The Effect of Financial Transaction Tax on Market Liquidity and Volatility: An Italian Perspective

by

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Abstract

This paper investigates the effect of the Financial Transaction Tax announcement, 29 December 2012, and the tax introduction, 1 March 2013, on the liquidity and volatility of the affected Italian stocks. The paper examines two-month windows of daily observations before and after each event. To assess the change in liquidity in pre- and post-event samples, the Mann-Whitney U-test for the equality of medians is employed, while for the assessment of volatility change, we apply the Levene test and its modifications for homogeneity of variances. The paper documents that the announcement of the tax positively affects market liquidity, whereas there is a dramatic decrease in liquidity as a result of tax introduction. It implies that the trading costs of the affected equities decrease after the tax announcement and significantly increase after the tax introduction events. As for volatility, the results mainly indicate no statistically significant changes between the pre- and post-tax announcement and introduction events.

JEL Categories: H250, G280, G180.

Keywords: Financial transaction tax, Volatility, Liquidity, Market capitalisation.

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1 Introduction

In 2007 - 2008, the world experienced one of the worst financial crises since 1930, which led to the failure of some financial institutions and to many others being bailed out by their governments (Hull, 2015). As a result of government support, to meet the costs of future crises, policy makers proposed several ways to raise revenues from the financial sector by imposing levies on financial institutions and additional tax instruments (Matheson, 2011). Thus, the already existing Financial Transaction Tax (FTT) policy has widely renewed its attention from regulators and researchers. The prevalence of FTT can also be seen from the fact that 11 countries of the European Union adapted new regulation rules for common FTT law (European Commission, 2011). Furthermore, various types of FTT already exist in approximately 30 countries in the world, including the United Kingdom, France, Italy, China and Brazil (Capelle-Blancard and Havrylchyk, 2014). Depending on state policy, FTT could be imposed on derivatives and/or the stock market. For instance, Matheson (2011) distinguishes several common types of FTT among which the security and currency transaction taxes are outlined.

The notion of FTT has been subject to extensive debate concerning its merits for decades. One of the first arguments regarding FTT usually refers to Keynes (1936) and Tobin (1978) who advocate the idea of tax imposition on financial transactions. Keynes (1936) argues that because many traders are motivated by short-term speculations and not by fundamentals, the imposition of FTT would discourage speculative trading and thus reduce wasted resources and stock price volatility. In addition, Tobin (1978) introduces a one-percent tax on all foreign exchange transactions, claiming that it would make short-term speculations with currencies unreasonable and reduce cross-border capital flow. Other proponents of the idea, Stiglitz (1989) and Summers and Summers (1989), claim that noise traders are the main obstacle for asset prices to follow their fundamentals that destabilise financial markets. They believe that FTT could discourage noise traders and hence mitigate asset price volatility. On the other hand, opponents such as Schwert and Seguin (1993) and Kupiec (1996) state that speculation is a stabilising aspect of the financial market because it increases liquidity of asset prices. Thus, they argue that the introduction of FTT will decrease the liquidity of asset prices and consequently amplify volatility.

However, there are several papers in the literature that demonstrate no effect of the imposition of FTT on market behaviour. Bloomfield et al. (2009) carry out an experiment to examine the impact of transaction cost increase in a form of tax on bid-ask spreads of stock prices. They conclude that an increase in transaction costs has no effect on spreads and thus that there is no change in liquidity. They explain this result by stating that the tax is an obstacle for trading not only for noise traders but also for rational members. In addition, Roll (1989) and Saporta and Kan (1997) argue that there is no relationship between the introduction of FTT and the volatility of asset prices.

Because the views do not reach a consensus, it is important to research this area of study and examine the effect of FTT on market quality. This paper studies the introduction of FTT on equity securities executed on exchange in Italy by analysing the impact of the FTT announcement and imposition on market liquidity and volatility. The Italian FTT was introduced by the Stability Bill (Law 228) on 24 December 2012 and was then published on 29 December 2012 in the Italian Official Gazette (di Wiesenhoff and Egori, 2013). The tax is applicable to shares traded on exchange and OTC (over-the-counter) issued by Italian resident companies with 500 million Euros or above market capitalisations from 1 March 2013 onwards. Both shares traded on exchange and OTC are taxable at a rate of 0.12% and 0.22%, respectively, for 2013 and 0.1% and 0.2% for 2014 and onwards. The list of exempted companies was published by the Ministry of Economy and Finance of Italy twice: in November 2012 as well as in February 2013 (di Wiesenhoff and Egori, 2013; Coelho, 2015).

A similar type of tax on financial transactions had already been imposed in France in 2012, and since then, some empirical studies such as the EU Commission (2013), Colliard and Hoffmann (2015), Becchetti et al. (2013) and Capelle-Blancard and Havrylchyk (2014) have investigated the effect of the tax on market liquidity and volatility in France; Coelho (2015) identifies a large tax avoidance response in both France and Italy.

The present paper makes the following contributions to the literature. First, this paper examines the effect of the announcement and imposition of Italian FTT on market liquidity and volatility. Second, given the conflicting results obtained by several authors using difference-in-difference methodology, we implement an alternative method of Levene's test statistic and its modified measures to evaluate the effect on volatility, while for the impact on liquidity measured as bid-ask spreads, we use the Mann-Whitney U-test statistic for the equality of medians, motivated by Baltagi et al. (2006). Both tests are found to be robust against non-normality in the financial series (Baltagi et al., 2006; Nachar, 2008). Finally, we construct and analyse joint as well as size-sorted decile portfolios from affected stocks traded in the Italian main exchange, weighting them by two different schemes, which helps us to provide a detailed and comprehensive robustness check.

Using daily data with two months prior to and two months after the announcement and introduction events, our study indicates that there is a modest increase in liquidity after the date of the announcement, while liquidity decreases dramatically after the tax introduction event. In contrast, any changes in volatility measures are found to be not statistically significant as a result of both the announcement and introduction of FTT events. The results support the predictions of Kupiec (1996) regarding the increase of market liquidity after the announcement of FTT. As for volatility, the insignificant results are consistent with most of the recent empirical studies on the French FTT, namely Colliard and Hoffmann (2015), Capelle-Blancard and Havrylchyk (2014) and Coelho (2015).

The rest of the paper is organised as follows. Section 2 provides the empirical literature review. Section 3 describes the methodology and data. Section 4 reports the obtained results. Section 5 concludes.

2 Background literature

Empirical research on the effect of Financial Transaction Tax usually focuses on three key factors: volatility, liquidity and asset prices. Because the effect of FTT on market liquidity and volatility are the main concerns to investors, many researchers focused their attention mainly on these two parameters in the literature. The most significant previous studies in this area are divided into two parts, namely, general literature on the effect of FTT on market quality in different parts of the world and more recent research of limited FTT imposed in France and Italy on asset price liquidity and volatility.

Worldwide research on transaction costs (including FTT).

The effects of FTT on market quality in different countries are diverse, and a few even show contradictive results. The introduction of FTT in approximately half of the considered studies below shows no effect on volatility; the other half concludes that FTT affects volatility positively, while Foucault et al. (2011) observe a decrease in volatility as a consequence of rising transaction costs. In contrast, in regard to the effect of FTT on liquidity, the papers mainly state a negative relationship between the introduction of tax and market liquidity.

One of the earliest works that examines the relationship between FTT and asset price volatility is presented in Roll (1989). This paper examines the effect of various regulations, including FTT, on price volatility in 23 different countries, four of which do not have any type of FTT. The data cover the pre- and post-1987 crash period where the standard deviation of returns regressed on price limits, margin requirements and trading taxes in 23 countries using the OLS method. The coefficients on the FTT variable are all negative but are not statistically significant, suggesting no impact of FTT on price volatility. Saporta and Kan (1997) investigate the effect of STT (stamp duty) on the UK all-FTSE index return volatility using daily data between 2 January 1969 and 22 November 1996, weekly data between 8 January 1965 and 21 June 1996 and monthly data from January 1955 to December 1995 share (all-FTSE index), and they conclude that changes in stamp duty do not have any impact on volatility. Hu (1998) studies the effect of STT on asset price volatility and turnover from the Asian perspective considering countries such as Hong Kong, Japan, Korea and Taiwan; Hu (1998) uses weekly data between 1975 and 1994. By comparing the means of turnovers before and after the introduction of tax event, Hu (1998) states that there are no significant changes. The method for volatility compares the standard deviations of returns before and after the transaction tax change where the null hypothesis equates the standard deviation of the period with the high tax rate to the standard deviation with the low tax rate. The author uses two types of volatility, namely market and idiosyncratic volatilities, where in the latter, the portfolios are sorted by size. The overall results show that the tax rate increase has no significant impact on volatility. In addition to the Asian perspective, Chou and Wang (2006) examine the effect of the reduction of tax on trading volume, bid-ask spreads and price volatility in Taiwan, which occurred in May 2000 using intraday and daily TAIEX futures data between 1 May 1999 and 30 April 2001. The volatilities are measured using an estimator of Andersen et al. (2001) for realised volatility and a high-low estimator of Parkinson (1980). These measures are used in a three-equation structural model mainly regressing each of the three parameters (trading volume, bid-ask spread and volatility) on the other two and own lagged values. Overall, the paper also comes to the conclusion that the tax reduction has no significant impact on price volatility but negatively affects liquidity. Analysing the US market, Pomeranets and Weaver (2011) study the impact of STT on stock liquidity and volatility using daily closing prices of the New York Stock Exchange (NYSE), the American Stock Exchange (AMEX) and the National Association of Securities Dealers Automated Quotations (NASDAQ) between 1932 and 1981, covering nine tax rate change regimes. The paper follows the portfolio approach of Jones and Seguin (1997) by comparing the portfolio of the NYSE/AMEX with NASDAQ stocks and calculates the volatility measure of Johnson and Kotz (1970), while for the liquidity parameter, they use the Amihud (2002) illiquidity measure. As a result, they show no consistent relationship between changes in transaction taxes and volatility, whereas their study indicates a negative impact of FTT on liquidity.

However, some researchers observe an increase in volatility after the introduction of FTT. Umlauf (1993) is one of the first to show this increase, using the Swedish market for the analysis. The data consists of daily and weekly Swedish all-share index returns from 1980 to 1987, including two tax rate increase announcements in the period. After the increase of the tax rate from 1% to 2% in 1986, 11 Swedish companies migrated to London. Umlauf (1993), therefore, compares the volatilities of these 11 companies' shares and those of the remaining companies in Sweden affected by tax. The result shows higher volatility for the Stockholm-based shares compared with their London-based counterparts. A few years later, a supplementary study to Umlauf (1993) by Jones and Seguin (1997), in contrast, studied the effect of tax reduction in US stock exchanges on price volatility. The daily data of NYSE/AMEX and NASDAQ used in the analysis are from one year prior and one year after the implementation of tax reduction on 1 May 1975 in the US stock exchanges. By using difference-in-difference approach changes in volatility for NYSE/AMEX, portfolios are compared with changes in volatility for the control NASDAQ portfolios. As a consequence, consistent with Umlauf (1993), Jones and Seguin (1997) conclude that the reduction in the transaction costs decreases stock return volatility. Baltagi et al. (2006) investigate the impact of a tax rate increase from 0.3% to 0.5% on trading value and price volatility in China on 10 May 1997. Shanghai and Shenzhen A level daily share indices are used in the period between 11 November 1996 and 10 November 1997. The change in trading value is tested using a two sample *t*-test, while the volatility change before and after the tax rate increase is assessed using the Levene statistics (Levene, 1960) as well as its modified estimators. The results suggest that trading value decreases and prices become more volatile after the increased tax rate. Additionally, Hau (2006) examines the volatility changes in the French stock market as a result of transaction costs increase between 1995 and 1999. The data consist of hourly intraday data for 26 stocks mostly from the CAC 40 index. Using panel regressions, Hau (2006) concludes that the volatility of stocks increases as transaction costs rise. Similarly, Phylaktis and Aristidou (2007) analyse the Greek stock market examining the effect of STT on volatility. They use daily the All-Share Index and the FTSE/ASE 20 Index in the period between 24 September 1997 and 31 December 2003, within which several STT changes in Greece occurred. To estimate the tax change impact on volatility GARCH-M and EGARCH-M models are used, and it is concluded that the STT rise increases volatility, particularly during the bull period for both index data. Using another GARCH model modification, namely AC-GARCH (asymmetric and component), Liau et al. (2012) analyse daily TAIEX futures data by comparing pre- and post-tax reduction periods between 21 July 1998 and 31 December 2007 in Taiwan. The results also show that the volatility in low tax periods is smaller compared with that of high tax periods. Further, the effect of transaction costs on exchange rate volatility is investigated by Lanne and Vesala (2010). They use Deutsche Mark–Dollar (DM/$) and Yen–Dollar (Yen/$) exchange rate intradaily data between 1 October 1992 and 30 September 1993 regressing on daily and intradaily equations. For the daily regression analysis realised variances are estimated and regressed on transaction costs and some control variables, while to analyse the intraday exchange rate quotations, the Flexible Fourier form regression (Galant, 1981) is employed. According to their results, an increase in transaction costs leads to higher volatility. Another study by Sinha and Mathur (2012) investigates the impact of an increase of STT from 0.1% to 0.125% on share price volatility in India using daily S&P CNX 500 index data one year prior to and after the implementation of the tax occurred on 1 June 2006. They employ a switching first order autocorrelation model and conclude that tax rise results in an asset price volatility increase.

