_{anticipation}\right) = \left(\frac{1}{26.6\%}\right)^2 \cdot \left\{\text{Var}\left(\hat{\beta}_3^{FTT_{FR}}\right) + \text{Var}\left(\hat{\beta}_3^{Lock-in\_FTT_{FR}}\right)\right\}$$

which is rather low relative to the other behavioral elasticities estimated in this section.[36]

In turn, the lock-in figure for on-exchange trading masks two different underlying marginal tax rates: high-frequency trading (HFT) at 0.01% and overnight changes in stock ownership at 0.2%. In order to disentangle the two behaviors, I resort to the assumption of mutually exclusive target groups for each tax, as stated above, and use European survey averages to proxy for the share of high-frequency traders. In theory, the observed total lock-in effect in any given exchange with both

[34] This non-trivially assumes the estimates for OTC overall and lock-in turnover change are independent of each other. If their covariance were non-zero, the degree of substitutability between retiming responses would suggest the covariance to be negative, in which case it would narrow the confidence interval over bounds provided. Likewise, the same reasoning applies to combinations between the variance of OTC and lit turnover changes; substitutability between platforms would suggest at most a negative covariance.

[35] For instance, portfolios with a set reallocation schedule for June and September may have anticipated September realizations to June, but this would not be reflected in the estimates.

[36] Note that in Italy we could not measure any significant anticipation response, which may be due to the confounding effect of the general elections increasing trading volume in the implementation month (March). For this reason, I chose the more precisely estimated French parameter estimate of anticipation elasticity for the calculation of the anticipation elasticity on lit markets.

types of taxes could be thought of as a weighted average[37] of the respective marginal tax rates and group-specific turnover elasticities. For notational simplicity, I will denote non-HFT trading volume as "FTT". For a single exchange, we thus have formally

$$HFT\_share \cdot HFT\_MTR \cdot \epsilon^{HFT}_{Lock-in} + FTT\_share \cdot FTT\_MTR \cdot \epsilon^{FTT}_{Lock-in} = \text{Observed overall lock-in}$$

For a single country, the elasticity parameters of interest are indeterminate. However, by combining the evidence of the two case studies covered in this paper, I am able to identify each elasticity separately, conditional on the assumptions described in previous paragraphs. In order to ensure we combine results from equivalent markets, I match the Italian $\hat{\beta}_3^{Lock-in\_LIT_{IT}}$ estimate (the computed value for the observed permanent decline in turnover) with that for the French 5th turnover quintile, which is most similar to the average Italian turnover levels[38]. As highlighted previously, both the empirical evidence shown here and theoretical models suggest that, all else equal, lock-in elasticities with respect to a transaction tax should be larger for stocks with higher turnover. Thus, we have

$$\begin{aligned} \Big\{France\_T5: \quad & 40\% \cdot \frac{0.01\%}{0.2\%} \cdot \epsilon^{HFT}_{Lock-in} + 60\% \cdot \frac{0.2\%}{0.75\%} \cdot \epsilon^{FTT}_{Lock-in} &=& \quad -31\% \\ \Big\{Italy: \quad & 40\% \cdot \frac{0.02\%}{0.2\%} \cdot \epsilon^{HFT}_{Lock-in} + 60\% \cdot \frac{0.1\%}{0.75\%} \cdot \epsilon^{FTT}_{Lock-in} &=& \quad -42.5\% \end{aligned}$$

where the 42.5% decline of on-exchange turnover in the second line is derived by subtracting the OTC to lit shift in Italy discussed earlier ($85\% \cdot \frac{1}{3} \cdot \frac{3}{2} = 42.5\%$ of pre-reform lit volume[39]) from the observed drop of 0%. The 31% decline for the 5th French turnover quintile corresponds to the

[37] Weighted by the respective share of participants from each group.
[38] In other words, I assume the non-HFT lock-in elasticity to be the same for the two subsamples.
[39] Given OTC pre-reform accounted for about a third of total cash equity volume in Italy.

overall observed lock-in decline for the group[40]. [41]Solving for each elasticity parameter, we get[42][43]

$$\begin{aligned} \epsilon^{FTT}_{Lock-in} &= \frac{\%\Delta \text{lit lock-in drop for non-HFT}}{\%\Delta \text{MTR increase lit FTT/ATC}} = & -0.8125 \\ \epsilon^{HFT}_{Lock-in} &= \frac{\%\Delta \text{lit lock-in drop for HFT}}{\%\Delta \text{MTR increase lit HFT/ATC}} = & -9 \end{aligned}$$

with corresponding variances

$$\begin{aligned} Var\left(\epsilon^{FTT}_{Lock-in}\right) &= \left(\frac{1}{12}\right)^2 \cdot \left\{ Var\left(\hat{\beta}_3^{5thQuintile\_LIT_{FR}}\right) + \frac{1}{4}\left[Var\left(\hat{\beta}_3^{Lock-in\_LIT_{IT}}\right) + \frac{1}{4} \cdot Var\left(\hat{\beta}_3^{OTC_{IT}}\right)\right]\right\} \\ Var\left(\epsilon^{HFT}_{Lock-in}\right) &= (50)^2 \cdot Var\left(\hat{\beta}_3^{5thQuintile\_LIT_{FR}}\right) + \left(\frac{25}{18}\right)^2 \cdot Var\left(\epsilon^{FTT}_{Lock-in}\right) \end{aligned}$$

The much larger elasticity for HFT transaction volumes, orders of magnitude beyond what the public finance literature is accustomed to see, can be explained by the relatively low cost of response under sophisticated technology available to these types of agents[44], but most importantly by the relatively high impact of the tax (even at a rate of 0.01%) on the profitability of HFT. The latter often exploit infinitesimal mispricing to make marginal gains that accumulate with order volume throughout the day - a not-so-infinitesimal tax takes a chunky bite off these profits that make HFT

[40]The equivalent treatment effect presented on Table 9, estimated exclusively within the 5th turnover quintile. Note that this permanent lock-in is approximately 3.5% *higher* than the immediate effect (equivalent to negative anticipatory response), implying a potential delayed adjustment by less sophisticated investors in very liquid stocks, which may have taken longer to wind down their positions (either because of salience of the measure only in August, because of vacation-related absence from the market, or other reasons).

[41] Since high-frequency trading largely bypasses the need for broker intervention by relying on algorithmic trading technology, commission fees are substantially lower than for traditional sales traders (Kim (2007)). Furthermore, as high-frequency trading institutions compete to provide liquidity, they take a significant part of the bid-ask spreads as profit, rather than costs. Therefore, overall transaction costs are in theory much lower for HFT than regular sales traders. Unfortunately, I am unaware of reliable empirical estimates of such costs, and as such limit ourselves to consider the elasticity estimate below as an upper bound; anecdotal evidence however suggests it could be at least 80% smaller (Blawat (2012)).

[42]Note these lock-in elasticities are still "contaminated" by shifting to derivative contracts, which cannot be captured given the existing variation. The estimate of the derivative shifting elasticity at the end of this section refers to the elasticity of cash equity transactions with respect to an increase in the tax wedge between economically equivalent derivative transactions and cash equities, and makes an important assumption regarding the informationally-driven source of a second round of turnover drop on the Milan stock exchange.

[43]Note I implicitly assume constant lock-in elasticity conditional on tax type. The presence of non-linear elasticities (not explicitly considered in this paper) can have important implications for optimal policy design. Given a second-best initial point, the interval estimates provided by the present study may lead to underestimating the first-best FTT linear rate for equity markets if the response margin given higher existing tax rates is lower up to a threshold.

[44]In fact, these agents "are technology" in the sense that algorithmic trading orders are executed by massive high-speed computers. This result is also consistent with recent work by Deng et al. (2014), which find that sophisticated institutional traders dominate mature markets in Hong Kong, where their discouragement under the presence of transaction taxes is associated with higher price volatility.

worthwhile, thus eliciting a much stronger response to a transaction tax than in more conventional trading floor operations.

2.4.6 Instrument shifting

Finally, I aim at identifying the magnitude of avoidance behavior via instrument shifting. While different possible combinations of derivative contracts could in theory be used to substitute for cash equity transactions (call-put option combinations, forward contracts, etc), the most straightforward and common derivative for the purposes just described are swaps known as contracts for differences (CFDs). CFDs stipulate that the contract seller will pay to the buyer the difference between the current value of an asset and its value at contract time. Thus, they can be used to gain exposure to price movements of the underlying asset without any of the parties involved actually even having to own it. In addition, they use leverage, trading on margin rather than cash positions. Unlike futures contracts, CFDs have no fixed contract size and no expiration date, making them attractive to investors seeking flexible arrangements. CFDs are illegal in the US but are widespread in Europe, providing thus an easy avoidance channel for both the French and Italian FTTs. Certainly broadening the applicability of an FTT to derivatives (as in the Italian case) ought to diminish opportunities for this kind of avoidance. Notwithstanding, tax arbitrage is still possible as long as assets are taxed differently.

I could not identify derivative shifting elasticities from trading volumes for derivatives contracts, since virtually all CFDs are executed over-the-counter and do not have any reporting requirements currently in place. I further conducted DiD estimation exercises for cash equities around the entry into effect of the derivatives tax in Italy on September 1st, 2013, but found no significant effects[45]. A plausible explanation for this is the limited time (four months) of derivative tax exemption relative to cash equities, making it not worthwhile for traders to shift instruments for hedging or other purposes only temporarily. If they were to shift to derivatives, they would do so fully and permanently (Cowell (1990)), since there are likely fixed costs involved[46]. In addition, even after derivatives came under the scope of the tax, the relative tax rate remained favorable towards derivatives (since at most the marginal rate for the latter would be 0.02% of notional contract value), reenforcing the hypothesis that if a trader chose to shift initially, she would do so permanently. Nonetheless, the two stage evolution of lit turnover in Italy after the initial implementation of the cash equities FTT does suggest derivatives avoidance played a role in the second round of turnover decline around the beginning of June 2013. Notably, from June 1st onwards a series of articles in the Italian and international press announce the postponement of the implementation of the

[45] Detailed estimation results can be obtained upon request from the author.

