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調降當日沖銷證券交易稅之影響：臺灣股票市場實證研究

吳貞慧*
國立中正大學會計與資訊科技學系

王姿韻
國立中正大學會計與資訊科技學系

摘要

本文檢測於 2017 年 4 月 28 日實施當日沖銷證券交易稅減半，臺灣股票市場前後各一年 30 檔交易活絡之股票。經採用傾向分數配對法尋求與未降稅前的股票加以配對，本研究實證結果顯示，實施當日沖銷證交稅減半有助於提升市場品質之衡量，即成交值、成交量、週轉率、波動性與流動性。本文再以差異中之差異法進行檢測，除了波動性呈現不顯著影響外，其他市場品質衡量之變數均獲得顯著提升。本文更進一步檢測調降當日沖銷證交稅對四項交易影響之衡量，即現股當沖成交量、現股當沖成交量比重、資券互抵張數與資券互抵比例。經本研究實證結果顯示，現股當沖成交量與現股當沖成交量比重均呈現顯著正向影響；反之，資券互抵張數與資券互抵比例則呈現顯著負向影響。以上實證結果在前述兩種統計方法的驗證下，均獲得穩健性的結果。整體而言，調降當日沖銷證交稅在本研究檢測期間，確實提升市場品質，同時導致當日沖銷取代融資融券之交易。

關鍵詞：當日沖銷、資券互抵、市場品質、證券交易稅

* 通訊作者電子信箱：chenhui@ccu.edu.tw。地址：62102 嘉義縣民雄鄉大學路 168 號。作者衷心感謝總編輯、編輯委員會、兩位匿名評審委員、及林嬋娟教授寶貴的意見及建議。

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The Effects of Reducing the Securities Transaction Tax on Day Trading: Evidence from the Taiwan Stock Market

Chen-Hui Wu*
Department of Accounting and Information Technology
National Chung Cheng University

Tzu-Yun Wang
Department of Accounting and Information Technology
National Chung Cheng University

Abstract

We have examined the 30 most actively-traded stocks for one year before and one year after the day trading transaction tax reduction implemented on April 28, 2017. Our findings show that the tax reduction increased market quality as measured by trading value, trading volume, turnover, volatility and liquidity while matching their prior untreated stocks using a propensity-score matching approach. When we use the difference-in-differences approach, qualitatively similar results also apply except for volatility, which has no significant effect. Furthermore, we investigate the effects of the tax reduction on the transaction impact as measured by the day trading volume, day trading ratio, margin netting and the margin netting ratio. The empirical results show that the day trading volume and the day trading ratio are positive and statistically significant, whereas the margin netting and the margin netting ratio are negative and statistically significant. These findings are robust to the two above-mentioned statistical approaches. Overall, the policy of reducing the securities transaction tax (STT) on day trading has improved market quality and resulted in the substitution of day trading for margin trading in the period.

Keywords: *Day trading, Margin netting, Market quality, Securities transaction tax.*

* Corresponding author, email: chenhui@ccu.edu.tw. Address: No. 168, Sec. 1, University Rd., Min-Hsiung Township, Chia-yi County 621, Taiwan (R.O.C.). The authors are grateful to the Editors, the Editorial Committee, two anonymous referees, and Professor Chan-Jane Lin for very helpful comments and suggestions.

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1. INTRODUCTION

The securities transaction tax (STT) has been widely adopted around the world in policy-making, and even the most developed countries operate several versions of the STT.[1] As the stock exchanges in many developing and emerging countries have been facing fierce competition in recent years due to technological advances in securities trading (Indriawan 2018),[2] the advent of innovative technologies, such as algorithmic trading and high frequency trading, has made it easier for day-traders to operate in the stock market. Taiwan currently imposes an STT of 0.3% on sellers in the stock market. To boost the Taiwanese stock market, the government decided to lower the STT on day trading activities to 0.15% on April 28, 2017, due to the reduction in trading volume since 2009. After a year of careful evaluation, the government decided to extend the implementation of the STT reduction until 2021.