In contrast, Foucault et al. (2011) examine the French reform which raised transaction costs in the forward market for noise traders and, using a difference-in-difference approach, conclude that market liquidity and volatility are significantly reduced as a result of the reform. Interestingly, the decrease in one of the volatility measures is also spotted by Green et al. (2000) using the London Stock Exchange data. The research is based on a long-run dataset covering the period of monthly data from 1870 to 1986 and identifies the effect of transaction costs on separate volatility measures such as market volatility, fundamental volatility and excess volatility. The data used in the paper consists of share price indices divided into three parts: the Green et al. (1996) index of 175 industrial and utility shares between 1866 and 1930, the Actuaries' Investment index of 140 industrial and utility shares from 1930 to 1962, and the Financial Times Actuaries index of 500 industrial shares from 1962 to 1986. Market volatility is calculated as the standard deviation of returns, while the fundamental volatility is measured as the standard deviation of difference between the discount rate and dividend yield. Excess volatility is given as the excess of the market volatility over the fundamental volatility. Using the OLS method, all these volatilities are then regressed separately on the model, including all of the components of lagged volatilities and transactions costs to check the importance of these costs via their parameters. The results show that transaction cost variables are collectively significant in all of the equations. The coefficients of transaction costs variables in market and excess volatility equations show uniformly positive signs, whereas the same transactions costs have equally uniformly negative signs in the equations of fundamental volatilities. These results indicate that there is a significant impact of transactions costs on price volatility, while the effect depends on the type of volatility. The feedback is positive for market and excess volatilities, suggesting an increase in volatility as a result of increase in transactions costs, whereas the opposite is true for fundamental volatility.

French and Italian FTT studies.

There are several papers in the literature that investigate the unique types of FTT imposed in 2012 and 2013 in France and Italy, respectively. The taxes are different because they do not affect all of the shares traded in these countries. For example, French FTT applies to stock trading of the companies of a minimum market capitalisation of 1 billion EUR, while for Italy, it is only for company shares with a minimum of 500 million EUR market capitalisation.

One of the first analyses of the effect of French FTT on trading volume and price volatility is given by the EU Commission (2013). The paper uses the period of one year prior to the tax policy change and 6 months after that date, analysing 108 large taxed companies' shares and 35 large taxed companies' shares of the CAC 40. Employing a difference-in-difference estimation, several untaxed company shares, such as DAX 30, 40 Italian companies and other French untaxed companies, are used as control groups. The results show that although the volume of trades decreased after the tax rate rise, there is no effect on the volatility parameter. Similarly, Colliard and Hoffmann (2015), relying on difference-in-difference methodology, compare trading volumes, bid-ask spreads and volatilities of shares of taxed French companies with the shares of non-taxed Dutch and Luxembourg companies. The intraday data are used for a period of two months prior to and three months after the FTT introduction. The results are consistent with EU Commission (2013) and show no significant effect of FTT on intraday volatility and a decrease in trading volume. They also show that FTT has no effect on bid-ask spreads. Further, Capelle-Blancard and Havrylchyk (2014) examine the daily data of share prices six months before (02.12-07.12) and after (08.12-01.13) the imposition of STT in France. The impact of STT on market volatility is measured using different forms of volatility estimated from squared logarithmic returns, GARCH (1, 1) and a high-low range, while for liquidity, activity-based, transaction-cost and price-impact measures are used. These types of volatility and liquidity are then used to estimate the impact of STT on market quality through a difference-in-difference approach, separating the impact of French large firms' stocks from foreign firms' and small French firms' stocks. The findings suggest that although the STT leads to a decline in trading activity, it does not affect market liquidity and shows no impact on volatility measures. Coelho (2015) evaluates the elasticities of substitution vs. avoidance after the introduction of French and Italian FTTs and finds large avoidance responses. Becchetti et al. (2014), analysing 106 taxed French companies as a treatment group and 220 French non-taxed companies as a control group, show a reduction in volatility as a consequence of FTT. They use intraday data within the period of 90 days prior to and 90 days after the introduction of FTT in France. Employing a difference-in-difference approach, the results indicate a significant decrease in volatility in the treatment group.

3 Methodology and data

3.1 Methodology

The main goal of this study is to examine the changes (if any) in liquidity and the volatility of stock returns affected by the transaction tax. To test the effect on liquidity, we use the Mann-Whitney U-Test (Mann and Whitney, 1947), while for the change in volatility, Levene (Levene, 1960), Brown-Forsythe (Brown and Forsythe, 1974), and O'Brien (O'Brien, 1981) tests are implemented.

Because for the measurement of volatility, two additional series are obtained using the market model and a seasonality and news adjustment model employed by Schwert (1990) and Chordia et al. (2005), these equations will be presented first. Then, test statistics for liquidity and volatility will be introduced.

Market model

Following Hu (1998), who implements the market model to examine the difference in idiosyncratic risk before and after the tax increase in the Asian market, we examine the so-called noise component of excess market returns by implementing the following model,

$$R_i - R_f = \alpha_i + b_i(R_M - R_f) + \varepsilon_i \qquad \textbf{(1)}$$

where $R_i - R_f$ is excess return on portfolio i, $R_M - R_f$ is excess market return or the market premium, a and b are an intercept and a slope, and ε_i is the series of the unexplained part of returns or an idiosyncratic component. The logarithmic return series and its idiosyncratic component will be employed to test for the volatility difference as a consequence of tax announcement and introduction events in the Italian stock market.

Seasonality and news adjustment model

Schwert (1990) and Chordia et al. (2005) implement a model to adjust return series for seasonal effects occurring within the periods of consideration. The model is given as,

$$R_{it} = a_1 + \sum_{j=1}^{4} a_{2j} D_{1j} + \sum_{j=1}^{11} a_{3j} D_{2j} + \sum_{j=1}^{12} a_{4j} R_{it-j} + e_{it}, \quad \textbf{(2)}$$

where D_{1j} is a dummy variable for the day of the week, D_{2j} is a dummy variable for a month, and R_{it} is return series. The model adjusts the raw series for possible seasonality, autocorrelation and heteroscedasticity. In our study, equation (2) is augmented by three news dummy variables:

$$R_{it} = a_1 + \sum_{j=1}^{4} a_{2j} D_{1j} + \sum_{j=1}^{11} a_{3j} D_{2j} + \sum_{j=1}^{12} a_{4j} R_{it-j} + a_5 D_{TA} + a_5 D_{TI} + a_5 D_S + e_{it}, \quad \textbf{(3)}$$

where D_{TA} stands for the day of the tax announcement, D_{TI} for the day of the tax introduction, and D_S for a dummy for the day of Saipem's share price fall. The latter event will be explained in Section 3.2. The use of equation (3) can also be justified for a reason to remove any present extreme values in the return series.

The Mann-Whitney U-Test

The Mann-Whitney U-test[2] can be implemented to compare the distributions of two samples and their medians even if the samples are small and poorly distributed, and thus, the test has a great advantage among other alternative tests that require the normality assumption (Nachar, 2008). To compare the two samples' probability distributions and their medians, both sample observations are combined to rank the measurements from the smallest to the largest, and if one sample's observations tend to have larger rates of rank differences than another, it is then expected that the sample distributions are not identical. Thus, the test statistic is based on the rank sums of both samples and is given as,

$$U_x = n_x n_y + \left(\frac{n_x(n_x + 1)}{2}\right) - R_x$$

$$U_y = n_x n_y + \left(\frac{n_y(n_y + 1)}{2}\right) - R_y,$$

where n_x and n_y are the number of observations in the first and second samples, respectively, while R_x and R_y are the sums of ranks assigned to each sample.

[2] The Mann-Whitney U-Test is also known as the Wilcoxon Rank Sum Test since they are equivalent (McClave et al., 2005).

The Mann-Whitney U-Test's null hypothesis states that the two samples come from identical populations and that the medians of both samples are not different, while the alternative hypothesis stipulates that the probability distribution of one sample shifted to the left or to the right of another; hence, one sample's median is larger than the other (Nachar, 2008; McClave et al., 2005). There are two main conditions that are required for the test to be valid. First, the two investigated samples are random, independent and drawn from the same population, and second, their probability distributions are continuous. Because it is not expected for the series of liquidity measures considered in this paper to be normally distributed and assuming that the series fit the abovementioned requirements, the Mann-Whitney test is chosen to compare changes in liquidities of stocks.

Levene's, Brown-Forsythe, and O'Brien Tests

We use a time series of logarithmic returns, residuals of equation (1) and equation (3) to test for the difference in return volatility before and after tax announcement and introduction events. The null hypothesis is that the variances of the two samples are equal. This approach is also employed by Baltagi et al. (2006), where the homogeneity of variances of returns is tested. There are several tests that can be implemented to examine the homogeneity of variances of two samples. In our study, the following statistics are used.

Because the common F-ratio and Bartlett's tests for equality of variances are very sensitive to departures from the normality assumption, in 1960, Howard Levene developed two different statistics and demonstrated their satisfactory power under non-normality conditions (Levene, 1960). The two modifications of Levene's tests employ the absolute and quadratic measures, which are given as follows:

$$W = \frac{(N-k)\sum_{i=1}^{k} N_i \left(\overline{Z}_i - \overline{Z}\right)^2}{(k-1)\sum_{i=1}^{k}\sum_{j=1}^{N_i}(Z_{ij} - \overline{Z}_i)^2} \quad \textbf{(5)}$$

where N_i is the sample size of the ith group and k is the number of groups, while the definition of Z_{ij} differs depending on the variety of the test. For the absolute estimate, the test statistic uses $Z_{ij} = \left|Y_{ij} - \overline{Y}_i\right|$, where $\overline{Y}_i$ is the mean of the ith subgroup, $\overline{Z}$ is the mean of all Z_{ij}, $\overline{Z}_i$ is the mean of Z_{ij} in subgroup i, while for the quadratic form, the test statistic uses $Z_{ij}^2 = \left(Y_{ij} - \overline{Y}_i\right)^2$, where $\overline{Y}_i$ is the mean of the ith subgroup. Levene's tests do not assume the equality of means of investigated group samples (Baltagi et al., 2006). Critical values are obtained from the Snedecor F-table (Brown and Forsythe, 1974).

However, Brown and Forsythe (1974) argue that the estimate of the mean in the Levene's test should be replaced by the median measure, which they prove to be a more robust estimate. As a result, they define Z_{ij} in equation (5) as $Z_{ij} = |Y_{ij} - \tilde{Y}_i|$, where $\tilde{Y}_i$ is the median of the *i*th subgroup.

Another modification of Levene's statistic is provided by O'Brien (1981). For this test type, the test statistic in equation (5) uses

$$Z_{ij} = \frac{(0.5 + n_i - 2)n_i(y_{ij} - \overline{y}_i)^2 - 0.5(n_i - 1)s_i^2}{(n_i - 1)(n_i - 2)},$$

where n_i is the size of the *i*th group and s_i^2 is the sample variance. Abdi (2007) states that O'Brien's test is versatile compared with other tests and minimises both the type I and type II errors. In this study, we use both versions of the test. However, the preference in obtained results is given to the modified test of Brown and Forsythe (1974) to be consistent with Baltagi et al. (2006).

3.2 Data description

Analysed in this paper are closing spot, bid and ask prices of Italian shares that are traded or used to trade in the Borsa Italiana, the Italian national stock exchange, with market capitalisation of above 500 million Euros on 30 November 2012 and 28 February 2013. Prices are obtained from Bloomberg and are denominated in Euros. Weekends and holidays are excluded, resulting in 125 daily observations.

The six-month period from 29 October 2012 to 30 April 2013 is chosen to examine the effect of the announcement and imposition of the FTT on liquidity and volatility of stock returns by comparing two months prior to and two months after the events. A six-month sample is divided into three equal subsamples: the period from the tax announcement event, 29 December 2012, to the tax introduction day, 1 March 2013, comprises two months, which is used as both a post-announcement period as well as a pre-tax imposition period. Similar short-term sample periods for detecting the effect of the financial tax on market efficiency are used by Baltagi et al. (2006) and Colliard and Hoffmann (2015).

The Ministry of Economy and Finance of Italy introduced a list of exempt resident Italian companies, the shares of which have a market capitalisation of less than 500 million Euros in November 2012 (di Wiesenhoff and Egori, 2013) and in February 2013 (Coelho, 2015). We compile a list of taxable shares using both November 2012 and February 2013 market capitalisations. The former is employed for evaluating the effect of the tax announcement, while the latter is used to study the effect of the tax imposition. There are 77 shares with market capitalisation exceeding 500 million Euros on 30 November 2012, and there are 81 shares with market capitalisation of 500 million Euros or above as of 28 February 2013, according to the Borsa Italiana.

To test for any effect of FTT on stock liquidity and volatility, all stocks are combined into one joint portfolio and ten size-sorted (decile) portfolios weighted by market capitalisation of November 2012 and February 2013. The joint portfolio is used to examine the effect of FTT, if any, on all chosen stocks, while size-sorted decile portfolios are used to note any sensitivity of the possible effect with respect to market capitalisation. The largest group by market capitalisation is denoted as Portfolio 1 (decile 1) and the smallest as Portfolio 10 (decile 10). Table 1 provides two lists of companies with a capitalisation of 500 million Euros or above based on two dates and the companies' corresponding weights. The weight of each share is estimated as

$$w_i = c_i/c_{t,}$$

where w_i is a weight of individual share i in a portfolio, c_i is individual share capitalisation and c_t is total sample capitalisation.

3.2.1 Bid and ask prices

Bid and ask prices are employed to extract two measures of liquidity following Chordia et al. (2005). The obtained measures are the quoted spread measured as a difference between bid and ask prices and the relative quoted spread measured as the quoted spread divided by the mid-point of the bid-ask prices. Quoted and relative quoted spreads are estimated for each stock and ordered by market capitalisation from the highest to the lowest according to the November 2012 and February 2013 market capitalisations. To create liquidity measures for the joint and size-sorted decile portfolios, the individual quoted and relative quoted spreads are multiplied by the corresponding weights given in Table 1. As a result, 11 portfolios (one joint and ten size-sorted) are generated from all stocks for each market capitalisation list.