[46] This implicitly assumes a common fixed adjustment cost or at a minimum one with a fairly narrow dispersion among traders.

derivatives tax from July 1st, as previously expected, to September 1st. Amidst a background of general uncertainty about the permanent character of the tax (and in particular whether derivatives would come under its scope), I argue that a plausible consequence of this announcement was to reinforce expectations that the tax was to stay. In addition, the announcement news is likely to have augmented the salience of derivatives shifting as an avoidance opportunity. I view this as an incentive to switch towards derivatives for those that had not yet done so in March, and use this parameter to identify a lower bound on equity turnover elasticity with respect to derivative taxes. Simple adjustment lag stories, uncertainty over how the tax was to be levied technically speaking or delayed first round of tax collection (retroactive)[47] are rejected by the fact that neither the OTC market in Italy, nor any of the French trading platforms exhibited a similar second round of behavioral response - the only tangible difference between this case and the others is the looming of a derivatives tax[48]. Hence, the corresponding estimate for *derivative shifting elasticity* in equity markets is

$$\epsilon_{derivative} = \frac{\%\Delta \text{lit lock-in drop upon derivative announcement}}{\%\Delta \text{MTR wedge between lit and derivatives/ATC}} = \frac{-18.6\%}{[(0.1\% - 0.02\%)/0.2\%]} = -0.465$$

, where the denominator is the maximum possible effective marginal tax rate imposed on an eligible derivative contract under Italian law. The corresponding variance is

$$\text{Var}\left(\epsilon_{derivative}\right) = \left(\frac{5}{2}\right)^2 \cdot \text{Var}\left(\hat{\beta}_3^{2nd \text{ round}_{IT}}\right)$$

The present exercise is intended to function principally as a guide for structuring our understanding of the relative magnitudes of underlying behavioral responses within financial transaction tax avoidance. I am aware that the exact ranges provided are sensitive to the estimates obtained in this study and the assumptions we needed to make regarding the microstructure of the OTC and lit markets, but see it as a first step in obtaining informative policy and welfare-relevant parameter estimates, rather than simply net aggregate responses.

[47] Both France and Italy had a delay of about 3 months between the date of implementation of the FTT and its first round of payment collection (the dues for the interim months were paid simultaneously).

[48] Estimating the same difference-in-differences specification for turnover of Italian companies just below the €500m threshold yields a non-significant decline smaller than the estimated June lock-in for high-market cap companies shown in the last column of Table 9; this suggests any move towards derivatives captured in June would not have been a shift from equity trading of exempt Italian companies, but rather a reduced overall lock-in effect.

3 Capital Market Efficiency

3.1 Is stock market volatility detrimental to social welfare?

By the envelope theorem, the behavioral effect of a tax policy reform on private welfare is approximately zero for a sufficiently small rate change. However, the impact of aggregate behavioral responses on asset returns and realized volatility may have non-trivial effects on social welfare, especially under the presence of externalities - not only among capital market participants, but also on investors, entrepreneurs and savers in the broader economy. One of the foremost arguments put forward in favor of financial transaction taxes is their purported ability to reduce short-term speculative trading activity, perceived as destabilizing for consumer confidence, investment and macroeconomic fluctuations. In fact, Tobin (1978)'s pioneering proposal in favor of transaction taxes itself focused on the goal of reducing market volatility. Not coincidentally, Italy's FTT introduction was part of of a legislative package entitled "Stability Law". Before describing the results of this study with respect to the FTT impact on a variety of volatility measures, it seems critical to ask first whether financial market volatility matters at all empirically as a shock contributing to business cycle fluctuations. There is a relatively thin literature on this subject. Beaudry and Portier (2006) look at the impact of a shock to the first moment of news about future productivity as incorporated in financial market indexes, and estimate it via a vector error correction model using US data, finding that a positive shock increases consumption, investment, output and hours on impact, but not total factor productivity. The literature looking at second moments of financial market indexes' impact on aggregate variables is of greater interest for the purposes of this paper, with the most frequently referenced work in that strand being that of Bloom (2009), who simulates the impact of an uncertainty shock on aggregate output, employment and productivity, and finds that uncertainty shocks induce sharp short recessions and recoveries (with a medium-term overshoot). His main measure of stock market uncertainty is the implied volatility index of S&P 100 options with rolling 30-day maturity. Cohen and Alexopoulos (2009) use a similar volatility index to Bloom in addition to a New York Times news based index of uncertainty shocks to estimate their effect on aggregate variables using vector auto-regressions. They report that at a 12 month horizon, uncertainty shocks explain 13% of variance in industrial production, 21% in employment and 18% in productivity.

Bloom (2009)outlines a structural firm-level model with a time-varying second moment of the driving process, as well as non-convex labor and capital adjustment costs, yielding a central region of inaction in hiring and investment. Higher uncertainty (proxied by stock market volatility) expands this region of inaction by making firms more cautious in responding to business conditions. In particular, higher uncertainty increases the real-option value to waiting, inducing firms to scale back their plans. Once uncertainty subsides, activity quickly bounces back as firms address pentup demand. Parallel arguments can be made for the Eurozone, giving us some observationally grounded motivation for expecting that short-run volatility may be destabilizing for main aggregate variables, justifying at a first pass the use of the FTT as a Pigouvian tax to correct for externalities arising outside the capital markets themselves.

More specifically, by reducing the number of market participants an FTT may lower the informational content of stock prices assuming information about fundamentals is highly dispersed, which in turn causes a rise in the excess volatility of stock returns. The increased volatility makes holding stocks unattractive and induces agents to demand a higher equity risk premium; this is equivalent to a higher expected dividend demanded by capital holders in general equilibrium (a higher expected marginal product of capital). Under standard functional assumptions, the higher required return implies a depressed steady-state level of capital accumulation and output - causing first-order welfare costs by lowering long-run levels of consumption (Hassan and Mertens (2011)). Thus, while the introduction of an FTT per se does not directly reflect an increased uncertainty by economic agents about the state of the economy or the future productivity of projects, it can still be a significant source of social welfare-reducing volatility if it decreases the informational efficiency of financial markets.

3.2 Do transactions taxes reduce, increase or have no effect on stock market volatility?

Theoretically, it is unclear whether discouraging "disruptive speculation" by increasing the cost of trading would reduce excess volatility in asset prices. Firstly, there is no consensus as to what "excess" volatility is given the difficulty in defining an optimal level thereof. Secondly, while the burden of a transactions tax may fall more heavily on short-term transactions, it is unclear whether these are the ones driving the gaps between market prices and intrinsic values, and furthermore the tax ends up falling on all trading activity, not just speculative trading, thus potentially reducing positive liquidity (this is the core trade-off in Davila (2013)'s derivation of the optimal linear FTT). This would be the case if market makers were affected by the tax for example.

At a microstructure level, there is a wide theoretical body of work scrutinizing the impact that short-term or speculative transactions have on volatility. One such strand of the literature focuses on heterogeneous agents models (Frankel (1996); Westerhoff (2003))[49]. These models depart from traditional assumptions of full rationality, with market agents making decisions according to potentially suboptimal "rules of thumb", and furthermore having different interests, access to funding or capabilities. Lanne and Vesala (2010) argue for instance that a transaction tax is

[49]Other branches of the literature focus on zero intelligence atomistic models which reproduce excess volatility through herding behavior in the population of traders (Ehrenstein et al. (2003)), or use game theoretical approaches (Bianconi et al. (2009)).

likely to amplify, rather than dampen, volatility in foreign exchange markets stemming from the assumption that informed trader valuations are likely to be less dispersed than those of uninformed traders, and that under a decentralized trading practice a transactions tax penalizes the former more heavily.

Empirically, the evidence is still sparse but overwhelmingly in support of either no effect or an increase in volatility following the introduction of a transactions tax. Among other papers, Umlauf (1993), Jones and Jones and Seguin (1997), Baltagi et al. (2006) and Pomeranets and Weaver (2011) all find statistically significant increases in volatility[50] following increases in FTTs. Pomeranets and Weaver (2011), for example, examine nine changes in the level of an FTT levied on equity transactions in New York state between 1932 and 1981 and conclude that an increase in the FTT is related to a statistically significant increase in volatility, bid-ask spreads and price impact on the New York Stock Exchange and the American Stock Exchange. In turn, Saporta and Kan (1997) are among a couple of other studies that do not find a relationship between FTTs and volatility, but to the best of my knowledge there is no study showing a significant decline in volatility being associated with an increase in FTTs, thus suggesting that on balance empirical evidence is consistent with arguments made by opponents of the tax.

I further explore the micro data on French and Italian high-market cap companies and the respective control groups described above to discern whether there has been any change in the volatility (short-run or long-run) of asset prices. A decline in short-run volatility would be suggestive of a decline in potentially speculative activity. It would likewise be indicative of a smaller price impact of each trade, conditional on the number of trades. Related to the question addressed in the next section, a smaller price impact of individual trades can be associated with greater informativeness of the price system. On the other hand, an increase in volatility is possible if the reduced liquidity induced by lower turnover is sufficiently large to make the market choppier.

In what follows I use three different measures of volatility of firm asset prices: the standard deviation of closing prices (over the month immediately preceding and following the tax reform) for each firm; the daily standard deviation of a firm's high, low, closing and opening prices; and the average bid-ask spread as a percentage of the daily closing price for the firm. None of these metrics are sufficiently informative across any of the control groups to discern a differential increase or decrease in price volatility for the firms under the scope of the tax.

Standard deviation volatility analysis using volatility of closing daily prices against Dutch/Belgian and Spanish comps is too noisy and not informative (Figures C.9 and C.10). A similar exercise is equally non-informative for the other two control groups (ADRs and smaller market cap companies)[51]. While these results do not necessarily reject the hypothesis that FTTs are volatility-

[50]Measured as the standard deviation of returns.
[51]Results available upon request.

reducing, the modest magnitude of most coefficients do suggest that despite the amount of noise present in the data, the introduction of the taxes had no notable effect on standard volatility measures on-exchange. The second column under each group in Tables 12 and 13 uses the daily standard deviations between high, low, opening and closing prices as its dependent variable.