The imposition of an STT in the stock market has been the subject of much debate. The positive effect of introducing or increasing the STT is that it curbs short-term speculative trading as well as excess volatility (e.g., Stiglitz 1989; Pomeranets and Weaver 2018). By contrast, the negative effect of levying the STT is that it gives rise to concerns regarding a deterioration in market quality by discouraging some of the more rational and stabilizing investors (e.g., Gomber, Haferkorn, and Zimmermann 2016; Cappelletti, Guazzarotti, and Tommasino 2017). A recent study provides an explanation of the effect of the STT based on the sophistication of the market. Deng, Liu, and Wei (2018) show that the STT has an impact on the market given the prevalence of uninformed traders, while it has no effect on the market if it is dominated by better-informed traders.

Taiwan is the first country in the world to implement a reduction in the tax on day trading.[3] The purposes underlying such a reduction in the STT on day trading are to lower transaction costs and create better investment opportunities. Proponents argue that a tax reduction would alleviate the transaction costs borne by day-traders, thereby improving the market volume and liquidity despite concerns that it might encourage speculative trading, which would affect the market quality. The relevant empirical investigation of a reduction in the STT has been limited because of its infrequent application. While most previous studies examine an introduction or increase in the STT (Table 1 provides a summary of the

[1] Pollin, Baker, and Schaberg (2003) survey 38 countries which operate diverse forms of the STT. For example, they look at major financial economies, such as Japan, the U.K., Germany, Italy, and France, and many emerging economies, such as Chile, China, India, and Malaysia.

[2] Desjardins (2017) reports that 9 out of the world's 20 largest stock exchanges are located in the Asia-Pacific region.

[3] Liberty Times Net, 2016.12.13. The reduction in the STT on day trading – Finance Minister: The longest might last for one year (https://ec.ltn.com.tw/article/paper/1061094). Accessed: January 6, 2020.

past literature),[4] the purpose of this study is to examine the effects of the reduction in the STT on day trading on the market quality and transaction impact.

We employ the propensity-score matching (PSM) and the difference-in-differences (DID) methods to uncover our formulated research questions. As to testing the effect on market quality, we investigate whether the five indicators representing the market quality measures are affected by the STT reduction. Our empirical findings show that trading value, trading volume, turnover, volatility, and liquidity are positive and statistically significant after matching them with prior untreated stocks based on the PSM analysis. The results based on the DID method also provide evidence of positive and significant impacts on four market quality measures with the exception of volatility, which is consistent with the findings of recent studies (e.g., Gomber et al. 2016; Hvozdyk and Rustanov 2016).

With regard to testing the transaction impact, this paper examines whether the four indicators representing the transaction impact measures exhibit changes following the implementation of the new STT policy. The empirical findings reveal that the day trading volume and day trading ratio exhibit positive and statistically significant PSM coefficients, whereas the margin netting and margin netting ratio give rise to negative and statistically significant PSM coefficients when matched with prior untreated stocks. The DID method provides qualitatively similar results to those of the PSM approach. Overall, the implementation of the STT reduction policy improves the market quality and encourages investors to engage in day trading by taking advantage of the tax reduction.[5]

We contribute to the literature on the issue of STT in several ways. First, the empirical evidence presented in this paper is directed towards the effects of the reduction in the STT on market quality and the substitution of day trading for margin trading activities, while most of the previous studies focus on the introduction or increase in STT. Second, this paper contributes to the existing literature in terms of the methodological aspect whereby we compare the treated stocks with a control group of ETF shares belonging to the same stock market with similar microstructure characteristics, which can mitigate extraneous factors arising from different stock markets. Several studies that examine the effect of the STT compare the treatment group with a control group from another country. For example, Gomber et al. (2016) compare the treated French STT stocks with a control group that is made up of the stocks in the German blue chip index DAX 30. Colliard and Hoffmann (2017) compare treated French STT stocks with a control group of non-French stocks listed on Euronext.

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[4] Although Chou and Wang (2006) investigate the effect of a tax reduction on trading volume, the bid-ask spread and price volatility, their sample is based on Taiwan Stock Index Futures.