Figure 1 plots the time series of quoted and relative quoted spreads of joint portfolios based on two market capitalisation records (solid and dotted lines). Although weighted differently, the joint portfolios based on two market capitalisation measures demonstrate similar fluctuations throughout the period. Both panels A and B indicate that both liquidity measures increase after the tax is imposed on 1 March 2013[3].

[3] Since the tax news was officially published on Saturday 29 December 2012 when the markets were closed until 4 January 2013, we take the previous day of 28 December as the pre-announcement sample end date. Our figures show 28 December as the announcement date for illustrative purposes only.

Table 1. List of shares issued by taxed Italian companies.

The list is based on market capitalisations of November 2012 and February 2013. The portfolios are based on a weighted market capitalisation approach where weights are estimated as $w_i = c_i/c_t$, where w_i is the weight of an individual share in a portfolio, c_i is individual share capitalisation and c_t is total sample capitalisation. Each weighting scheme has one joint portfolio and 10 size-sorted decile portfolios. Portfolio 1 (P1) represents the decile portfolio with the largest market capitalisation, while Portfolio 10 (P10) is the decile portfolio with the smallest market capitalisation.

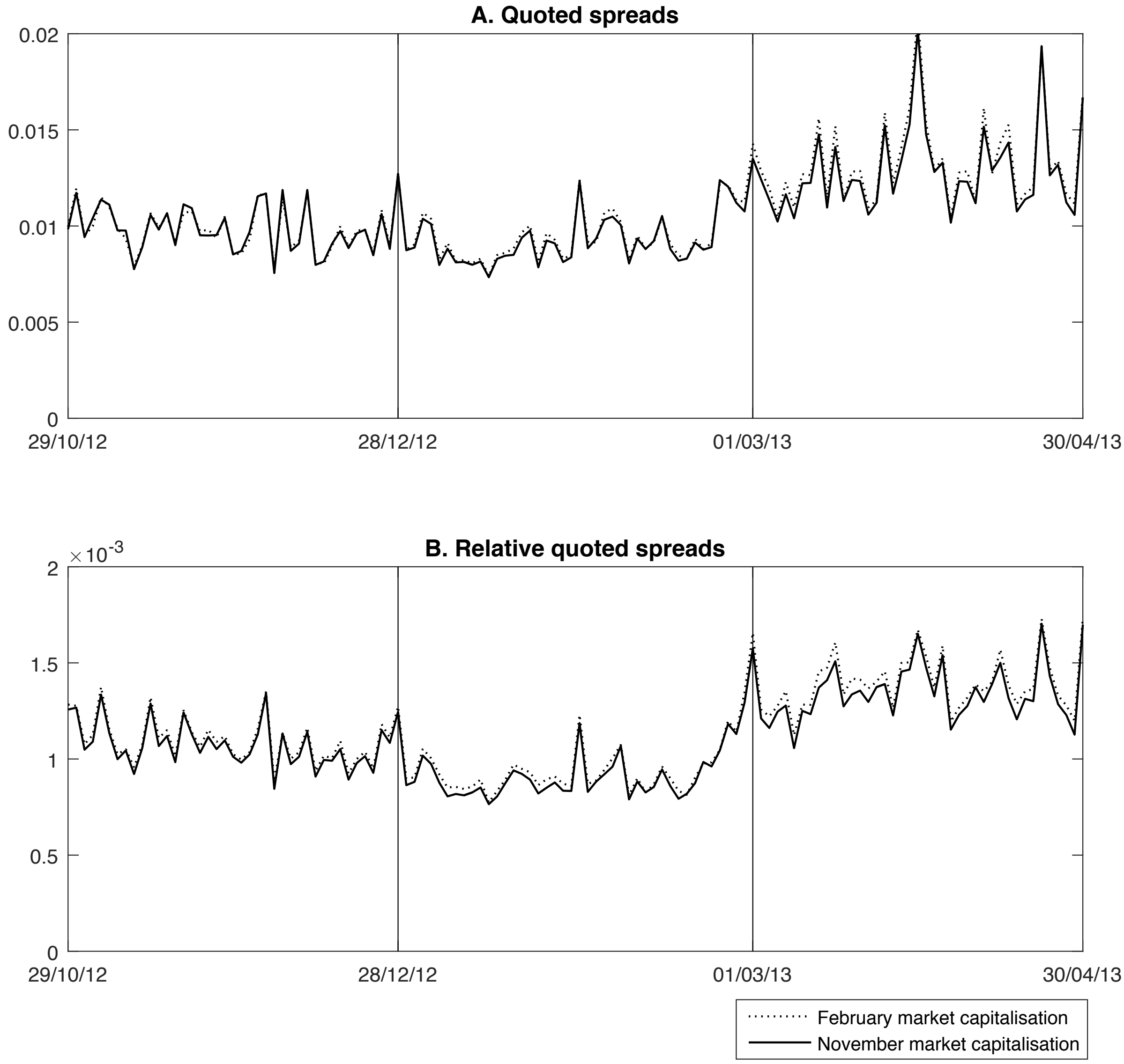
	November 2012 market capitalisation					February 2013 market capitalisation				
	Share		Market cap., million euro	Weights		Share		Market cap., million euro	Weights	
				decile	joint				decile	joint
Portfolio 1	1	ENI	66383.10	0.3377	0.1978	1	ENI	63251.62	0.3324	0.1864
	2	ENEL	27568.17	0.1402	0.0822	2	ENEL	25921.21	0.1362	0.0764
	3	UNICREDIT	20833.48	0.1060	0.0621	3	UNICREDIT	22493.09	0.1182	0.0663
	4	GENERALI	20157.55	0.1025	0.0601	4	INTESA SANPAOLO	19247.92	0.1011	0.0567
	5	INTESA SANPAOLO	20134.08	0.1024	0.0600	5	GENERALI	19186.48	0.1008	0.0565
	6	SAIPEM	15143.11	0.0770	0.0451	6	LUXOTTICA GROUP	16646.67	0.0875	0.0490
	7	LUXOTTICA GROUP	14849.02	0.0755	0.0443	7	SNAM	12242.39	0.0643	0.0361
	8	SNAM	11518.94	0.0586	0.0343	8	FIAT INDUSTRIAL	11303.68	0.0594	0.0333
	Total of decile 1		*196587.45*			*Total of decile 1*		*190293.06*		
Portfolio 2	9	FIAT INDUSTRIAL	10098.95	0.1904	0.0301	9	SAIPEM	9044.08	0.1738	0.0266
	10	TELECOM ITALIA	9412.11	0.1775	0.0281	10	ATLANTIA	8718.31	0.1676	0.0257
	11	ATLANTIA	8691.42	0.1639	0.0259	11	TELECOM ITALIA	7529.88	0.1447	0.0222
	12	ENEL GREEN POWER	6606.44	0.1246	0.0197	12	ENEL GREEN POWER	7025.89	0.1350	0.0207
	13	TERNA	5871.15	0.1107	0.0175	13	TERNA	6396.85	0.1230	0.0188
	14	FIAT	4425.27	0.0834	0.0132	14	FIAT	5073.25	0.0975	0.0149
	15	PIRELLI & C	4247.02	0.0801	0.0127	15	PIRELLI & C	4229.24	0.0813	0.0125
	16	MEDIOBANCA	3683.83	0.0695	0.0110	16	MEDIOBANCA	4009.54	0.0771	0.0118
	Total of decile 2		*53036.19*			*Total of decile 2*		*52027.04*		
Portfolio 3	17	TELECOM ITALIA RSP	3672.61	0.1467	0.0109	17	PRYSMIAN	3605.85	0.1340	0.0106
	18	CAMPARI	3351.1	0.1339	0.0100	18	SALVATORE FERRAGAMO	3535.5	0.1313	0.0104
	19	PRYSMIAN	3133.5	0.1252	0.0093	19	CAMPARI	3519.28	0.1307	0.0104
	20	PARMALAT	3119.68	0.1247	0.0093	20	EXOR	3417.78	0.1270	0.0101
	21	EXOR	3044.58	0.1217	0.0091	21	TOD'S	3377.9	0.1255	0.0100
	22	LOTTOMATICA	2930.64	0.1171	0.0087	22	PARMALAT	3208.18	0.1192	0.0095
	23	SALVATORE FERRAGAMO	2920.97	0.1167	0.0087	23	UBI BANCA	3136.82	0.1165	0.0092
	24	TOD'S	2853.97	0.1140	0.0085	24	MEDIOLANUM	3115.93	0.1158	0.0092
	Total of decile 3		*25027.05*			*Total of decile 3*		*26917.24*		
Portfolio 4	25	MEDIOLANUM	2764.99	0.1593	0.0082	25	LOTTOMATICA	3057.51	0.1580	0.0090
	26	UBI BANCA	2738.88	0.1578	0.0082	26	TELECOM ITALIA RSP	2961.48	0.1531	0.0087
	27	BANCA MONTE PASCHI SIENA	2370.48	0.1366	0.0071	27	AUTOGRILL	2470.35	0.1277	0.0073
	28	FINMECCANICA	2346.16	0.1352	0.0070	28	BANCA MONTE PASCHI SIENA	2463.96	0.1273	0.0073
	29	BANCO POPOLARE	2006.61	0.1156	0.0060	29	BANCO POPOLARE	2262.82	0.1170	0.0067
	30	AUTOGRILL	1935.96	0.1116	0.0058	30	FINMECCANICA	2183.56	0.1129	0.0064
	31	DIASORIN	1597.06	0.0920	0.0048	31	MEDIASET	1986.19	0.1027	0.0059
	32	BANCA POP EMILIA ROMAGNA	1594.71	0.0919	0.0048	32	BUZZI UNICEM	1962.69	0.1014	0.0058
	Total of decile 4		*17354.85*			*Total of decile 4*		*19348.56*		
Portfolio 5	33	BUZZI UNICEM	1545.98	0.1310	0.0046	33	GEMINA	1935.61	0.1408	0.0057
	34	DE' LONGHI	1542.3	0.1307	0.0046	34	BANCA POP EMILIA ROMAGNA	1825.19	0.1327	0.0054
	35	SIAS	1518.7	0.1287	0.0045	35	DE' LONGHI	1771.58	0.1288	0.0052
	36	MEDIASET	1508.28	0.1278	0.0045	36	AZIMUT HOLDING	1737.37	0.1263	0.0051
	37	BANCA CARIGE	1494.53	0.1266	0.0045	37	BANCA POPOLARE MILANO	1663.1	0.1209	0.0049
	38	AZIMUT HOLDING	1448.01	0.1227	0.0043	38	EXOR PRV	1608.28	0.1170	0.0047
	39	BANCA GENERALI	1394.28	0.1181	0.0042	39	SIAS	1605.5	0.1168	0.0047
	40	HERA	1351.67	0.1145	0.0040	40	IMPREGILO	1604.82	0.1167	0.0047
	Total of decile 5		*11803.75*			*Total of decile 5*		*13751.45*		

Portfolio 6	41	BANCA POPOLARE SONDRIO	1350.21	0.1305	0.0040	41	HERA	1602.65	0.1377	0.0047
	42	RECORDATI	1350.12	0.1305	0.0040	42	DIASORIN	1596.39	0.1372	0.0047
	43	BANCA POPOLARE MILANO	1329.83	0.1285	0.0040	43	RECORDATI	1579.18	0.1357	0.0047
	44	A2A	1319.04	0.1275	0.0039	44	BANCA GENERALI	1524.08	0.1309	0.0045
	45	IMPREGILO	1285.31	0.1242	0.0038	45	BANCA POPOLARE SONDRIO	1441.11	0.1238	0.0042
	46	EXOR PRV	1267.81	0.1225	0.0038	46	BANCA CARIGE	1396.4	0.1200	0.0041
	47	CREDITO EMILIANO	1232.45	0.1191	0.0037	47	A2A	1298.82	0.1116	0.0038
	48	GEMINA	1212.76	0.1172	0.0036	48	CREDITO EMILIANO	1200.03	0.1031	0.0035
	Total of decile 6		*10347.53*			*Total of decile 6*		*11638.66*		
Portfolio 7	49	ANSALDO STS	1092.43	0.1451	0.0033	49	ANSALDO STS	1179.74	0.1446	0.0035
	50	INTESA SANPAOLO RSP	986.17	0.1310	0.0029	50	BRUNELLO CUCINELLI	1059.56	0.1299	0.0031
	51	BRUNELLO CUCINELLI	934.03	0.1241	0.0028	51	FONDIARIA - SAI	1058.9	0.1298	0.0031
	52	DANIELI & C	931.38	0.1237	0.0028	52	ERG	1034.93	0.1269	0.0030
	53	RCS MEDIAGROUP	924.15	0.1228	0.0028	53	INTESA SANPAOLO RSP	988.19	0.1211	0.0029
	54	SARAS	891.67	0.1185	0.0027	54	ACEA	975.68	0.1196	0.0029
	55	CREDITO BERGAMASCO	888.99	0.1181	0.0026	55	BENI STABILI	939.71	0.1152	0.0028
	56	FONDIARIA - SAI	878.19	0.1167	0.0026	56	AMPLIFON	920.77	0.1129	0.0027
	Total of decile 7		*7527.01*			*Total of decile 7*		*8157.48*		
Portfolio 8	57	ACEA	853.98	0.1547	0.0025	57	SORIN	914.46	0.1415	0.0027
	58	BENI STABILI	852.83	0.1544	0.0025	58	SARAS	829.52	0.1284	0.0024
	59	ERG	810.71	0.1468	0.0024	59	DANIELI & C	825.36	0.1277	0.0024
	60	SORIN	795.09	0.1440	0.0024	60	YOOX	809.95	0.1253	0.0024
	61	AMPLIFON	777.47	0.1408	0.0023	61	ITALCEMENTI	784.09	0.1213	0.0023
	62	PIAGGIO & C	717.81	0.1300	0.0021	62	ASTM	773.75	0.1197	0.0023
	63	UNIPOL	713.85	0.1293	0.0021	63	UNIPOL	765.59	0.1185	0.0023
						64	RCS MEDIAGROUP	759.89	0.1176	0.0022
	Total of decile 8		*5521.74*			*Total of decile 8*		*6462.61*		
Portfolio 9	64	YOOX	672.74	0.1493	0.0020	65	CREDITO BERGAMASCO	755.71	0.1361	0.0022
	65	CIR	666.33	0.1479	0.0020	66	PIAGGIO & C	728.69	0.1312	0.0021
	66	CATTOLICA ASSICURAZIONI	663.30	0.1472	0.0020	67	CATTOLICA ASSICURAZIONI	728.66	0.1312	0.0021
	67	INDESIT COMPANY	638.31	0.1416	0.0019	68	BREMBO	708.38	0.1276	0.0021
	68	ITALCEMENTI	633.30	0.1405	0.0019	69	MILANO ASSICURAZIONI	683.01	0.1230	0.0020
	69	ASTM	631.84	0.1402	0.0019	70	GEOX	654.92	0.1180	0.0019
	70	BREMBO	600.61	0.1333	0.0018	71	INTERPUMP GROUP	652.95	0.1176	0.0019
						72	INDESIT COMPANY	639.65	0.1152	0.0019
	Total of decile 9		*4506.43*			*Total of decile 9*		*5551.97*		
Portfolio 10	71	INTERPUMP GROUP	591.46	0.1547	0.0018	73	CAMFIN	637.16	0.1212	0.0019
	72	MILANO ASSICURAZIONI	571.06	0.1494	0.0017	74	IREN	623.63	0.1186	0.0018
	73	EI TOWERS	570.15	0.1491	0.0017	75	CIR	618.29	0.1176	0.0018
	74	GEOX	545.25	0.1426	0.0016	76	EI TOWERS	616.96	0.1173	0.0018
	75	IMA	526.88	0.1378	0.0016	77	IMA	604.07	0.1149	0.0018
	76	IREN	514.56	0.1346	0.0015	78	MARR	578.74	0.1101	0.0017
	77	DANIELI & C RSP	504.12	0.1318	0.0015	79	ASTALDI	535.38	0.1018	0.0016
						80	SAFILO GROUP	524.18	0.0997	0.0015
						81	DANIELI & C RSP	520.27	0.0989	0.0015
	Total of decile 10		*3823.48*			*Total of decile 10*		*5258.68*		
Total market capitalisation			***335535.48***			***Total market capitalisation***		***339406.75***		