The third column under each case study uses the daily average bid-ask spread as a percentage of closing price as the left-hand side variable. Due to data limitation reasons, bid-ask spread data is only available since the beginning of 2012 on-exchange and 2013 for OTC, and hence the triple difference-in-differences analysis that has been modified throughout this paper cannot be adequately implemented. Although mostly statistically insignificant, these findings suggest a weak overall impact of the FTT on the volatility of affected stocks. The exception seems to be OTC in Italy, where the bid-ask spread shows a significant decline of 6 basis points as a percentage of share price in March 2013 (the first month of implementation). The much larger turnover effects identified in OTC platforms than on-exchange suggest the reduced market participation may be the principal explanation of the reduced measured volatility, in a way potentially supporting contentions that the tax may have a corrective role - at least wherever reduced turnover cannot be easily circumvented by avoidance. Interestingly, albeit non-statistically significant, these estimates suggest a mirror pattern between OTC and exchange platforms in both countries. In particular, while we observe a slight increase in closing price volatility together with a decline in intraday variation in prices in OTC, the opposite seems to have happened on-exchange. The only significant increase in the measures used occurs on intraday volatility on the Milan stock exchange - which could be accounted for by the explanation used earlier in the paragraph as to why OTC volatility measures may have declined somewhat.

Finally, I include a common measure of the average daily price impact of order flow as proposed by Amihud (2002), a proxy for both illiquidity and realized scaled volatility. For each stock i, the measure is defined as:

$$ILLIQ_{i,t} = \frac{1}{D_{iy}} \cdot \sum_{t=1}^{Diy} \frac{|R_{iyd}|}{VOLE_{iyd}}$$

where $|R_{iyd}|$ is the daily absolute return on the stock, $VOLE_{iyd}$ is the respective trading volume in euros, and D_{iy} is the number of days for which data is available for stock i in year y. An advantage of this ratio is that it captures transaction costs associated with trading more generally than bid-ask spreads, since part of the return measured in response to trading is price movement to the bid or ask, but also a function of the order depth around the quote. Insofar as price impact is considered by fund managers as lost return associated with a given amount of trading[52], it represents a broader obstacle for costless portfolio reallocation (Lang and Maffett (2011)). Moreover, the Amihud measure enables

[52]The rationale being that price is driven up by the initial purchase and down by the ultimate sale.

identification of DiD effects in the absence of sufficiently long bid-ask spread time series (as is the case for OTC trades). The fourth column in each case study can be interpreted as the price impact cost (as a percentage of original quoted price) of a 1000 Euro trade. As with standard deviation based measures and bid-ask spreads, the analysis is not informative about any significant impact of the introduction of the respective FTTs on market illiquidity proxied by the Amihud measure, on-exchange or OTC.

Consistently across the different metrics, there was a very large relative decline of volatility for both treatment and control groups in the aftermath of August 1st 2012 for France, which can be seen visually from the figure below. Yet, the differential between the two is not sufficiently large to be statistically significant. In contrast, the gap in average intraday volatility between Italian and Spanish high-market cap companies seems to narrow slightly around the entry into force of the FTT in March 2013.

These results are consistent with experimental evidence reported by Bloomfield et al. (2009), who use a laboratory market to investigate the behavior of uninformed traders in response to a securities transaction tax. While noise trading increases market depth and volume, and reduces bid-ask spreads, it curtails the ability of the market to adjust to new information. Under a transaction tax, both uninformed and informed trader activity gets reduced by approximately the same amount, leaving unaltered the impact of noise trading on the informational efficiency of the market.

Finally, it is worthwhile noting that alternative tax system designs can have important differential effects on market volatility and risk exposure. For example, OTC platforms were taxed more heavily than exchange markets in Italy under the pretext that it would constitute an incentive for market participants to move the bulk of their trading activities to lit markets - which are more transparent and under stricter regulatory conditions than the former. Such a shift in itself, by seemingly improving access to information and mitigating systemic risk exposure potential, may have contributed positively to capital markets efficiency beyond any impact (or lack thereof) on measured volatility as presented above.

A principal role of capital markets as intermediaries is to inform investors about the value of projects (firms, sectors, etc) so as to best reallocate funding resources from those ventures with lowest return potential to the most productive ones. One of the main signals provided for this purpose by capital markets is the correspondence of the price system to the fundamental expected returns associated with an asset. As hinted at by the volatility analysis above, a decline in asset liquidity could be associated with increased participant uncertainty about the fundamental value of the security. In part, this could be reflecting lower informational capacity of the market, where noise and true signals about fundamental values become more easily confounded. Loss of informativeness in these markets could then have important implications for the efficient intermediation of resource allocation in the economy; this is particularly true in a scenario such as the one of the present case study, as publicly-listed companies in the EU represent over two-thirds of aggregate output.

There is also a sizable literature linking idiosyncratic shocks to large market cap firms to a large share of variation in output and productivity over business cycles (Gabaix (2011)). Large firms may also be the most productive in the economy (Melitz and Ottaviano (2005)), exacerbating the welfare loss from misallocation of financial resources. Together with the impact of perceptions of stock market volatility for movements in macroeconomic variables, this is an important area of subsequent research, albeit outside the scope of this paper.

4 Policy Implications

The evaluation of the introduction of an asset-specific transaction tax reform such as the one described above has direct implications for our understanding of optimal taxation of financial activity. While a comprehensive design of a first-best tax structure in the sector is beyond the scope of this paper, there have been a few recent forays into this literature, among which I highlight Davila (2013), summarized in section 2. While the author proposes a closed-form solution for the optimal linear Pigouvian FTT, in practice we should consider not only the optimal tax from a corrective standpoint, but also with an objective of maximizing government revenue. The simple case where the government aims exclusively at maximizing revenues accruing from a linear tax with a tax base responsive to the tax rate gives us an optimal rate of $\tau^* = \frac{1}{1+\epsilon}$, where ϵ would be the elasticity of nominal volume transacted with respect to a change in the net of tax rate. In this context, the presence of avoidance behavior to an alternative taxed at rate $t \leq \tau$ will alter the optimal linear tax formula by adding an extra term to the numerator, such that $\tau^* = \frac{1+t \cdot s \cdot \epsilon}{1+\epsilon}$, where s is the fraction of the response due to income shifting (Saez et al. (2012)). Feldstein (1999) argues that if the alternative tax rate is 0, then it is irrelevant whether we observe "real" or avoidance responses. However, if $t > 0$, then $\tau^* > \frac{1}{1+\epsilon}$, due to the fiscal externality involved. At an optimum, $t{=}\tau$ and $\tau^* = \frac{1}{1+(1-s)\cdot\epsilon}$, where $(1-s)\cdot\epsilon$ corresponds to the "real" elasticity of trading volume (the "lock-in elasticity" in the present context). The optimal financial transaction tax rate depends also on other pre-existing taxes on financial assets, such as the more widespread capital gains or dividend taxes, which I abstract from in this version.

To get an idea of what the fraction of the observed response may be due to income shifting (s), I resort to a back-of-the-envelope computation for each country in the sample used here, drawing on the estimates from section 2.3. Specifically, we know both the original official estimates of government revenue accruing from the introduction of the tax, and the actual respective shortfalls (since actual receipts were much lower than anticipated). Assuming the original government estimates were predicated on purely mechanical factors[53], we can subtract the turnover decline in each

[53]Mechanical responses are understood as those excluding any of the behavioral responses identified in this paper, such as retiming and tax arbitrage.

market platform (multiplied by the respective average marginal tax rate) to compute behaviorally-corrected expected government revenue figures. In the case of France, original official estimates were for revenues of €530 million[54], in contrast to the actual receipts over that period of approximately €250 million[55]. Adding the permanent decline in regulated exchange turnover and the temporary anticipation effect OTC, we have

$$\begin{aligned} -45\% \cdot \text{OTC Aug 2011} \cdot 0.2\% - 24\% \cdot \text{Lit 2011} \cdot (0.01\% \cdot 40\% + 0.2\% \cdot 60\%) &= \text{-€165.7 million} \\ \Rightarrow \mathbb{E}_{Adjusted}\left(Revenues\right) &= \text{€}530m - \text{€}165.7m \\ &= \text{€364.3 million} \end{aligned}$$

For Italy, we correct the original estimates of €1 billion [56] for the decline observed OTC[57], which brings us closer to the actual lower receipts of €200 million:

$$\begin{aligned} -85\% \cdot \text{OTC 2012} \cdot 0.2\% &= \text{-€442.51 million} \\ \Rightarrow \mathbb{E}_{Adjusted}\left(Revenues\right) &= \text{€}1bn - \text{€}442.51m \\ &= \text{€557.49 million} \end{aligned}$$

We are thus able to account for $\frac{165.7}{280} = 59.18\%$ and $\frac{442.51}{800} = 55.31\%$ of revenue shortfalls in France and Italy, respectively. Therefore, a significant share of the shortfall measured can be attributed to income shifting of some form. The remaining unexplained difference could be due to changes in average asset prices over the years of reform, macroeconomic factors affecting either volume or prices, measurement error, or lags in revenue collection, among others.

The results described in this paper are thus suggestive that the true optimal FTT might be lower than expected when looking only at the response of market turnover to an increase in transaction costs. Of note, HFT-targeted taxing may be relatively less worthwhile from a revenue raising perspective, given the massive avoidance response estimated for this type of market participants in this paper. Yet, insofar as HFT may be socially inefficient, there may be Pigouvian grounds for the taxation of HFT trading. On the other hand, more comprehensive policy designs may actually invert the former recommendation. By setting positive tax rates for common income shifting categories and limiting legal loopholes, Italy's FTT design is likely to have weathered some of the revenue losses

[54] From August 1, 2012 through the end of that calendar year.