Similarly, Figure 2 demonstrates relative quoted spreads of the decile portfolios based on the February market capitalisation record. Like the spreads of joint portfolios, the spreads of decile portfolios, regardless of the size, tend to increase after the introduction of the tax and seem to demonstrate no effect of the announcement date. Furthermore, the figure shows that the higher the market capitalisation of the portfolio (see decile portfolios P1-P4 in Figure 2), the smaller the bid-ask spread on average, while portfolios with small market capitalisation demonstrate much wider bid-ask spreads (see for example portfolios P6-P10 in Figure 2)[4]. This observation is confirmed by Figure 3, which documents an upward tendency in the quoted and relative quoted spreads averaged over the whole time period of six months for each decile portfolio. Figure 3 shows that the higher the market capitalisation, the smaller the bid-ask spread.

Figure 1. Quoted and relative quoted spreads of joint portfolios, October 2012 – April 2013, daily observations.

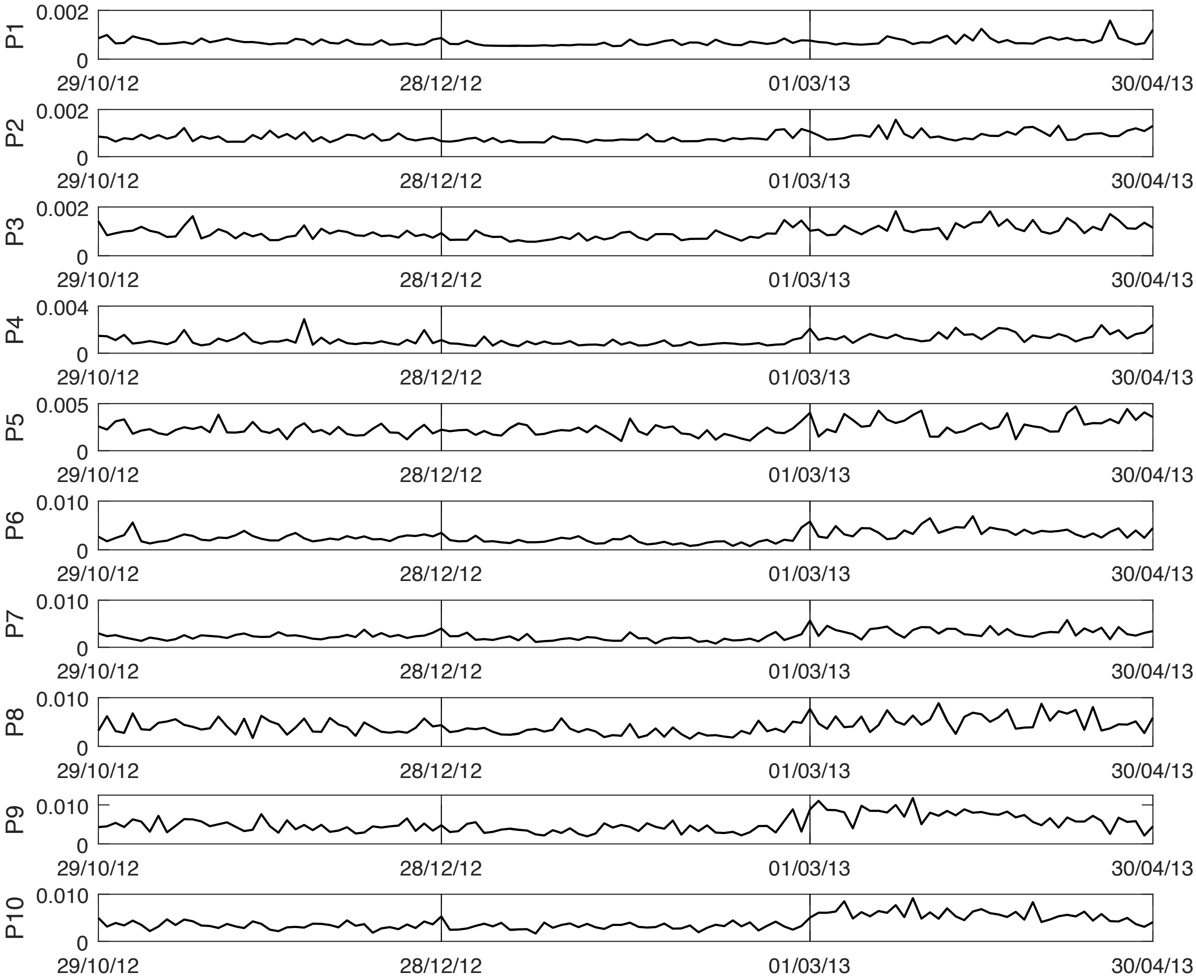
The figure presents plots of quoted (panel A) and relative quoted spreads (panel B) based on orders of November 2012 and February 2013 market capitalisations. The date of the tax announcement is marked as 28 December because the tax news was published on Saturday 29 December when the markets were closed.



[4] Figures of quoted spreads of the February market capitalisation, as well as of both liquidity measures based on the November capitalisation are similar. They are omitted for brevity and are available from authors upon request.

Figure 2. Relative quoted spreads of size-sorted decile portfolios (February market cap).

The figure presents the plots of size-sorted decile portfolios for relative quoted spreads based on February 2013 market capitalisation. *P1* and *P10* stand for the largest and the smallest decile portfolio by market capitalisation, respectively.



Using 11 portfolios (one joint and ten decile portfolios) for both liquidity measures and both market capitalisations, Table 2 provides the summary statistics of the series. In addition to confirming the graphical evidence about the average liquidity values across decile portfolios, relative quoted spreads of all portfolios have lower variations than those of the quoted spread series because the means and standard deviations of the former series are several times lower than those of the latter series. The skewness and kurtosis of all series of spreads clearly deviate from those of the normal distribution, and the Jarque-Bera (JB) tests confirm that the series are not normally distributed by rejecting the null hypothesis of normality at a less than 10% significance level. Another test of the Ljung-Box for an up-to-22-order serial correlation indicates that most of the series are autocorrelated, where the null hypothesises of no serial correlations is rejected at a less than 10% significant level.

Figure 3. Average values of quoted and relative quoted spreads of size-sorted decile portfolios.
The figure presents the scatterplots of the quoted spreads (panel A) and relative quoted spreads (panel B) averaged over the period 30 October 2012 – 30 April 2013 and weighted by the November 2012 and February 2013 market capitalisations, as well as the corresponding regression lines. Numbers 1 to 10 on the horizontal axis indicate the size of the market capitalisation of decile portfolios from the largest to the smallest, respectively.

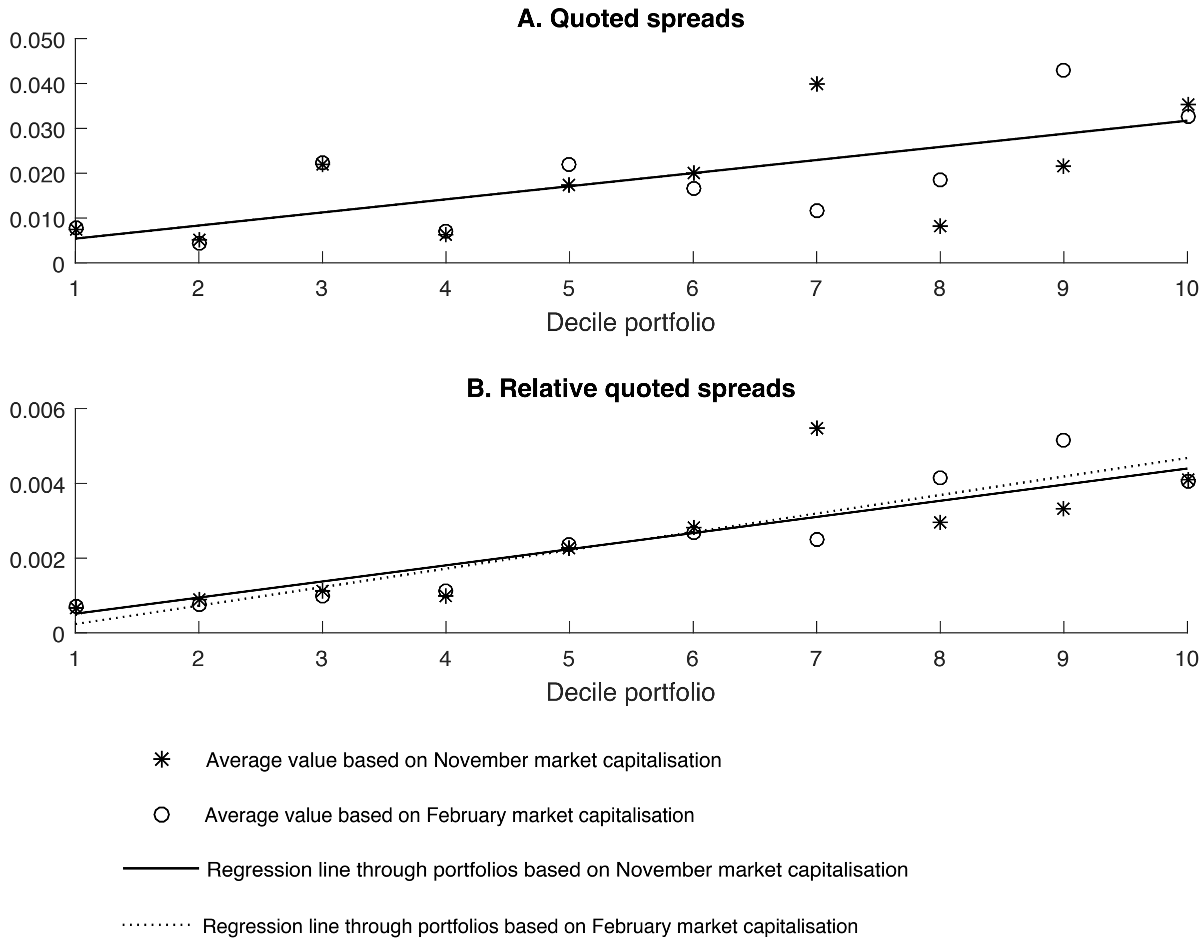


Table 2. Summary statistics of the time series of liquidity measures, November 2012 and February 2013 market capitalisation records, October 2012 – April 2013, 125 daily observations.

The table presents summary statistics for the quoted spreads (QS) and relative quoted spreads (RQS) for the joint and decile portfolios.

		November 2012 market capitalisation						February 2013 market capitalisation					
P	Variable	Mean	Standard Deviation	Skewness	Kurtosis	Jarque-Berra	Q(22)	Mean	Standard Deviation	Skewness	Kurtosis	Jarque-Berra	Q(22)
Joint	*QS*	0.010	0.007	-9.149	96.912	47678.19 (0.00)	12.21 (0.95)	0.011	0.005	-6.512	64.601	20647.40 (0.00)	68.05 (0.00)
	RQS	0.001	0.000	-3.274	27.991	3476.20 (0.00)	260.97 (0.00)	0.001	0.000	-0.934	8.994	205.26 (0.00)	520.94 (0.00)
1	*QS*	0.007	0.012	-10.471	114.953	67562.72 (0.00)	0.68 (1.00)	0.008	0.002	2.931	14.386	854.15 (0.00)	34.26 (0.05)
	RQS	0.001	0.001	-10.426	114.317	66803.08 (0.00)	0.65 (1.00)	0.001	0.000	2.565	11.866	546.49 (0.00)	32.92 (0.06)
2	*QS*	0.005	0.001	1.342	4.600	50.87 (0.00)	65.85 (0.00)	0.004	0.024	-10.943	121.520	75656.64 (0.00)	0.40 (1.00)
	RQS	0.001	0.000	1.288	4.432	45.23 (0.00)	105.38 (0.00)	0.001	0.002	-10.878	120.582	74472.87 (0.00)	0.24 (1.00)
3	*QS*	0.022	0.011	2.301	10.460	400.22 (0.00)	341.65 (0.00)	0.022	0.011	2.454	11.546	505.89 (0.00)	299.96 (0.00)
	RQS	0.001	0.000	2.341	10.789	430.17 (0.00)	216.80 (0.00)	0.001	0.001	2.511	11.974	550.80 (0.00)	183.06 (0.00)
4	*QS*	0.006	0.002	1.332	4.385	46.94 (0.00)	112.43 (0.00)	0.007	0.003	1.780	6.439	127.59 (0.00)	273.82 (0.00)
	RQS	0.001	0.000	1.239	3.948	36.66 (0.00)	186.45 (0.00)	0.001	0.001	1.734	6.458	124.90 (0.00)	284.03 (0.00)
5	*QS*	0.018	0.006	0.822	4.096	20.33 (0.00)	61.73 (0.00)	0.022	0.009	1.210	5.244	56.71 (0.00)	81.51 (0.00)
	RQS	0.002	0.001	0.730	3.758	14.08 (0.00)	83.01 (0.00)	0.003	0.001	1.021	4.920	40.92 (0.00)	30.14 (0.12)
6	*QS*	0.020	0.010	1.061	4.134	30.15 (0.00)	215.85 (0.00)	0.017	0.007	1.103	4.686	40.17 (0.00)	195.28 (0.00)
	RQS	0.004	0.002	0.939	4.019	23.76 (0.00)	109.00 (0.00)	0.002	0.001	1.079	4.584	37.34 (0.00)	228.66 (0.00)
7	*QS*	0.040	0.018	0.535	3.119	6.04 (0.05)	59.55 (0.00)	0.012	0.005	1.142	4.473	38.49 (0.00)	101.89 (0.00)
	RQS	0.006	0.003	0.545	3.180	6.37 (0.04)	73.18 (0.00)	0.002	0.001	0.972	4.075	25.70 (0.00)	64.12 (0.00)
8	*QS*	0.008	0.004	0.898	3.177	16.98 (0.00)	326.33 (0.00)	0.018	0.009	1.038	3.692	24.93 (0.00)	278.51 (0.00)
	RQS	0.003	0.001	0.813	3.192	13.97 (0.00)	241.01 (0.00)	0.003	0.001	0.997	3.683	23.14 (0.00)	242.73 (0.00)
9	*QS*	0.022	0.010	1.194	4.131	36.37 (0.00)	252.82 (0.00)	0.043	0.019	0.555	2.825	6.57 (0.04)	81.35 (0.00)
	RQS	0.003	0.001	1.124	4.103	32.67 (0.00)	116.62 (0.00)	0.007	0.003	0.596	2.907	7.43 (0.02)	82.35 (0.00)
10	*QS*	0.035	0.018	1.562	5.475	82.71 (0.00)	294.37 (0.00)	0.033	0.015	1.765	6.945	145.97 (0.00)	333.96 (0.00)
	RQS	0.004	0.002	1.520	5.519	81.18 (0.00)	193.51 (0.00)	0.004	0.001	1.104	4.163	32.43 (0.00)	568.29 (0.00)

3.2.2 Spot prices

We use the closing prices of stocks to obtain three measures of return time series to test them for possible volatility changes around the tax announcement and tax imposition dates. For this reason, motivated by Baltagi et al. (2006), Hu (1998) and Chordia et al. (2005), three series are respectively estimated, namely logarithmic returns, residuals of equation (1) and residuals of equation (3).

Individual logarithmic return series are calculated as continuously compounded daily returns:

$$r_t = \ln(p_t/p_{t-1})*100\%,$$

where p_t and p_{t-1} are stock prices at time t and t-1, respectively, and *ln* is the natural logarithm.

Logarithmic returns of joint and size-sorted decile portfolios are calculated as weighted average returns where the weights correspond to the market capitalisation records given in Table 1. As a result, 11 portfolio return series, including one joint and ten decile portfolios, are obtained for the November 2012 and February 2013 market capitalisations.

Table 3. Market model regressions.

The table provides results of the market model regressions represented by equation (1) using excess returns of joint portfolios, the largest (P1) and smallest (P10) decile portfolios for both market capitalisations. Regressions are adjusted for possible autocorrelation and heteroscedasticity in the residuals using Newey-West procedure. Standard errors are in italics in parentheses. ***, ** and * indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Variables	*Excess returns, joint portfolio*		*Excess returns, decile portfolio P1*		*Excess returns, decile portfolio P10*	
	November cap	*February cap*	*November cap*	*February cap*	*November cap*	*February cap*
Intercept	-0.001 (*0.01*)	0.017* (*0.01*)	-0.033 (*0.03*)	0.006 (*0.02*)	0.158** (*0.07*)	0.182** (*0.07*)
Excess market return	0.967* (*0.01*)	0.954* (*0.00*)	1.060* (*0.03*)	1.037* (*0.02*)	0.664* (*0.04*)	0.598* (*0.04*)
Adj R^2:	0.99	0.997	0.96	0.97	0.65	0.58
Residual diagnostics:						
Q(12)	11.01 (*0.53*)	17.61 (*0.13*)	15.62 (*0.21*)	16.33 (*0.18*)	9.85 (*0.63*)	14.62 (*0.26*)
JB	679.13 (*0.00*)	2.06 (*0.37*)	873.29 (*0.00*)	49.93 (*0.00*)	6.50 (*0.04*)	2.03 (*0.36*)
Obs*R^2	12.92 (*0.00*)	0.73 (*0.69*)	14.08 (*0.00*)	6.17 (*0.05*)	0.87 (*0.65*)	0.13 (*0.94*)

Note: *P*-values are in parentheses for the residual diagnostics.

Table 3 presents the results of estimating equation (1) for one joint portfolio, the largest decile portfolio and the smallest decile portfolio[5] for two market capitalisation records. The FTSE Italian All Shares Index is used as a proxy for the market return variable in the market model, while the risk-free rate is represented by the US one-month Treasury Bill. The excess return on the market proxy shows highly significant explanatory power for the variability of all excess returns of the given portfolios. Residuals from these regressions will be employed for subsequent testing. Although the residuals do not show serial correlation at any significance level less than 10%, as demonstrated by the Ljung-Box test statistics for an up-to-22-order serial correlation, they deviate from the normality in about two-thirds of the cases.

Regression results and residual diagnostics for equation (3) are presented in Table 4. Because none of the coefficients on the day of the week dummy variables are significant across all regressions, they are omitted from the regressions. The month of February has a negative and statistically significant impact at a less than 5% level on the returns of joint portfolios and large market capitalisation portfolio P1, while it causes no impact on the small capitalisation portfolio P10. January, in contrast, positively affects the small capitalisation portfolio, but not the large one or the joint one. Interestingly, coefficients on the tax announcement dummy variables are positive and statistically significant at a less than 1% level, while coefficients on the tax imposition event are negative and highly statistically significant. The coefficient on a dummy variable for the Saipem share price drop is negative as expected and is highly significant in all regression specifications. Regression residuals show no signs of serial correlation and are normally distributed.

Figure 4 plots the time series of three return measures for joint portfolios based on two market capitalisation records: the logarithmic returns on Panel A, residuals of the market model in Panel B and residuals of the adjusted model in Panel C. In Panel A, there is an abrupt return plunge on 30 January 2013, when the Saipem's[6] share price dropped by 34.3%, resulting in other stocks tumbling, which knocked down Italy's stock market (Stevenson, 2013). The overall tendency of the joint portfolio returns in Panel A, despite the difference in weights, shows similar fluctuations throughout the period, indicating no sign of changes in return variations among three subsample periods. Panel B plots the residuals of equation (1), or market model residuals. A dramatic plunge on 30 January remains the lowest for the

[5] Regression results for the other decile portfolios are available from the authors upon request.

[6] Italian oil services group.

residuals based on the November capitalisation. However, for the February capitalisation record, the fitted return is very close to the actual return on 30 January, resulting in a small residual value. Both series will be employed for testing, and the difference between the two will be noted. Panel C plots the residuals of the adjustment regression (3). Adjusting the return series shows lower variations throughout the period compared with those of the raw return series. Overall, the plots do not demonstrate any noticeable changes in variations between pre- and post-FTT announcement and imposition days.

Figures 5, 6 and 7 illustrate three return measures of size-sorted decile portfolios for both market capitalisation records. All graphs show no distinguishable changes in variations between pre- and post-announcement or tax introduction periods.

The summary statistics of the logarithmic return series and residuals of equations (1) and (3) for the joint and decile portfolios based on two market capitalisation records are presented in Table 5[7]. The logarithmic returns of the decile portfolios are mainly not normally distributed as expected, except for portfolios P3, P4 and P10 of the February market capitalisation. Residuals of the market model are normally distributed for 12 out of 20 cases without any discernible pattern across portfolios. For the adjusted residuals, portfolios with medium capitalisation tend to be non-normal (P4-P9 for the November capitalisation, P5-P8 for the February capitalisation). Ljung-Box test statistics for an up-to-22-order serial correlation for all but three portfolio returns do not reject the null hypothesis of no autocorrelation at the 10% significance level.

[7] There are 22 portfolios in total: two joint portfolios and 20 decile portfolios for each return measure: one half is based on the November market capitalisation, and the other half is based on the February market capitalisation.

Table 4. Adjustment regressions.

The table provides the results of estimating equation (3) using a return series of joint portfolios, the largest and smallest decile portfolios based on the November and February market capitalisations. Regressions are adjusted for possible autocorrelation and heteroscedasticity in the residuals using Newey-West procedure. Standard errors are in italics in parentheses. ***, ** and * indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Variables	*Log return, joint portfolio*		*Log returns, decile portfolio P1*		*Log returns, decile portfolio P10*	
	November cap	***February cap***	***November cap***	***February cap***	***November cap***	***February cap***
Intercept	0.271 (*0.21*)	0.274 (*0.21*)	0.401*** (*0.24*)	0.386 (*0.23*)	0.068* (*0.01*)	0.138 (*0.27*)
November	-	-	-	-	-0.152 (*0.27*)	-
December	-0.098 (*0.31*)	-0.064 (*0.30*)	-0.185 (*0.34*)	-0.270 (*0.35*)	0.142 (*0.25*)	0.039 (*0.31*)
January	0.150 (*0.25*)	0.174 (*0.25*)	0.072 (*0.27*)	-0.001 (*0.26*)	0.536* (*0.13*)	0.284 (*0.37*)
February	-0.712** (*0.33*)	-0.680** (*0.33*)	-1.006** (*0.41*)	-1.002* (*0.38*)	-0.142 (*0.27*)	-0.119 (*0.36*)
March	-0.335 (*0.31*)	-0.354 (*0.31*)	-0.584 (*0.38*)	-0.462 (*0.37*)	0.134 (*0.17*)	0.076 (*0.35*)
April	0.092 (*0.38*)	0.098 (*0.38*)	0.086 (*0.43*)	0.041 (*0.43*)	0.420 (*0.26*)	0.187 (*0.40*)
FTT announcement	2.653* (*0.27*)	2.569* (*0.27*)	2.819* (*0.29*)	2.995* (*0.26*)	1.763* (*0.13*)	1.804* (*0.26*)
FTT imposition	-1.258* (*0.25*)	-1.235* (*0.25*)	-0.977* (*0.32*)	-0.934* (*0.31*)	-0.466* (*0.17*)	-1.344* (*0.30*)
30 Jan 2013 (Saipem)	-4.443* (*0.14*)	-3.700* (*0.14*)	-3.017* (*0.18*)	-6.115* (*0.16*)	-3.507* (*0.13*)	-2.716* (*0.27*)
AR(1)			-0.191* (*0.07*)	-0.166** (*0.07*)		
AR(3)						0.159 (*0.11*)
AR(8)						0.125 (*0.11*)
AR(12)	-0.189** (*0.09*)	-0.192** (*0.10*)	-0.194** (*0.10*)	-0.179** (*0.09*)		
R^2	0.22	0.20	0.22	0.29	0.15	0.17
Residual diagnostics:						
Q(12)	10.91 (*0.54*)	10.79 (*0.55*)	9.60 (*0.65*)	8.80 (*0.72*)	6.56 (*0.89*)	10.20 (*0.60*)
JB	3.84 (*0.15*)	4.50 (*0.11*)	4.52 (*0.10*)	2.77 (*0.25*)	2.06 (*0.36*)	0.48 (*0.79*)
Obs*R^2	27.53 (*0.02*)	29.52 (*0.01*)	34.30 (*0.06*)	29.32 (*0.17*)	9.42 (*0.40*)	22.62 (*0.48*)

Note: *P*-values are in parentheses for the residual diagnostics.

Figure 4. Plots of three return series of the joint portfolios based on the November 2012 and February 2013 market capitalisations, October 2012 – April 2013, 125 daily observations.

The figure plots portfolio returns as the logarithmic returns (panel A), market model residuals (panel B) and adjusted residuals (panel C). The adjusted series lose the first few observations due to the lag component of equation (3). The date of the tax announcement is marked as 28 December for illustrative purposes because the tax news was published on Saturday 29 December when the markets were closed.