[55] I use the total euro value of trading volume (i.e., number of shares multiplied by closing daily price) for the affected companies in those same months in the preceding year (2011) as the ex-ante tax base. For the temporary anticipatory response OTC, the posited expected tax base is the total euro value of trading volume OTC in August. Note that I continue to use the assumed percentage of high-frequency trading in regulated markets of 40% to calculate the relevant average marginal tax rate.

[56] From March 1, 2013 through December 31, 2013.

[57] Using as the ex-ante tax base March through December 2012 trading volumes in euros.

characterizing the French experience, without incurring further first order efficiency losses. Such an argument (obviating from any further macroeconomic and fiscal externalities) would support the introduction of higher rates, as long as available shifting categories are also taxed. This rate would then be added to the optimal Pigouvian rate à la Davila (2013), since corrective taxes are additive with respect to optimal revenue raising taxes (Sandmo (1975); Kopczuk (2003)).

A few more insights arising from the empirical case studies are granted at this point. Firstly, comprehensive taxation across asset types and economically equivalent financial contracts is imperative to ensure compliance and avoid a shrinkage of the original tax base. Avoidance strategies are easily constructed to explore loopholes whenever tax-exempt instruments remain available. In this context, transactions that give rise to identical payoff patterns should be taxed at the same rates, in order to mitigate substitution possibilities[58][59]. In addition, mitigating avoidance involves guaranteeing cooperation across jurisdictions in enforcement of tax collection and reporting, even before considering cross-border tax harmonization[60]. Cooperation is also critical to avoid double-taxation.

Secondly, as capitalization of the tax is higher for assets with higher turnover[61], a non-linear tax schedule as a function of asset turnover may be preferable to a linear and strictly proportional schedule[62], with stepwise rates lower for more liquid markets.

Moreover, the likely overestimation of revenues accruing from the introduction of a FTT (due to underestimated behavioral effects documented above) can be exacerbated by fiscal externalities not yet addressed by policy makers or the transaction tax literature. Namely, avoidance of the FTT via deferred realization of stock sales and use of derivative contracts such as CFDs lowers the effective capital gains tax rate incurred by asset holders, and migration of capital transactions to foreign markets completely eliminates any capital gains tax revenues formerly accruing from such trades. It would be an interesting empirical exercise to investigate whether capital gains tax revenues were somehow adversely affected by the introduction of the FTT. On balance, the fiscal losses of CGTs may actually outweigh any perceived additional revenues from the FTT, further undermining the government revenue argument in its favor.

[58]See Campbell and Froot (1993).

[59]While CFDs are illegal in the US, other derivative strategies could still be used to circumvent a cash equity or fixed income FTT. Therefore, this recommendation is generalizable across legislative frameworks.

[60]This message is corroborated systematically in the securities transaction tax literature.

[61]As described earlier, this is a result of the fact that shorter holding periods allow for shorter amortization periods of the tax over the terminal asset value. In a world of liquidity clienteles, this differential is capitalized more heavily into more liquid assets.

[62]Virtually all securities transaction taxes currently in place are linear for a given asset type.

5 Conclusion and subsequent extensions

I find very small substitution responses to the introduction of an FTT (as measured by changes in asset returns), but impressively large avoidance responses. Especially, I find huge temporary shifts in timing of transaction realizations over-the-counter, a sharp lock-in effect of high-frequency trading, and an almost complete divergence of trading across platforms to exploit tax arbitrage opportunities. Overall, the behavioral responses measured in this paper suggest introducing financial transaction taxes with similar designs to those currently in place in France and Italy (especially the former), may be not be the best choice of tax instrument from a revenue raising perspective. However, such a tax may be welfare-enhancing as a Pigouvian tax if comprehensively designed to induce optimal trading behavior and mitigate avoidance loopholes.

At a subsequent stage, I would like to expand the current analysis to estimate the impact of the tax on cost of capital and corporate funding decisions. In both instances analyzed in this paper, equity became relatively more expensive as a means of funding relative to debt, so a priori we would expect this measure not only to hamper investment by large firms in France (and thereby macroeconomic growth), but also to incentive firms to leverage (assuming the cost of debt remains constant). Under a non-behavioral Matheson type of model, a 0.2% FTT would be estimated to increase cost of capital by a mere 0.5% at most, making it a second order consideration. Yet, Amihud and Mendelson (1992) conclude that 0.5% FTT could lead to a 1.33% increase in the cost of capital, due to the positive relationship between required rates of return and transaction costs. Evaluating changes in corporate funding decisions for the firms under the French FTT in the year following the reform (2013 and 2014, respectively) could shed light on the empirical validity of these conjectures.

A distributional analysis of the incidence of the tax is yet another relevant topic of future related research. If large institutional traders have access to a broader range of avoidance opportunities than non-institutional market participants (such as pension funds and retail clients), then the burden of the tax may fall disproportionately more on household savings, rather than reducing (as claimed by some policy-makers) excessive financial sector rents. From a generational perspective, elderly individuals are a priori more likely to bear a larger share of welfare losses, since they typically have relatively larger holdings of financial assets and a shorter investment horizon. In turn, this may have implications for the sustainability of funded annuity and pension plans, which have so far been ignored by the mainstream debate on the optimality of FTTs.

Finally, understanding the actual impact of FTTs on capital market efficiency and welfare per se merits further research. Davila (2013) has cast doubt into whether volatility measures are informative about welfare losses in capital markets. Instead, based on a model where belief dispersion among investors gives rise to suboptimal non-fundamental trading, he suggests the dispersion of expected returns across investors is the single sufficient statistic for the optimal linear financial transactions tax. In turn, Banerjee (2011) shows cross-sectional evidence in support of investor disagreement being positively related to return volatility. Therefore, one could use variance of total portfolio returns as a proxy for the amount of non-fundamental trading being exercised by a given investor/institution - the type of "speculative" activity that an optimal FTT ought to target, since it can affect it most directly.

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A Appendix

A.1 Baseline mechanical asset price effect

Matheson (2011) provides a basic partial equilibrium model of the impact of a proportional transaction tax on asset valuation. This model assumes no behavioral response to the tax and thus provides an upper bound on the valuation effect. Agents are homogenous, forward-looking and risk neutral and trade every N periods, where N is determined exogenously by assumption. The tax-inclusive price of a share to the buyer after implementation is then

$$V(0) = \int_0^N D_t e^{-rt} dt + (1-T) e^{-rN} V(N)$$

Iterating forward and assuming constant dividend growth rate g, she gets that

$$V(0) = \frac{D\left(1 - e^{-RN}\right)}{R\left[1 - (1-T) e^{RN}\right] \cdot \left(1 - e^{-rN}\right)}$$

where r is some discount rate, and $R = r - g > 0$. Thus the price reduction induced by the tax (the difference between the last expression and $\frac{D}{R}$) is an increasing and concave function of T.

For plain equity transactions, the liable party in both case studies is the net buyer, while for derivative contracts in Italy both parties are statutorily liable. Hence, there is an implicit assumption in what follows that the buyer has all the bargaining power in the bidding process, such that there is complete passthrough of the tax to the selling agent at the time of sale. In practice, given forward-looking agents, the price impact of the tax should be fully capitalized at announcement given perfect foresight of the implementation date. While an oversimplistic setup most clearly because of the ad-hoc trading frequency assumption, the Matheson (2011) setup could still provide an upper bound on the price decline we should expect to observe in the data - both due to the behavioral decline of turnover, but also due to the full impact of the tax to current asset holders being discounted by more the greater the anticipation period between announcement and implementation. Given an average holding period for the companies sampled of approximately 2.4 months, the expression above would give us an upper bound in the order of 20% decline in security values due to the tax, which as I show is well above the effective impact by several orders of magnitude, implying either expected reversal of policy, or a sizable behavioral adjustment. As shown in section 2.3, the latter is patent from the data.

B Tables

Table 1: Market Cap by Treatment Groups (Millions of Euros) - France

Treatment group		Quintiles of Market Cap					
		1	2	3	4	5	Total
Dutch & Belgian	Mean	1042	2044	3660	6863	42450	9163
	N	16	11	12	11	9	59
French	Mean	1290	2224	3723	6954	30583	9601
	N	18	23	21	23	24	109
Total	Mean	1173	2166	3700	6924	33819	9447
	N	34	34	33	34	33	168

Table 2: Turnover by Treatment Groups (% of outstanding shares) - France

Treatment group		Quintiles of Turnover					
		1	2	3	4	5	Total
Dutch and Belgian	Mean	0.09	0.25	0.39	0.58	1.01	0.45
	N	15	10	13	9	12	59
French	Mean	0.09	0.28	0.40	0.55	0.99	0.47
	N	19	24	20	25	21	109
Total	Mean	0.09	0.27	0.40	0.56	1.00	0.46
	N	34	34	33	34	33	168

Table 3: Market Cap by Treatment Groups (Millions of Euros) - Italy

Treatment group		Quintiles of Market Cap					
		1	2	3	4	5	Total
Spanish	Mean	708	1381	2214	5291	28156	8889
	N	14	6	14	10	15	59
Italian	Mean	805	1348	2237	4678	21850	5159
	N	12	19	12	15	10	68
Total	Mean	753	1356	2225	4923	25633	6892
	N	26	25	26	25	25	127

Table 4: Turnover by Treatment Groups (% of outstanding shares) - Italy

Treatment group		Quintiles of Turnover					
		1	2	3	4	5	Total
Spanish	Mean	0.17	0.40	0.67	0.96	1.76	0.78
	N	13	10	11	13	11	58
Italian	Mean	0.22	0.41	0.66	1.01	2.10	0.88
	N	13	15	14	12	14	68
Total	Mean	0.20	0.41	0.67	0.98	1.95	0.83
	N	26	25	25	25	25	126

Table 5: Diff-in-Diff French and Italian Small and HMCAP (On-Exchange)

	France		Italy		
	Abnormal Return February 27	Turnover Aug 1	Abnormal Return Oct 12	Abnormal Return Dec 21	Turnover Mar 1
Treatment Group	0.001	-0.088	0.005**	0.002	0.398
	(0.002)	(0.503)	(0.002)	(0.002)	(0.429)
Announcement date	0.003		0.000	0.005*	
	(0.002)		(0.003)	(0.002)	
Treatment Effect - Announcement	-0.006		-0.001	-0.009**	
	(0.004)		(0.005)	(0.004)	
Year		-0.515**			-0.015
		(0.210)			(0.170)
Month		0.173**			0.291***
		(0.083)			(0.106)
Month*Year		-0.676***			-0.063
		(0.117)			(0.186)
Month*Treated		-0.029			-0.184
		(0.114)			(0.148)
Year*Treated		0.381			-0.046
		(0.228)			(0.214)
Treatment Effect - Implementation		-0.006			-0.152
		(0.164)			(0.210)
r2	0.008	0.072	0.023	0.009	0.012
N	245	2117	255	357	3414

Standard errors in parentheses

Conceptually, the most intuitive test for the treatment effect of the introduction of the equity transactions tax in each country exploits the discontinuity in tax-treatment generated by different company size. Due to the small sample problems raised by such tests, however, these are our weakest set of evidence in support of a large significant effect of the FTT on market values and turnover.