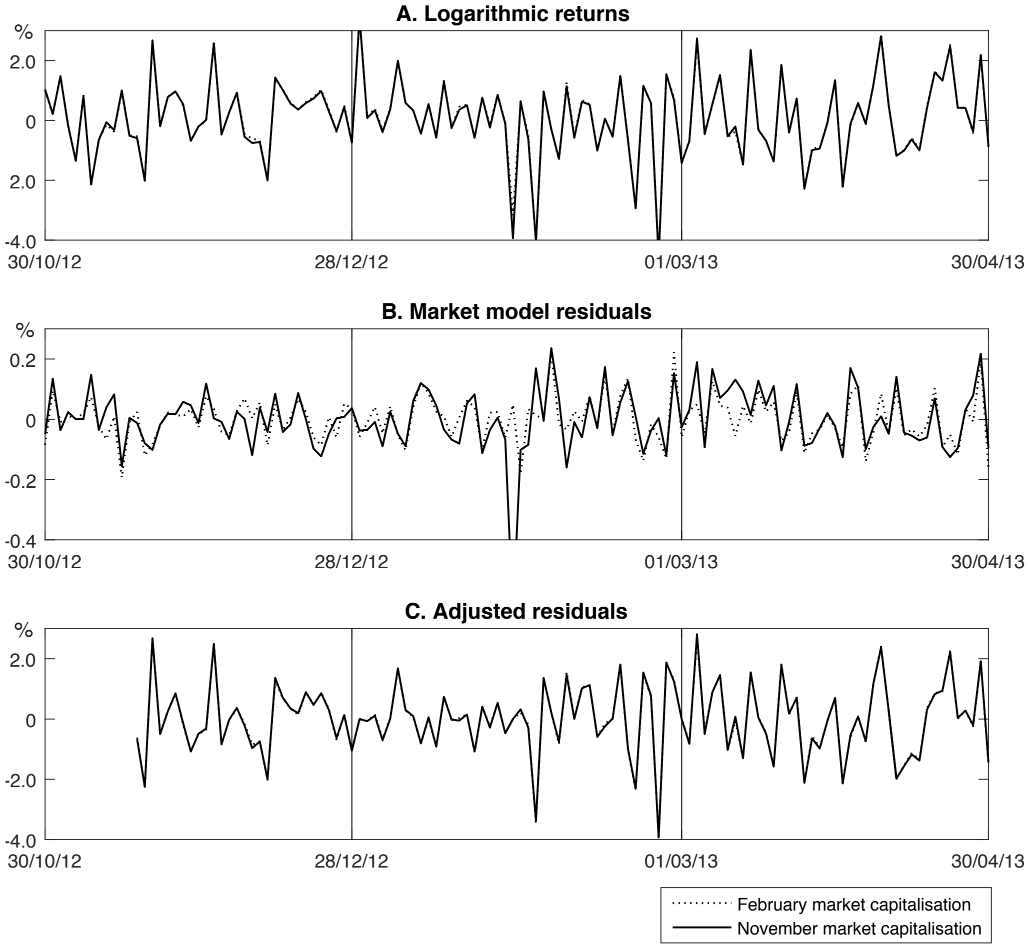


Table 5. The summary statistics of the logarithmic returns, market model residuals and adjusted return residuals, October 2012 – April 2013, daily observations. *R* stands for logarithmic returns, *MM* for residuals of the market model and *ADJ* for residuals of the adjusted equation. *P*-values are in parentheses for the Jarque-Berra and Q-tests.

		Market capitalisation of November 2012						Market capitalisation of February 2013					
P	**Variable**	**Mean**	**Standard Deviation**	**Skewness**	**Kurtosis**	**Jarque-Berra**	**Q(22)**	**Mean**	**Standard Deviation**	**Skewness**	**Kurtosis**	**Jarque-Berra**	**Q(22)**
Joint	*R*	0.069	1.319	-0.534	4.677	20.41 (0.00)	28.10 (0.17)	0.086	1.299	-0.497	4.574	17.90 (0.00)	27.93 (0.18)
	MM	0.000	0.104	-1.670	13.968	679.13 (0.00)	18.39 (0.68)	0.000	0.076	0.207	3.477	2.06 (0.36)	38.81 (0.02)
	ADJ	0.000	1.191	-0.243	3.767	3.84 (0.15)	22.57 (0.43)	0.000	1.189	-0.273	3.817	4.50 (0.11)	22.63 (0.42)
1	*R*	0.044	1.474	-0.639	5.048	30.10 (0.00)	27.67 (0.19)	0.081	1.434	-0.455	4.330	13.42 (0.00)	28.91 (0.15)
	MM	0.000	0.306	-2.136	15.279	873.29 (0.00)	21.43 (0.49)	0.000	0.266	0.179	6.088	49.93 (0.00)	21.32 (0.50)
	ADJ	0.000	1.267	-0.300	3.484	2.77 (0.25)	15.42 (0.84)	0.000	1.296	-0.401	3.569	4.52 (0.10)	17.11 (0.76)
2	*R*	0.057	1.329	-0.410	4.386	13.39 (0.00)	32.90 (0.06)	-0.011	1.465	-1.516	10.600	345.96 (0.00)	23.35 (0.38)
	MM	0.000	0.596	0.187	3.394	1.52 (0.47)	27.04 (0.21)	0.000	0.750	-2.170	19.472	1499.13 (0.00)	20.99 (0.52)
	ADJ	0.000	1.248	-0.219	3.563	2.38 (0.30)	22.97 (0.40)	0.000	1.178	-0.015	3.093	0.05 (0.98)	23.24 (0.39)
3	*R*	0.105	0.992	0.183	3.448	1.73 (0.42)	20.91 (0.53)	0.145	1.181	-0.032	3.787	3.22 (0.20)	17.44 (0.74)
	MM	0.000	0.571	0.286	2.925	1.72 (0.42)	16.72 (0.78)	0.000	0.544	0.327	3.143	2.32 (0.31)	18.80 (0.66)
	ADJ	0.000	0.957	0.070	3.333	0.61 (0.74)	21.93 (0.46)	0.000	1.107	-0.074	3.767	2.84 (0.24)	17.65 (0.73)
4	*R*	0.089	1.929	-0.093	4.090	6.32 (0.04)	16.53 (0.79)	0.072	1.606	-0.053	3.846	3.76 (0.15)	24.89 (0.30)
	CAPM	0.000	0.918	-0.230	3.469	2.23 (0.33)	16.02 (0.82)	0.000	0.771	0.144	2.929	0.45 (0.80)	15.56 (0.84)
	ADJ	0.000	1.812	-0.091	4.013	5.47 (0.06)	19.26 (0.63)	0.000	1.514	0.020	3.729	2.62 (0.27)	24.52 (0.32)
5	*R*	0.143	1.385	-0.450	4.094	10.37 (0.01)	19.97 (0.59)	0.242	1.372	-0.150	4.151	7.30 (0.03)	9.78 (0.99)
	MM	0.000	0.767	-0.248	3.114	1.33 (0.51)	16.73 (0.78)	0.000	0.776	0.961	6.504	82.51 (0.00)	21.74 (0.48)
	ADJ	0.000	1.310	-0.234	3.912	5.43 (0.07)	19.04 (0.64)	0.000	1.327	-0.003	4.252	8.10 (0.02)	16.89 (0.77)
6	*R*	0.223	1.342	-0.390	4.691	17.91 (0.00)	12.64 (0.94)	0.112	1.237	-0.550	5.600	41.18 (0.00)	18.21 (0.69)
	MM	0.000	0.610	0.881	5.906	59.68 (0.00)	23.25 (0.39)	0.000	0.651	0.004	3.378	0.74 (0.69)	30.67 (0.10)
	ADJ	0.000	1.269	-0.299	4.645	15.83 (0.00)	19.63 (0.61)	0.000	1.143	-0.438	4.939	23.37 (0.00)	14.86 (0.87)
7	*R*	0.108	1.231	-0.294	5.682	38.93 (0.00)	12.74 (0.94)	0.176	1.165	-0.608	5.099	30.40 (0.00)	13.90 (0.91)
	MM	0.000	0.790	-0.014	4.412	10.30 (0.01)	20.59 (0.55)	0.000	0.669	0.119	3.536	1.78 (0.41)	22.07 (0.46)
	ADJ	0.000	1.178	-0.301	5.129	25.30 (0.00)	16.67 (0.78)	0.000	1.103	-0.462	5.002	25.11 (0.00)	13.75 (0.91)
8	*R*	0.164	1.175	-0.500	4.002	10.36 (0.01)	9.47 (0.99)	0.130	1.250	-0.542	3.316	6.59 (0.04)	10.41 (0.98)
	MM	0.000	0.732	0.397	3.059	3.27 (0.19)	21.20 (0.51)	0.000	0.857	-0.418	4.719	18.89 (0.00)	10.81 (0.98)
	ADJ	0.000	1.111	-0.428	3.980	8.76 (0.01)	10.45 (0.98)	0.000	1.205	-0.539	3.437	7.00 (0.03)	11.76 (0.96)
9	*R*	0.162	1.183	-0.319	4.836	19.52 (0.00)	13.48 (0.92)	0.152	1.173	-0.288	4.326	10.80 (0.00)	22.49 (0.43)
	MM	0.000	0.786	-0.097	2.787	0.43 (0.81)	15.64 (0.83)	0.000	0.693	0.218	2.943	1.00 (0.61)	22.09 (0.46)
	ADJ	0.000	1.098	-0.579	4.330	16.07 (0.00)	16.70 (0.78)	0.000	1.029	-0.316	3.611	3.80 (0.15)	21.76 (0.47)
10	*R*	0.207	1.116	-0.441	3.688	6.46 (0.04)	11.10 (0.97)	0.227	1.063	-0.106	3.450	1.28 (0.53)	23.31 (0.39)
	MM	0.000	0.656	-0.089	4.108	6.50 (0.04)	13.67 (0.91)	0.000	0.686	0.291	2.767	2.03 (0.36)	18.63 (0.67)
	ADJ	0.000	1.029	-0.276	3.306	2.06 (0.36)	12.06 (0.96)	0.000	0.982	0.157	3.013	0.48 (0.79)	20.36 (0.56)

Figure 5. Logarithmic return series, size-sorted decile portfolios, market capitalisations of November 2012 (solid line) and February (dotted line).

P1 and *P10* stand for the largest and the smallest decile portfolios by market capitalisation, respectively.

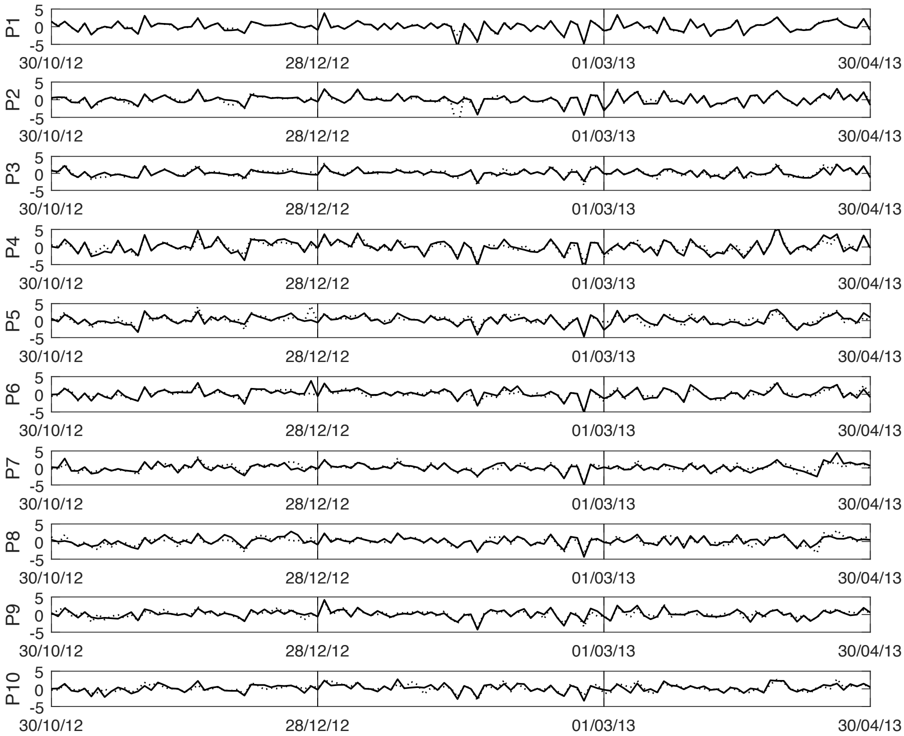


Figure 6. Market model residuals, size-sorted decile portfolios, market capitalisations of November 2012 (solid line) and February (dotted line).

P1 and *P10* stand for the largest and the smallest decile portfolios by market capitalisation, respectively.