Includes observations six days prior and following the event date.

Standard errors are clustered at the company level.

France counts 35 companies in this sample, 19 of which are in the control group.

Italy counts 52 companies in this sample, 27 of which are in the control group.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: French and Italian HMCAP (Domestic Exchange vs ADRs)

	France					Italy		
	AR Jan 12	AR Feb 7	AR Feb 27	AR Dec 1	Volume Aug 1	AR Oct 12	AR Dec 21	Volume Mar 1
Treatment Group	-0.001	-0.001	-0.004*	0.048*	3.865***	-0.001*	-0.000	5.602***
	(0.003)	(0.002)	(0.002)	(0.027)	(0.368)	(0.001)	(0.001)	(0.548)
Announcement date	0.005	0.004	-0.001	0.048		0.003	0.010*	
	(0.003)	(0.003)	(0.003)	(0.037)		(0.006)	(0.005)	
Treatment Effect - Announcement	-0.010***	-0.008***	0.005***	-0.087**		-0.006**	-0.009	
	(0.003)	(0.003)	(0.002)	(0.041)		(0.002)	(0.005)	
Year					0.310**			0.495*
					(0.146)			(0.245)
Month					0.336***			0.148
					(0.088)			(0.173)
Month*Year					-0.534***			-0.397*
					(0.139)			(0.225)
Month*Treated					-0.158*			-0.059
					(0.089)			(0.171)
Year*Treated					-0.275			-0.452*
					(0.174)			(0.254)
Treatment Effect - Implementation					-0.156			0.170
					(0.144)			(0.234)
r2	0.002	0.008	0.006	0.010	0.391	0.017	0.057	0.596
N	802	383	683	450	5397	92	154	2621

Standard errors in parentheses

Like the treatment discontinuity sample in Table 1, cross-asset estimation of the effect of FTTs is mired by the relatively small sample size.

Nonetheless, we identify significant asset value decline of French domestic assets.

Italian ADRs are included as a placebo control group in the rightmost three columns.

Includes observations six days prior and following the event date.

Includes stock-days for which there is both on-exchange and ADR trading data available.

Standard errors are clustered at the company level.

Samples consist of 40 and 25 companies with active (sponsored and unsponsored) ADRs for France and Italy, respectively.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: DiD French vs Dutch & Italian vs Spanish (Prices)

	France		Italy	
	Abnormal Return Feb 7	Abnormal Return February 27	Abnormal Return Oct 12	Abnormal Return Dec 21
Treatment Group	0.002	0.005**	0.001	0.004**
	(0.002)	(0.002)	(0.001)	(0.002)
Announcement date	0.007***	0.007***	-0.002	0.004
	(0.002)	(0.002)	(0.002)	(0.003)
Treatment Effect - Announcement	-0.010***	-0.010***	0.003	-0.008**
	(0.003)	(0.003)	(0.003)	(0.004)
r2	0.019	0.018	0.002	0.009
N	495	825	1227	915

Standard errors in parentheses

We find a significant negative effect of announcements over the introduction of a financial transactions tax in the order of 1% of daily returns of affected assets. We associate this effect with the asset substitution response of investors. This effect is much smaller than simplistic models of capitalization of transaction costs would have predicted.

Includes observations six months prior and following the announcement date, with an event window of 6 days around the latter.

Standard errors are clustered at the company level.

1st sample includes 109 French companies and 66 Dutch/Belgian.

2nd sample consists of 68 Italian companies and 59 Spanish.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: DiD French vs Dutch & Italian vs Spanish (Turnover by Quintiles)

	France											Italy
	Turnover Aug 1	Q1	Q2	Q3	Q4	Q5	T1	T2	T3	T4	T5	Turnover Mar 1
Treatment Group	0.152	-0.665	0.717	-0.359	0.561*	0.125	-0.617	0.091	-0.108	0.000	0.117	0.359
	(0.216)	(0.756)	(0.490)	(0.283)	(0.310)	(0.219)	(0.598)	(0.132)	(0.098)	(0.081)	(0.154)	(0.231)
Year	-0.030	-0.085	-0.007	0.040	0.044	-0.111**	-0.156	-0.175	0.082	-0.079	0.080	0.076
	(0.065)	(0.183)	(0.155)	(0.132)	(0.082)	(0.043)	(0.120)	(0.117)	(0.130)	(0.059)	(0.157)	(0.087)
Month	0.281***	0.143	0.346***	0.251**	0.417***	0.316***	0.249**	0.278***	0.336***	0.311***	0.247***	0.097**
	(0.043)	(0.108)	(0.072)	(0.105)	(0.063)	(0.081)	(0.108)	(0.088)	(0.095)	(0.095)	(0.082)	(0.043)
Month*Year	-0.471***	-0.206	-0.631***	-0.375**	-0.703***	-0.594***	-0.438***	-0.480***	-0.588***	-0.386***	-0.459***	-0.129**
	(0.057)	(0.128)	(0.072)	(0.152)	(0.080)	(0.062)	(0.146)	(0.136)	(0.112)	(0.085)	(0.107)	(0.058)
Month*Treated	-0.083	0.174	-0.145	-0.133	-0.279***	-0.080	0.039	-0.159	-0.001	-0.193*	-0.070	-0.009
	(0.055)	(0.185)	(0.089)	(0.127)	(0.074)	(0.097)	(0.192)	(0.103)	(0.106)	(0.103)	(0.097)	(0.069)
Year*Treated	-0.022	-0.031	-0.009	-0.025	-0.196	0.084	0.025	0.098	0.052	-0.005	-0.043	-0.012
	(0.085)	(0.229)	(0.211)	(0.154)	(0.194)	(0.061)	(0.233)	(0.139)	(0.154)	(0.074)	(0.187)	(0.115)
Treatment Effect	-0.279***	-0.631***	-0.255**	-0.301	-0.027	-0.038	-0.284	-0.252	-0.249*	-0.300***	-0.320**	0.010
	(0.071)	(0.209)	(0.103)	(0.185)	(0.094)	(0.095)	(0.246)	(0.153)	(0.123)	(0.096)	(0.136)	(0.083)
r2	0.032	0.040	0.082	0.081	0.099	0.141	0.052	0.205	0.197	0.268	0.141	0.018
N	11513	2317	2379	2272	2308	2237	2317	2308	2166	2414	2308	8325

Standard errors in parentheses

This table shows a triple difference-in-differences estimate of the impact of the implementation of a financial transactions tax on equity turnover. The results show very large and significant negative effects on trading volume of taxed assets. Furthermore, as discussed in the text, this detrimental impact is heterogeneous across firm size and liquidity.

Includes observations one month prior and following the event date. We difference treatment and control groups, months and years to ensure we take into account any possible seasonality or macroeconomic events biasing our results.

Standard errors are clustered at the company level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9: DiD French vs Dutch & Italian vs Spanish (Retiming: Lock-in vs Anticipation)

	France		Italy		
	Turnover Aug 1	Lock-in Aug 1	Turnover Mar 1	Lock-in Mar 1	Lock-in Jun 1
Treatment Group	0.152	0.095	0.359	0.320	0.398*
	(0.216)	(0.198)	(0.231)	(0.234)	(0.228)
Year	-0.030	0.118*	0.076	0.047	-0.028
	(0.065)	(0.061)	(0.087)	(0.104)	(0.116)
Month	0.281***	0.188***	0.097**	0.235***	-0.004
	(0.043)	(0.045)	(0.043)	(0.068)	(0.064)
Month*Year	-0.471***	-0.271***	-0.129**	-0.256***	0.186**
	(0.057)	(0.052)	(0.058)	(0.092)	(0.089)
Month*Treated	-0.083	0.125**	-0.009	-0.075	-0.150*
	(0.055)	(0.056)	(0.069)	(0.088)	(0.080)
Year*Treated	-0.022	-0.035	-0.012	0.149	-0.015
	(0.085)	(0.082)	(0.115)	(0.136)	(0.147)
Treatment Effect	-0.279***	-0.195***	0.010	-0.012	-0.206*
	(0.071)	(0.070)	(0.083)	(0.116)	(0.104)
r2	0.032	0.008	0.018	0.023	0.015
N	11513	11182	8325	8452	8843

Standard errors in parentheses

We look at the short-term (one-month before and after reform) and long-term (two months before and after) turnover decline in taxed assets. The results presented here are consistent with a persistent detrimental effect of the tax on trading volumes on registered exchanges in France (rather than anticipatory retiming around the date of implementation), and no (apparent) effect on Italian exchanges.

Includes observations one month prior and following the event date.