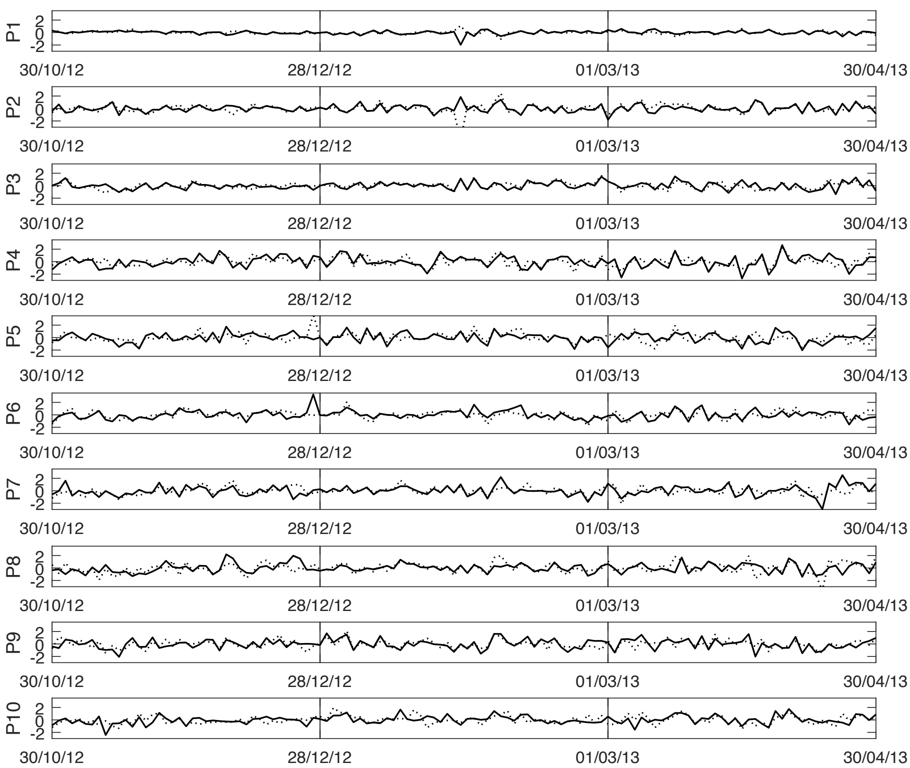
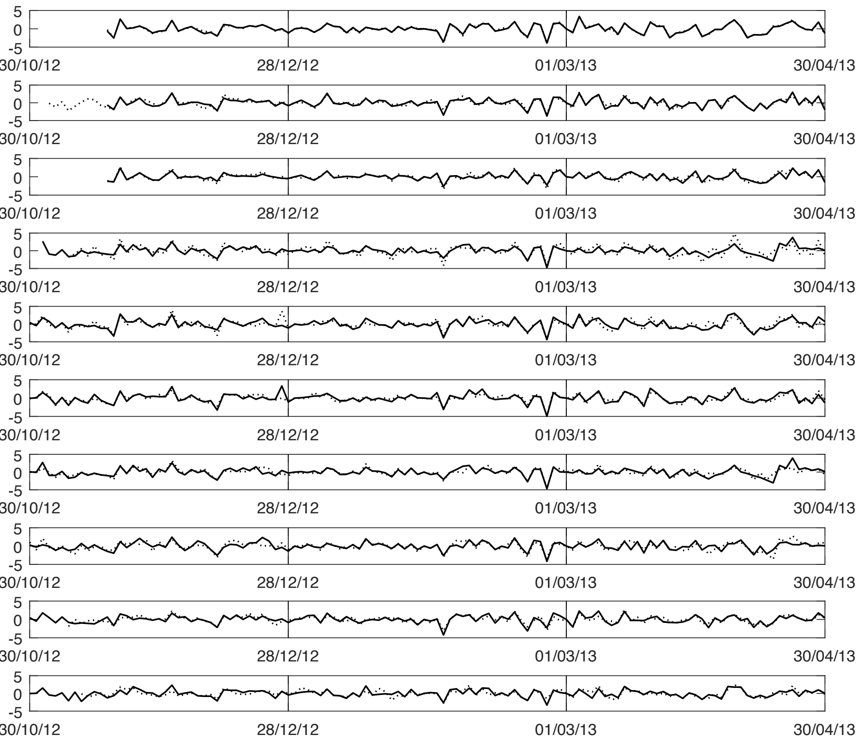


Figure 7. Adjusted returns, size-sorted decile portfolios, market capitalisations of November 2012 (solid line) and February (dotted line).

P1 and *P10* stand for the largest and the smallest decile portfolios by market capitalisation, respectively.



4 Empirical results

In this section, the results of the test concerning the liquidity change around the tax announcement and tax imposition events for the portfolios comprised of Italian stocks are reported. The obtained results regarding volatility effect are introduced separately for each series, namely, logarithmic returns, market model residuals and adjusted returns. The effect of the tax announcement of 29 December 2012 is evaluated using the November capitalisation since the February 2013 capitalisation cannot be known in December 2012. The impact of the tax imposition event of 1 March 2013 is studied from the perspective of the nearest market capitalisation of February 2013.

4.1 Liquidity

Using the method in section 3.1, quoted and relative quoted measures of the joint and decile portfolios are tested for changes in their medians as a consequence of the tax announcement and tax imposition. Table 6 presents the Mann-Whitney test results for two joint portfolios. For completeness, test statistics for homogeneity of variances are also included in the table.

Table 6. Test statistics for two liquidity measures of joint portfolios around the tax announcement, 29 December 2012, and tax imposition dates, 1 March 2013, daily observations, October 2012 – April 2013.
***, ** and * indicate statistical significance at 10%, 5% and 1%, respectively.

Statistic	Quoted spreads	Relative quoted spreads
A. Tax announcement, 29 December 2012, November market capitalisation		
Median before the event	0.0097	0.0011
Median after the event	0.0089	0.0009
Mann-Whitney U-test	2043*	2378*
Standard Deviation before	0.011	0.000
Standard Deviation after	0.001	0.000
Levene's absolute	2.184	1.207
Levene's quadratic	1.052	1.052
Brown-Forsythe	1.090	1.302
O'Brien	1.029	1.026
B. Tax imposition, 1 March 2013, February market capitalisation		
Median before the event	0.0091	0.0009
Median after the event	0.0128	0.0014
Mann-Whitney U-test	970 *	926*
Standard Deviation before	0.001	0.000
Standard Deviation after	0.002	0.000
Levene's absolute	9.661*	2.366
Levene's quadratic	5.408**	1.278
Brown-Forsythe	6.061**	2.541
O'Brien	5.275**	1.250

Table 6 Panel A demonstrates that the median quoted and relative quoted spread values decrease from 0.0097 to 0.0089 and from 0.0011 to 0.0009 after the tax announcement date of 29 December 2012 at the less than 1% significance level, suggesting that liquidity of the affected Italian stocks increases after the FTT announcement. In contrast, Panel B shows that the median quoted and relative quoted spreads increase after the tax introduction from 0.0091 to 0.0128 and 0.0009 to 0.0014 at the less than 1% statistically significant level, indicating that liquidity of the affected stocks decreases after the tax imposition. The size of the statistically significant increase in spreads ranges between 41% and 56%. Interestingly, the volatility of quoted spreads almost doubles as a result of FTT imposition of 1 March 2013 at the less than 5% significance level. However, there is no statistically significant difference between volatility of liquidity measures around the tax announcement date.

Table 7. Mann-Whitney U-test statistics for quoted and relative quoted spreads of decile portfolios around the tax announcement and the tax imposition dates.

P-values are in parentheses. ***, ** and * denote statistical significance at the 10%, 5% and 1% levels, respectively.

P	Statistic	Quoted spreads	Relative quoted spreads
A. Tax announcement, 29 December 2012, November market capitalisation			
1	Median before	0.0076	0.0006
	Median after	0.0074	0.0006
	Mann-Whitney U-test	1903 (0.10)***	1993 (0.06)***
2	Median before	0.0045	0.0008
	Median after	0.0041	0.0007
	Mann-Whitney U-test	1841.5 (0.28)	2251 (0.00)*
3	Median before	0.0146	0.0007
	Median after	0.0183	0.0008
	Mann-Whitney U-test	1509.5 (0.01)*	1597 (0.09)***
4	Median before	0.0053	0.0008
	Median after	0.0048	0.0006
	Mann-Whitney U-test	1941 (0.16)	2206 (0.00)*
5	Median before	0.0177	0.0023
	Median after	0.0136	0.0016
	Mann-Whitney U-test	2152 (0.00)*	2335 (0.00)*
6	Median before	0.0152	0.0035
	Median after	0.0160	0.0031
	Mann-Whitney U-test	1724 (0.59)	1949 (0.14)
7	Median before	0.0400	0.0055
	Median after	0.0273	0.0036
	Mann-Whitney U-test	2148 (0.00)*	2178 (0.00)*
8	Median before	0.0060	0.0021
	Median after	0.0058	0.0018
	Mann-Whitney U-test	1849 (0.57)	2065 (0.01)*
9	Median before	0.0164	0.0026
	Median after	0.0171	0.0023
	Mann-Whitney U-test	1745 (0.72)	1983 (0.08)***
10	Median before	0.0271	0.0035
	Median after	0.0258	0.0030
	Mann-Whitney U-test	1920 (0.23)	2056 (0.02)**
B. Tax imposition, 1 March 2013, February market capitalisation			
1	Median before	0.0065	0.0005
	Median after	0.0074	0.0006
	Mann-Whitney U-test	1475 (0.01)*	1457 (0.01)*
2	Median before	0.0051	0.0006
	Median after	0.0070	0.0009
	Mann-Whitney U-test	1391.5 (0.00)*	1265 (0.00)*
3	Median before	0.0191	0.0009
	Median after	0.0259	0.0011
	Mann-Whitney U-test	1184.5 (0.00)*	1258 (0.00)*
4	Median before	0.0052	0.0007
	Median after	0.0092	0.0014
	Mann-Whitney U-test	1021 (0.00)*	985 (0.00)*
5	Median before	0.0196	0.0026
	Median after	0.0268	0.0033
	Mann-Whitney U-test	1288 (0.00)*	1350 (0.00)*
6	Median before	0.0106	0.0012
	Median after	0.0205	0.0024
	Mann-Whitney U-test	959 (0.00)*	937 (0.00)*
7	Median before	0.0088	0.0017
	Median after	0.0140	0.0026
	Mann-Whitney U-test	1254 (0.00)*	1288 (0.00)*
8	Median before	0.0123	0.0018
	Median after	0.0255	0.0039
	Mann-Whitney U-test	1093 (0.00)*	1094 (0.00)*
9	Median before	0.0312	0.0049
	Median after	0.0511	0.0080
	Mann-Whitney U-test	1245 (0.00)*	1241 (0.00)*
10	Median before	0.0243	0.0032
	Median after	0.0441	0.0053
	Mann-Whitney U-test	1007 (0.00)*	942 (0.00)*

Table 7 reports the Mann-Whitney U-test results for both liquidity measures of all decile portfolios around the tax announcement and tax imposition dates. Three out of ten quoted spreads and eight out of ten relative quoted spreads demonstrate a significant decrease after the tax announcement, while the liquidity measures of the decile portfolio P3 show a significant increase, albeit small in magnitude. Furthermore, after the tax introduction, both spreads considerably increase for all decile portfolios, clearly indicating a decrease in liquidity for all stocks. The magnitude of the liquidity decrease is inversely proportional to the market capitalisation; that is, smaller companies experience a larger liquidity dry up.

Overall, the results suggest that the announcement of FTT has a positive effect on the liquidity of affected stocks in the Italian market, while the liquidity of stocks reduces substantially after tax introduction.

The obtained results, in terms of FTT introduction effect, are consistent with Chou and Wang (2006), who use a similar measure of liquidity. Furthermore, although Baltagi et al. (2006), Pomeranets and Weaver (2011) and Foucault et al. (2011) use different measures of liquidity, the results are found to be consistent with these papers as well.

4.2 Volatility

Volatility of the logarithmic returns, market model residuals and adjusted returns is analysed in this section. Table 8 presents results from four tests of homogeneity of variances for the joint portfolio around the tax announcement and tax imposition dates.

Table 8. Test statistics for the volatility change around the tax announcement and tax imposition dates, joint portfolios based on three return measures.

Statistic	Logarithmic returns	Market model residuals	Adjusted returns
A. Tax announcement, 29 December 2012			
Standard Deviation before[&]	1.061	0.068	1.097
Standard Deviation after[&&]	1.539	0.136	1.203
Levene’s absolute	1.257 (0.27)	4.356 (0.04)**	0.008 (0.93)
Levene’s quadratic	2.337 (0.13)	1.874 (0.17)	0.158 (0.69)
Brown-Forsythe	0.845 (0.36)	4.401 (0.04)**	0.008 (0.93)
O'Brien	2.277 (0.14)	1.824 (0.18)	0.138 (0.71)
B. Tax imposition, 1 March 2013			
Standard Deviation before	1.501	0.086	1.212
Standard Deviation after	1.322	0.080	1.257
Levene’s absolute	0.104 (0.75)	0.033 (0.86)	1.213 (0.27)
Levene’s quadratic	0.405 (0.53)	0.221 (0.65)	0.038 (0.85)
Brown-Forsythe	0.071 (0.79)	0.004 (0.95)	1.234 (0.27)
O'Brien	0.393 (0.53)	0.205 (0.65)	0.038 (0.85)

Notes: [&], [&&]Standard Deviations of portfolio returns before and after the tax announcement and tax imposition days. *P*-values are in the parentheses. ***, ** and * indicate statistical significance at 10%, 5% and 1%, respectively.

Table 8 demonstrates that the null hypothesis of equality of variances is not rejected at all conventional significance levels for the logarithmic returns and adjusted returns of joint portfolios around the tax announcement date, even though they show an increase in standard deviations from 1.061 to 1.539, and from 1.097 to 1.203. The results for the market model residuals are mixed around the tax announcement date: Levene's test for absolute measures and the Brown-Forsythe test confirm an increase at the 5% level, while Levene's test for quadratic measures and O'Brien's test confirm that the volatilities are not significantly different around the tax announcement date.

The tax imposition event did not change the volatility at the less than 10% significance level for all return measures as confirmed by all four tests. For example, the standard deviation of the logarithmic returns and market model residuals lowers after the tax imposition date: a pre-tax value of 1.501 vs. a post-tax value of 1.322, and 0.086 vs. 0.080, respectively, but the change is not statistically significant. Adjusted returns, in contrast, demonstrate an increase in standard deviation from 1.212 to 1.257 around the tax introduction event, although this change is also not statistically significant. A relatively smaller value of the standard deviation before the tax imposition event here can be attributed to the Saipem share price drop of the pre-tax period, which was accounted for by a dummy variable in equation (3).