Standard errors are clustered at the company level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10: DiD French vs Dutch & Italian vs Spanish (Trades)

	France		Italy	
	Turnover Aug 1	Trades Aug 1	Turnover Mar 1	Trades Mar 1
Treatment Group	0.152	0.025	0.359	0.296
	(0.216)	(0.304)	(0.231)	(0.285)
Year	-0.030	-0.052	0.076	0.038
	(0.065)	(0.058)	(0.087)	(0.071)
Month	0.281***	0.219***	0.097**	-0.022
	(0.043)	(0.038)	(0.043)	(0.043)
Month*Year	-0.471***	-0.382***	-0.129**	-0.037
	(0.057)	(0.053)	(0.058)	(0.047)
Month*Treated	-0.083	-0.102**	-0.009	0.102*
	(0.055)	(0.044)	(0.069)	(0.060)
Year*Treated	-0.022	-0.037	-0.012	-0.040
	(0.085)	(0.069)	(0.115)	(0.092)
Treatment Effect - Implementation	-0.279***	-0.232***	0.010	-0.095
	(0.071)	(0.062)	(0.083)	(0.069)
r2	0.032	0.016	0.018	0.010
N	11513	11342	8325	8017

Standard errors in parentheses

This table supports the claim that the bulk of the post-FTT reduction in trading volume was driven by a smaller number of trades executed daily, rather than smaller transaction sizes.

Includes observations one month prior and following the event date.

Standard errors are clustered at the company level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Diff-in-Diff Italian vs Spanish and French vs Dutch HMCAP (OTC)

	France			Italy
	Aug 1 2012	Lock-in Aug 1	Mar 1 2013	Lock-in Mar 1
Treatment Group	-0.138	-0.037	0.158	0.339
	(0.308)	(0.309)	(0.239)	(0.265)
Year	0.054	0.106	-0.343**	-0.662***
	(0.082)	(0.086)	(0.140)	(0.191)
Month	0.418***	0.301***	0.211***	0.304**
	(0.099)	(0.071)	(0.065)	(0.126)
Month*Year	-0.562***	-0.203**	-0.057	0.261
	(0.099)	(0.102)	(0.115)	(0.174)
Month*Treated	-0.314***	-0.140	-0.085	-0.269*
	(0.112)	(0.103)	(0.089)	(0.158)
Year*Treated	0.528***	0.161	0.317*	0.447**
	(0.102)	(0.115)	(0.178)	(0.224)
Treatment Effect (Interaction)	-0.296**	-0.019	-1.893***	-2.013***
	(0.125)	(0.135)	(0.188)	(0.247)
r2	0.022	0.004	0.119	0.108
N	9020	8825	7661	7741

Standard errors in parentheses

The detrimental effect of the transaction taxes measured by our triple difference-in-differences estimation is even more pronounced when we look at the behavior in over-the-counter platforms.

In Italy, OTC trading in taxed assets dropped permanently by 85%, while in France the observed decline of 26% represented pure anticipation of transactions to the month preceding tax enactment.

Includes observations one month prior and following the event date.

Standard errors are clustered at the company level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Volatility Effect - French vs Dutch & Italian vs Spanish HMCAP (Exchange)

	France				Italy			
	Last Price S.D.	Intraday Price S.D.	Bid ask spread	Amihud	Last Price S.D.	Intraday Price S.D.	Bid ask spread	Amihud
Treatment Group	-0.127	0.495***	0.010	0.002	-0.133	-0.481**	-0.116*	0.001
	(0.868)	(0.149)	(0.051)	(0.002)	(0.081)	(0.189)	(0.061)	(0.008)
Year	-0.097	-0.070		0.013	0.093	0.074	0.051	-0.003
	(0.193)	(0.044)		(0.010)	(0.092)	(0.061)	(0.039)	(0.004)
Month	0.439**	0.583***	-0.021**	0.037	0.074	0.059*	0.031	0.000
	(0.174)	(0.031)	(0.009)	(0.035)	(0.056)	(0.030)	(0.020)	(0.001)
Month*Year	-0.929***	-0.740***		-0.042	-0.031	-0.125***	-0.020	0.006
	(0.321)	(0.041)		(0.041)	(0.047)	(0.039)	(0.026)	(0.007)
Month*Treated	-0.127	-0.093**	0.024	-0.034	-0.056	-0.085*	0.046	-0.007
	(0.228)	(0.044)	(0.015)	(0.035)	(0.058)	(0.045)	(0.041)	(0.006)
Year*Treated	1.635	-0.032		-0.006	-0.074	-0.107		-0.003
	(1.659)	(0.056)		(0.011)	(0.096)	(0.086)		(0.007)
Treatment Effect (Interaction)	-0.244	0.046		0.049	0.000	0.198***	-0.047	-0.000
	(0.497)	(0.052)		(0.042)	(0.063)	(0.059)	(0.043)	(0.009)
r2	0.004	0.111	0.001	0.001	0.021	0.047	0.016	0.001
N	696	15232	7530	14111	508	8010	6080	7952

Standard errors in parentheses

This table presents evidence of little or no net effect of the transactions tax on standard measures of stock market volatility. The results presented cannot reject the hypothesis that the actual impact may have been heterogeneous across more low-latency (and arguably efficiency-relevant) measures of volatility.

The standard deviation of closing prices, intraday prices, and the average bid-ask spread are intended to capture aggregate price dispersion.

In addition, the Amihud liquidity measure is meant to capture realized scaled volatility.

Includes observations one month prior and following the event date (enactment of the tax).

Standard errors are clustered at the company level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Volatility Effect - French vs Dutch & Italian vs Spanish HMCAP (OTC)

	France				Italy			
	Last Price S.D.	Intraday Price S.D.	Bid ask spread	Amihud	Last Price S.D.	Intraday Price S.D.	Bid ask spread	Amihud
Treatment Group	-0.051	0.437***	0.015	-0.001	-0.185**	-0.766***	-1.286***	-0.002
	(0.590)	(0.154)	(0.023)	(0.001)	(0.086)	(0.184)	(0.075)	(0.002)
Year	-0.080	-0.076		-0.001	0.121	-0.058		0.001
	(0.139)	(0.052)		(0.001)	(0.117)	(0.088)		(0.001)
Month	1.163	0.533***	0.009	-0.001	0.095	0.102**	0.059**	-0.002
	(0.717)	(0.041)	(0.016)	(0.001)	(0.070)	(0.048)	(0.028)	(0.002)
Month*Year	-1.548**	-0.809***		0.001	-0.078	-0.139*		0.008
	(0.751)	(0.053)		(0.001)	(0.058)	(0.082)		(0.008)
Month*Treated	-0.959	-0.054	0.016	0.004	-0.062	-0.080	-0.059**	0.002
	(0.721)	(0.048)	(0.017)	(0.002)	(0.072)	(0.062)	(0.028)	(0.002)
Year*Treated	0.045	0.009		0.003*	-0.098	0.055		
	(0.178)	(0.066)		(0.002)	(0.119)	(0.107)		
Treatment Effect (Interaction)	0.800	-0.041		-0.006*	0.049	-0.061		-0.009
	(0.762)	(0.062)		(0.003)	(0.071)	(0.125)		(0.008)
r2	0.020	0.108	0.007	0.001	0.034	0.080	0.720	0.002
N	656	11256	5244	11323	569	7151	1694	6474

Standard errors in parentheses

This table reproduces the tests for volatility change for over-the-counter prices. While still not able to reject clearly the lack of an effect on aggregate volatility measures, we find some evidence that OTC volatility may have declined somewhat relative to pre-reform levels.

Includes observations one month prior and following the event date.

Standard errors are clustered at the company level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

C Figures

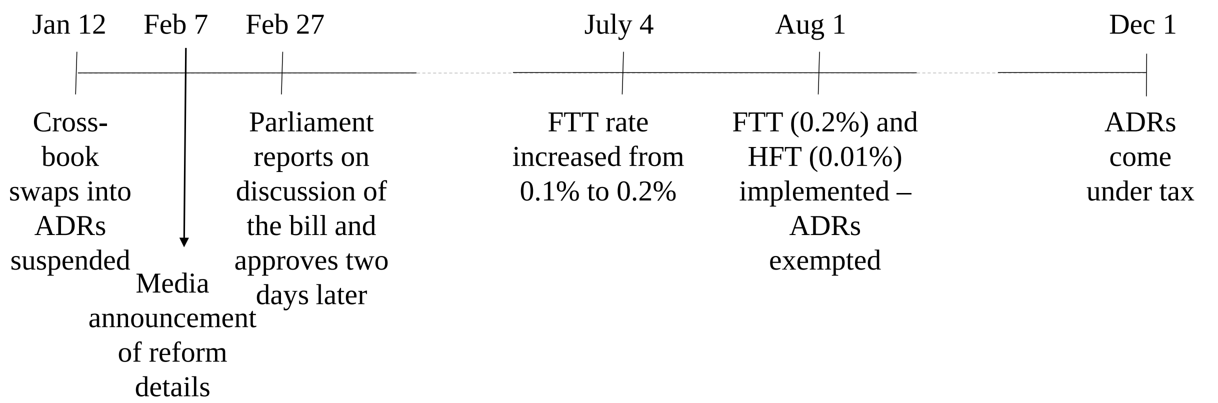

Figure C.1: Timeline of events - France, 2012

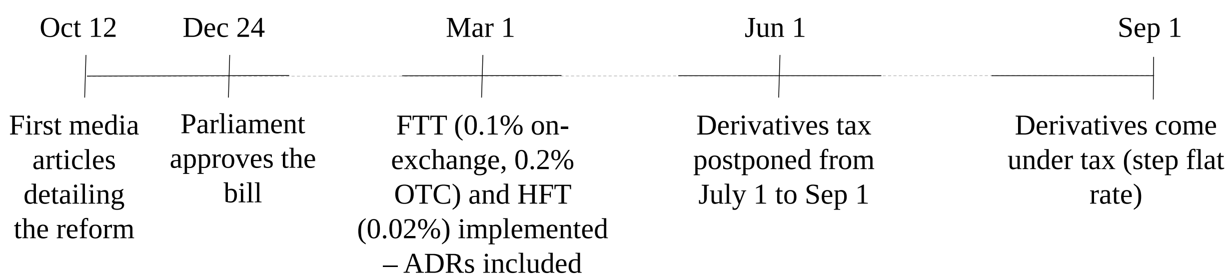

Figure C.2: Timeline of events - Italy, 2012-2013

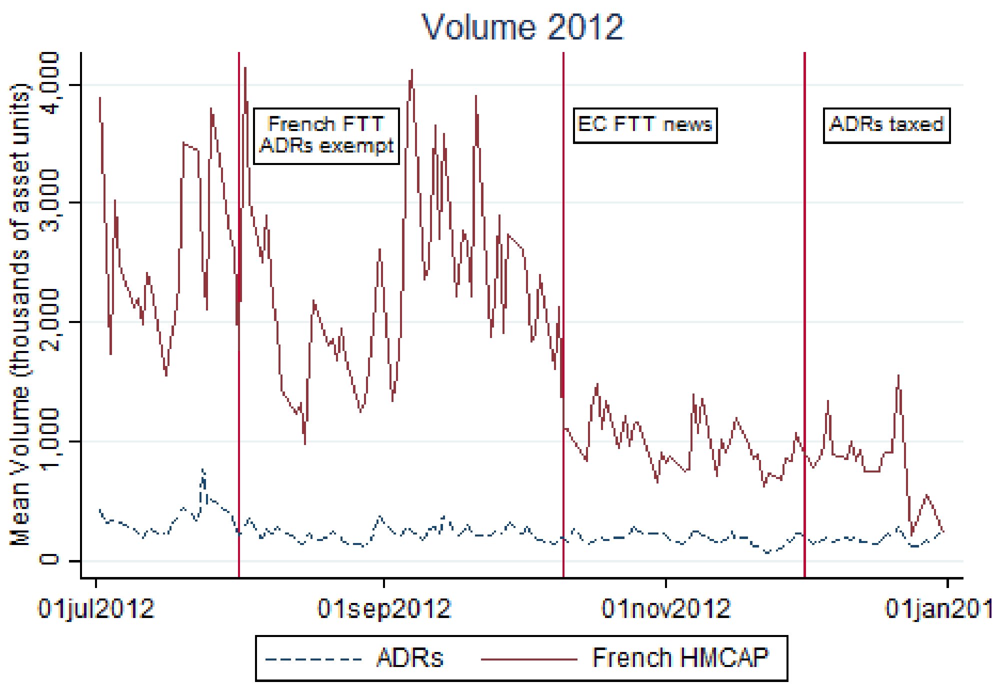

Figure C.3: France: ADR vs domestic treatment group trading volume, 2012

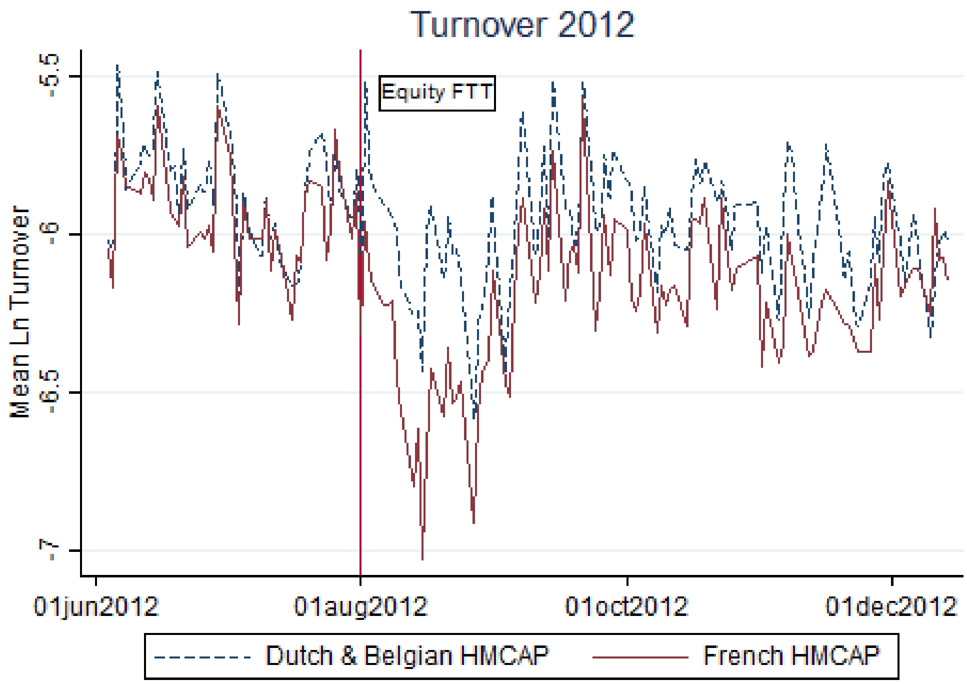

Figure C.4: France: High-market cap Dutch and Belgian vs French turnover, 2012

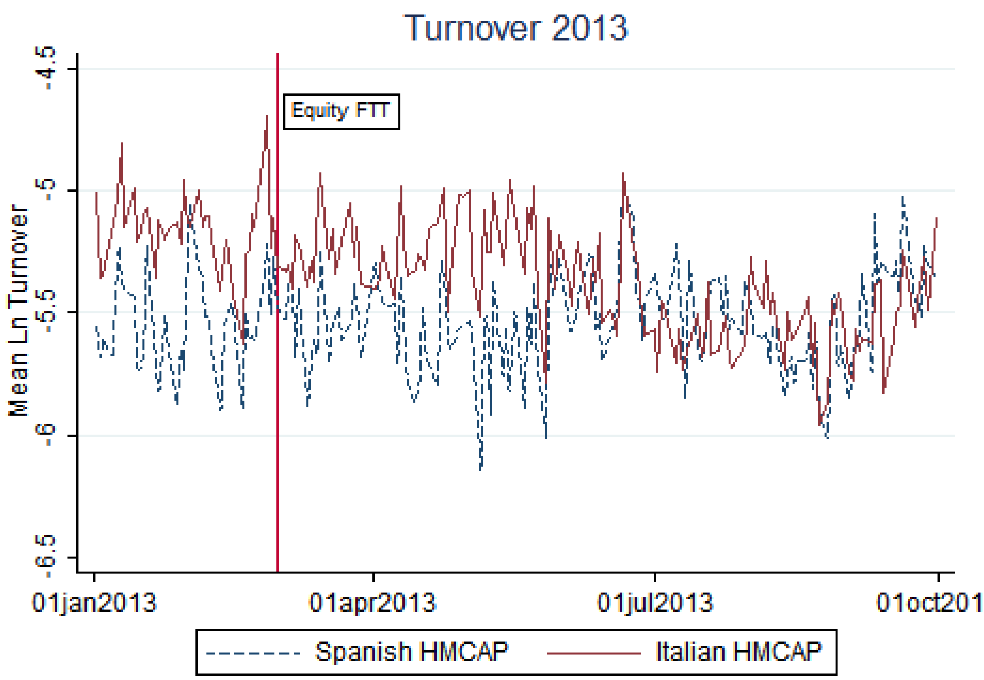

Figure C.5: Italy: High-market cap Spanish vs Italian turnover, 2013