Table 9 provides a breakdown of the test results for the standard deviations of three return series around the tax announcement event of 29 December 2012 by size-sorted decile portfolios. Generally, there is no pattern indicating a significant change in volatility as a result of the tax announcement. However, there are some individual occurrences of a significant change in the return variance. For example, the standard deviation of logarithmic returns increases for decile portfolios P1 and P9 at the 10% significance level. Additionally, the market model residuals of portfolios P1-P3 and P9 enjoy an increase in variance at the 5% significance level. At the same time, portfolio P8 demonstrates a statistically significant decrease in volatility from 0.841 to 0.545 as a result of the tax announcement. In the case of adjusted returns, test statistics show no effect of the announcement on the volatility of stocks sorted by market size.

Table 9. Test statistics for the volatility change around the tax announcement date of 29 December 2012, decile portfolios based on three return measures (*p*-values in parentheses).

P	Statistic	Logarithmic returns	Market model residuals	Adjusted returns
1	Standard Deviation before	1.136	0.192	0.010
	Standard Deviation after	1.778	0.406	0.011
	Levene's absolute	3.155 (0.08)***	3.532 (0.06)	0.202 (0.65)
	Levene's quadratic	3.152 (0.08)***	0.056 (0.16)	0.363 (0.55)
	Brown-Forsythe	2.165 (0.15)	3.814 (0.05)**	0.226 (0.64)
	O'Brien	3.071 (0.08)***	2.005 (0.16)	0.352 (0.55)
2	Standard Deviation before	1.002	0.444	0.009
	Standard Deviation after	1.432	0.649	0.012
	Levene's absolute	0.845 (0.36)	6.242 (0.01)*	1.033 (0.31)
	Levene's quadratic	1.816 (0.18)	4.374 (0.04)**	1.466 (0.23)
	Brown-Forsythe	0.848 (0.36)	4.853 (0.03)**	1.070 (0.30)
	O'Brien	1.769 (0.19)	4.261 (0.04)**	1.428 (0.24)
3	Standard Deviation before	0.857	0.425	0.011
	Standard Deviation after	1.017	0.554	0.011
	Levene's absolute	0.053 (0.82)	4.358 (0.04)**	0.031 (0.86)
	Levene's quadratic	0.687 (0.41)	2.439 (0.12)	0.011 (0.92)
	Brown-Forsythe	0.058 (0.81)	4.164 (0.04)**	0.049 (0.83)
	O'Brien	0.668 (0.42)	2.373 (0.13)	0.010 (0.92)
4	Standard Deviation before	1.806	0.793	0.015
	Standard Deviation after	2.011	0.823	0.015
	Levene's absolute	0.044 (0.83)	0.001 (0.98)	0.988 (0.32)
	Levene's quadratic	0.291 (0.59)	0.072 (0.79)	0.001 (0.98)
	Brown-Forsythe	0.061 (0.81)	0.001 (0.97)	0.967 (0.33)
	O'Brien	0.283 (0.60)	0.069 (0.79)	0.001 (0.98)
5	Standard Deviation before	1.221	0.679	0.012
	Standard Deviation after	1.456	0.780	0.013
	Levene's absolute	0.139 (0.71)	0.326 (0.57)	0.007 (0.93)
	Levene's quadratic	0.595 (0.44)	0.672 (0.41)	0.069 (0.79)
	Brown-Forsythe	0.080 (0.78)	0.367 (0.55)	0.000 (0.99)
	O'Brien	0.579 (0.45)	0.652 (0.42)	0.066 (0.80)
6	Standard Deviation before	1.299	0.769	0.009
	Standard Deviation after	1.432	0.630	0.014
	Levene's absolute	0.000 (0.99)	0.155 (0.70)	0.423 (0.52)
	Levene's quadratic	0.165 (0.69)	0.481 (0.49)	1.795 (0.18)
	Brown-Forsythe	0.005 (0.94)	0.172 (0.68)	0.466 (0.50)
	O'Brien	0.160(0.69)	0.470 (0.49)	1.749 (0.19)
7	Standard Deviation before	1.120	0.699	0.010
	Standard Deviation after	1.309	0.683	0.011
	Levene's absolute	0.043 (0.84)	0.474 (0.49)	0.098 (0.76)
	Levene's quadratic	0.394 (0.53)	0.014 (0.91)	0.115 (0.74)
	Brown-Forsythe	0.032 (0.86)	0.497 (0.48)	0.122 (0.73)
	O'Brien	0.383 (0.54)	0.014 (0.91)	0.111 (0.74)
8	Standard Deviation before	1.152	0.841	0.012
	Standard Deviation after	1.302	0.545	0.011
	Levene's absolute	0.034 (0.85)	4.944 (0.03)**	0.653 (0.42)
	Levene's quadratic	0.361 (0.55)	4.867 (0.03)**	0.135 (0.71)
	Brown-Forsythe	0.036 (0.85)	3.648 (0.06)***	0.614 (0.44)
	O'Brien	0.350 (0.55)	4.750 (0.03)**	0.133 (0.72)
9	Standard Deviation before	0.914	0.657	0.009
	Standard Deviation after	1.448	0.838	0.011
	Levene's absolute	2.514 (0.12)	2.889 (0.09)***	0.557 (0.46)
	Levene's quadratic	3.379 (0.07)***	2.591 (0.11)	1.552 (0.22)
	Brown-Forsythe	2.599 (0.11)	2.898 (0.09)***	0.569 (0.45)
	O'Brien	3.293 (0.07)***	2.521 (0.12)	1.511 (0.22)
10	Standard Deviation before	1.015	0.627	0.007
	Standard Deviation after	1.299	0.577	0.008
	Levene's absolute	0.867 (0.35)	0.028 (0.87)	0.806 (0.37)
	Levene's quadratic	1.606 (0.21)	0.166 (0.68)	0.230 (0.63)
	Brown-Forsythe	0.850 (0.36)	0.051 (0.82)	0.843 (0.36)
	O'Brien	1.563 (0.21)	0.163 (0.69)	0.223 (0.64)

Table 10. Test statistics for the volatility change around the tax imposition date of 1 March 2013, decile portfolios based on three return measures (*p*-values in parentheses).

P	Statistic	Logarithmic returns	Market model residuals	Adjusted returns
1	Standard Deviation before	1.664	0.323	0.012
	Standard Deviation after	1.340	0.268	0.013
	Levene's absolute	0.004 (0.95)	0.008 (0.93)	1.979 (0.16)
	Levene's quadratic	0.363 (0.55)	0.558 (0.46)	0.237 (0.63)
	Brown-Forsythe	0.015 (0.90)	0.011 (0.92)	2.273 (0.14)
	O'Brien	0.353 (0.55)	0.542 (0.46)	0.233 (0.63)
2	Standard Deviation before	1.824	1.032	0.011
	Standard Deviation after	1.402	0.622	0.013
	Levene's absolute	0.055 (0.82)	0.458 (0.50)	1.786 (0.19)
	Levene's quadratic	0.624 (0.43)	1.114 (0.29)	1.112 (0.29)
	Brown-Forsythe	0.088 (0.77)	0.459 (0.50)	1.862 (0.18)
	O'Brien	0.608 (0.44)	1.086 (0.30)	1.088 (0.30)
3	Standard Deviation before	1.296	0.520	0.012
	Standard Deviation after	1.181	0.592	0.011
	Levene's absolute	0.081 (0.78)	3.620 (0.06)	0.132 (0.72)
	Levene's quadratic	0.226 (0.64)	0.755 (0.39)	0.061 (0.81)
	Brown-Forsythe	0.098 (0.76)	3.316 (0.07)	0.135 (0.71)
	O'Brien	0.219 (0.64)	0.740 (0.39)	0.059 (0.81)
4	Standard Deviation before	1.704	0.911	0.014
	Standard Deviation after	1.720	0.805	0.015
	Levene's absolute	0.434 (0.51)	1.738 (0.19)	1.610 (0.21)
	Levene's quadratic	0.003 (0.96)	0.717 (0.40)	0.335 (0.56)
	Brown-Forsythe	0.382 (0.54)	1.758 (0.19)	1.632 (0.21)
	O'Brien	0.003 (0.96)	0.696 (0.41)	0.329 (0.57)
5	Standard Deviation before	1.342	0.666	0.013
	Standard Deviation after	1.342	0.809	0.014
	Levene's absolute	1.002 (0.32)	1.433 (0.23)	0.801 (0.37)
	Levene's quadratic	0.000 (0.99)	1.487 (0.23)	0.015 (0.90)
	Brown-Forsythe	0.877 (0.35)	1.130 (0.29)	0.806 (0.37)
	O'Brien	0.000 (0.99)	1.454 (0.23)	0.015 (0.90)
6	Standard Deviation before	1.367	0.656	0.011
	Standard Deviation after	1.287	0.703	0.011
	Levene's absolute	0.422 (0.52)	1.024 (0.31)	0.576 (0.45)
	Levene's quadratic	0.065 (0.80)	0.151 (0.70)	0.009 (0.93)
	Brown-Forsythe	0.210 (0.65)	1.051 (0.31)	0.417 (0.52)
	O'Brien	0.063 (0.80)	0.148 (0.70)	0.009 (0.93)
7	Standard Deviation before	1.376	0.578	0.010
	Standard Deviation after	1.024	0.764	0.010
	Levene's absolute	0.389 (0.53)	3.085 (0.08)***	0.687 (0.41)
	Levene's quadratic	1.492 (0.23)	2.119 (0.15)	0.040 (0.84)
	Brown-Forsythe	0.452 (0.50)	3.079 (0.08)***	0.573 (0.45)
	O'Brien	1.453 (0.23)	2.071 (0.15)	0.040 (0.84)
8	Standard Deviation before	1.302	0.715	0.012
	Standard Deviation after	1.306	1.048	0.011
	Levene's absolute	0.327 (0.57)	2.897 (0.09)***	0.024 (0.88)
	Levene's quadratic	0.000 (0.99)	2.450 (0.12)	0.574 (0.45)
	Brown-Forsythe	0.464 (0.50)	2.818 (0.10)***	0.018 (0.89)
	O'Brien	0.000 (0.99)	2.391 (0.13)	0.557 (0.46)
9	Standard Deviation before	1.417	0.727	0.011
	Standard Deviation after	1.073	0.692	0.012
	Levene's absolute	0.744 (0.39)	0.105 (0.75)	0.730 (0.40)
	Levene's quadratic	1.827 (0.18)	0.096 (0.76)	0.009 (0.93)
	Brown-Forsythe	0.504 (0.48)	0.071 (0.79)	0.798 (0.37)
	O'Brien	1.779 (0.19)	0.092 (0.76)	0.009 (0.93)
10	Standard Deviation before	1.248	0.698	0.008
	Standard Deviation after	1.092	0.746	0.010
	Levene's absolute	0.152 (0.70)	0.460 (0.50)	2.295 (0.13)
	Levene's quadratic	0.608 (0.44)	0.226 (0.64)	1.241 (0.27)
	Brown-Forsythe	0.143 (0.71)	0.551 (0.46)	2.261 (0.14)
	O'Brien	0.590 (0.44)	0.223 (0.64)	1.214 (0.27)

Moving on to the effect of tax announcement on volatility of the affected stocks, Table 10 shows that all but two decile portfolios based on three return measures experience no significant effect of the FTT imposition because the test statistics for homogeneity of variances are not statistically significant even at the 10% level. Only two decile portfolios, P7 and P8, based on market model residuals experience a significant increase in volatility as confirmed by Levene's absolute and Brown-Forsyth tests, while this result is not supported by Levene's quadratic and O'Brien's tests.

To summarise, we can see that all test results mainly show no changes in stock return volatility for the joint and decile portfolios. However, there are a few indications of volatility change for the logarithmic return series as well as for the market model residuals resulting from the tax announcement event. In comparison, the adjusted series shows no indication of volatility change between subsamples for all portfolios. This difference might be explained as an impact of Saipem's share price drop during the post-announcement period that was accounted for in the case of adjusted returns. Thus, based on the results of adjusted series, we state that neither the announcement nor introduction of FTT events affects return volatility of the taxed Italian stocks regardless of the size of the portfolio considered.

5 Conclusions

The analysis of the impact of financial transaction taxes on market behaviour is a topic of current interest in financial research. However, this area of study still remains a contentious issue not only for researchers but also for policy makers. Proponents of FTT argue that the introduction of tax positively affects market quality, whereas the ideas of opponents are contradictive.

In this study, the effect of the announcement and introduction of Italian FTT on the affected stocks is examined. Although the paper's results for volatility contradict the ideas of proponents and opponents of FTT such as Keynes (1936), Tobin (1978), Schwert and Seguin (1993), and Kupiec (1996), they show consistency with recent French and Italian FTT research papers, namely the EU Commission report (2013), Colliard and Hoffmann (2015), Capelle-Blancard and Havrylchyk (2014) and Coelho (2015).

Data on affected Italian stocks show that the announcement of the 0.12% tax decreases quoted and relative quoted measures by 8% and 18%, respectively, whereas the same measures of liquidity dramatically widen by 41% and 56%, respectively, as a result of a tax introduction event. As for volatility, the results indicate no statistically significant changes throughout all subsamples before and after the announcement and introduction events. Thus, volatility does not change as a result of the FTT introduction as some proponents argue.

It is known that liquidity is an important aspect of trading because, in a less liquid market, traders take higher losses because of increased bid-ask spreads (Hull, 2015). As FTT is imposed in part due to raising revenue for future support of the financial sector, the burden of FTT should be laid on financial institutions only (Matheson, 2011). Since all traders pay for the increased bid-ask spreads, including businesses and individuals, policy makers should take it into account for future consideration.

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