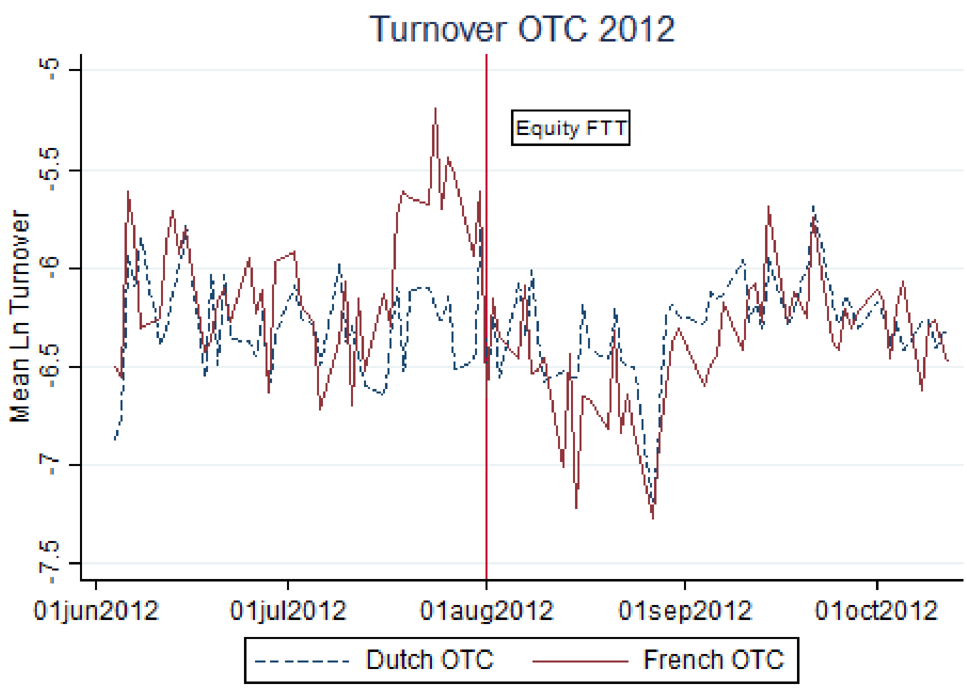

Figure C.6: France: Turnover OTC, 2012

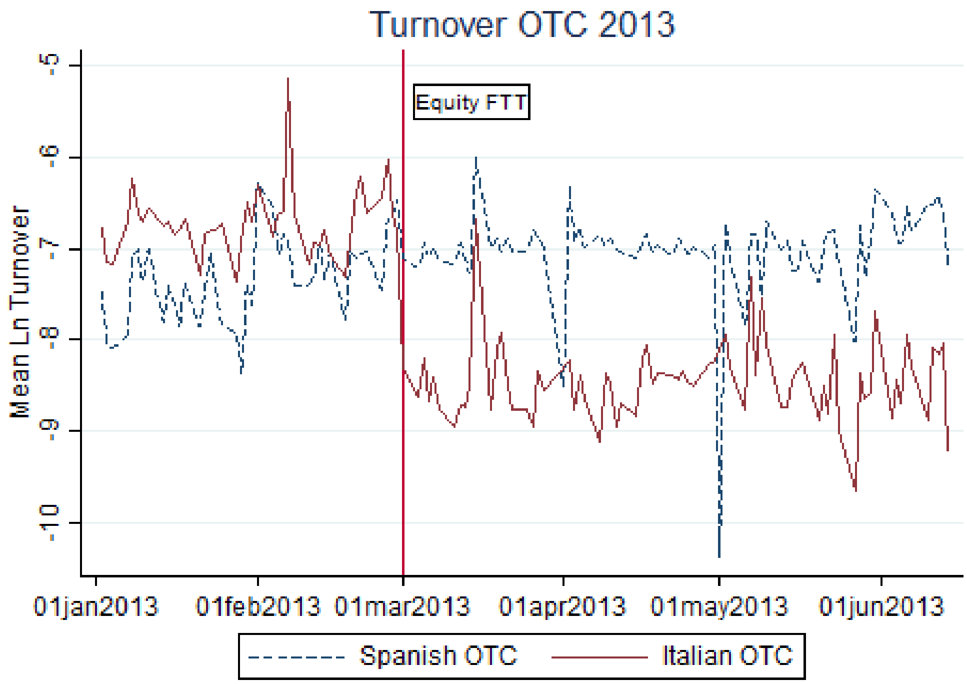

Figure C.7: Italy: Turnover OTC, 2013

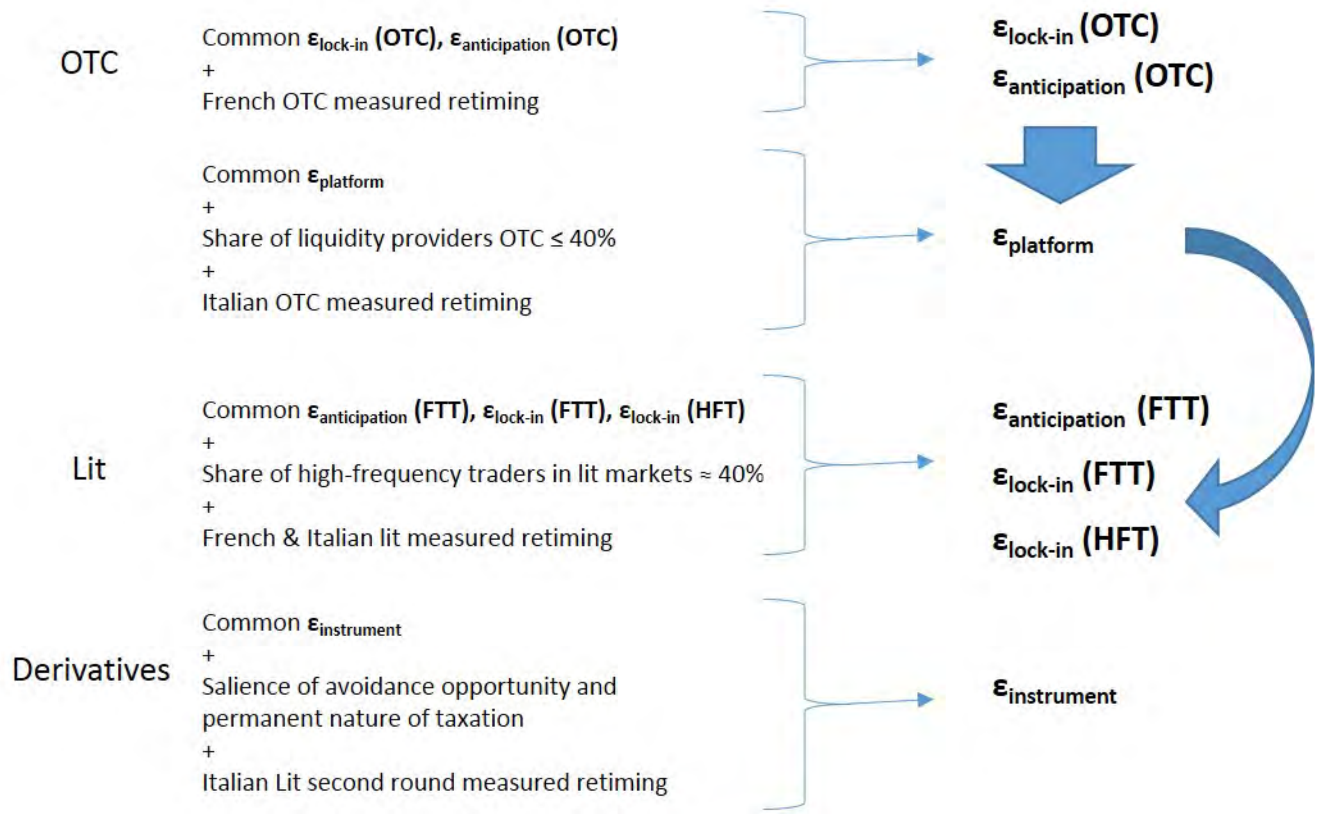

Figure C.8: Behavioral Elasticities Identification Diagram

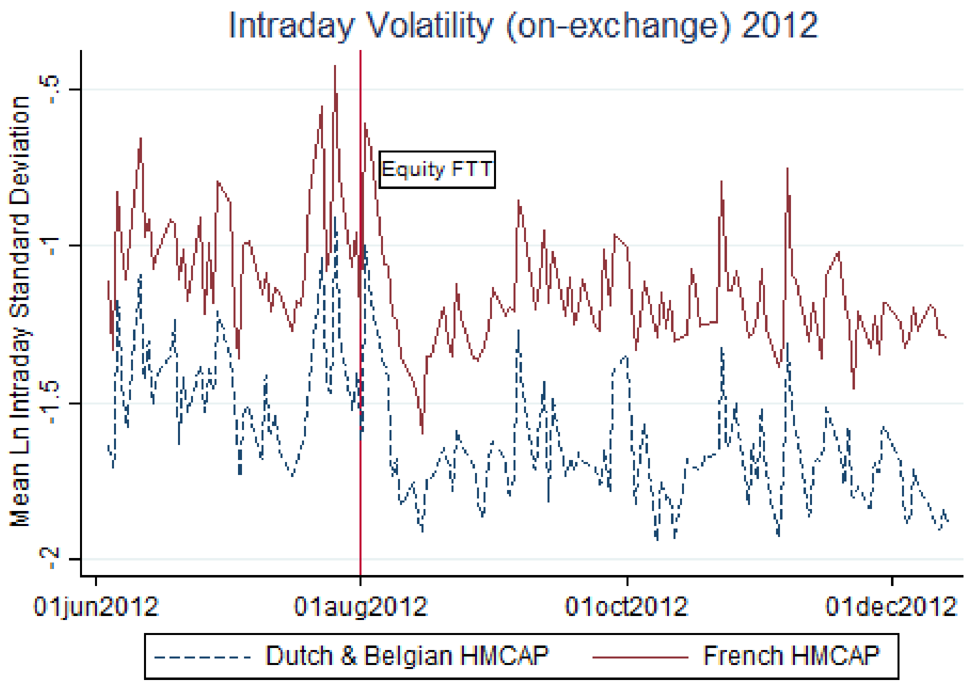

Figure C.9: France: Intraday Price Volatility (s.d., on exchange), 2012

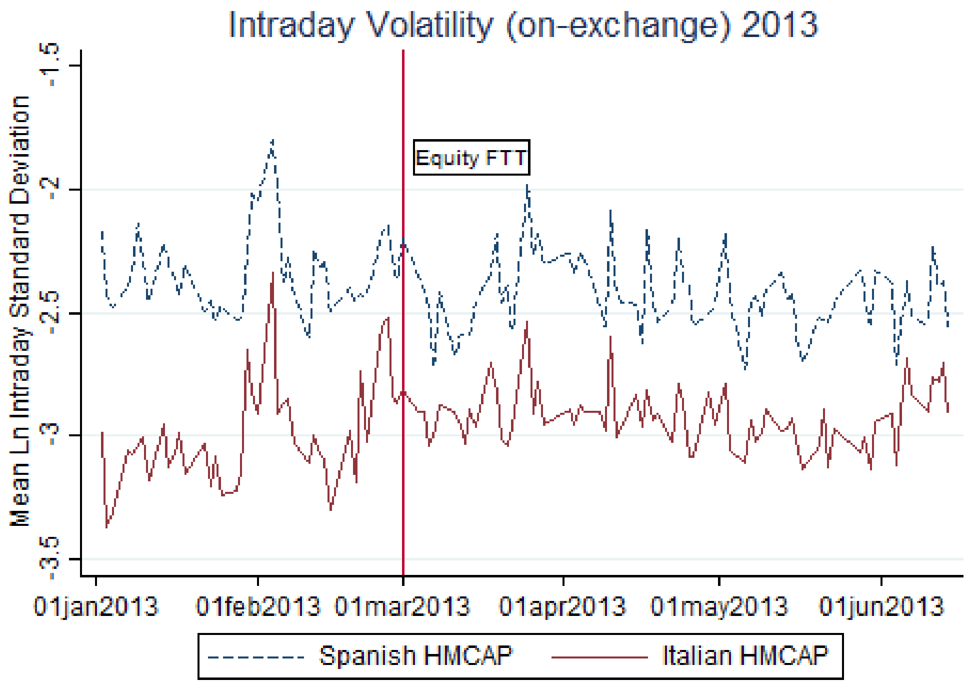

Figure C.10: Italy: Intraday Price Volatility (s.d., on exchange), 2013