[5] We cannot find comparable empirical findings on the effect of the STT on the transaction impact measures since Taiwan is the first country in the world to implement a reduction in the STT on day trading.

This paper thus contributes to the debate on whether the STT reduction policy improves or worsens market quality, regarding which the results provide important implications for regulators and participants in the stock market. Specifically, the empirical findings on the impact of the reduction in the STT on several market quality measures are able to assist regulators and practitioners in evaluating the effectiveness of the reduced STT on day trading activities. In addition, stock markets worldwide are benefiting from the advances in computerized trading technology that are further facilitating the execution of day trading. This paper reveals a gradual shift from margin trading to day trading activities which provides additional insights to all market participants.

The remainder of the paper is organized as follows. Section 2 discusses the related literature. Section 3 describes the Taiwanese stock market and the regulatory history of the STT. Section 4 provides the dataset, measurement of variables, and methodological descriptions. Section 5 reports the empirical results. Section 6 concludes.

2. RELATED LITERATURE

The issue of using a tax policy as a tool to influence the stock market has been intensely debated among practitioners, legislators, and academics. The benefits and costs of levying an STT are complex and depend on its characteristics, size, and implementation (Campbell and Froot 1994). Advocates of an STT argue that a tax on transactions is likely to discourage short-term speculative trading, reduce price volatility, and enhance the efficiency of the stock market (Stiglitz 1989). The efficiency benefits of curbing the instability introduced by speculation outweigh any costs of reduced liquidity or increased costs of capital that arise as the result of imposing the STT (Summers and Summers 1989).

Opponents of a transaction tax argue that levying any such tax may induce investors to change their behavior to reduce tax payments. When the objective of the tax is to reduce the negative externalities of excess volatility and speculative trading, the tax base tends to shrink as the tax rate increases. Specifically, investors can change the location of their transactions by engaging in them offshore or only trade untaxed substitute securities that generate similar payoffs (Campbell and Froot 1994). The empirical evidence reveals that several Swedish companies relocated to London when the transaction tax in Sweden increased to 2% in 1986 (Umlauf 1993).[6]

Schwert and Seguin (1993) provide a comprehensive review of the pros and cons of the STT. The potential benefits of an STT involve reducing the excess price volatility, limiting unproductive speculation, focusing on the long-term evaluation horizons, and

[6] As posited by Campbell and Froot (1994), international experience with STTs are quite different due to their nature, size, and implementation. The empirical findings of this paper concentrate on the effect of STT reduction on market quality and the substitution from margin trading to day trading strategy.

increasing tax revenues. By contrast, the drawbacks point to the possible investment portfolio and capital structure distortions. Since the STT only applies to a subset of securities, it will change the relative costs of holding and issuing different classes of securities. In addition, a transaction tax will have an impact on the supply of and demand for the various securities classes, suggesting deviations from the no-tax-equilibrium to the with-tax-equilibrium. An STT directly affects the transaction cost and indirectly affects the liquidity via the bid-ask spread that results in the market inefficiency. The costs associated with the tax implementation, compliance and avoidance are expected to increase.

Due to the controversial viewpoints regarding the STT, previous empirical studies directly investigate the consequences of implementing the STT on market quality. Hu (1998) examines the effects of 14 stock transaction tax changes during the period from 1975 to 1994 in four Asian securities markets, namely, Hong Kong, Japan, Korea, and Taiwan. The announcement effect of tax rate changes depends on the nature and length of the tax's implementation. The empirical results reveal that an increase in the tax rate reduces the stock price, but has an insignificant effect on market volatility and market turnover.

Table 1 provides an overview of the effects of the STT on either the introduction or tax rate changes on relevant market quality measures. Evidently, the empirical findings yield mixed results, possibly due to the different samples and periods investigated. Most notably, a substantial number of studies examine the initiation of or increase in the STT (e.g., Gomber et al. 2016; Hvozdyk and Rustanov 2016; Cappelletti et al. 2017), but the effects of an STT reduction have not been fully explored in the literature. While this paper is closely related to studies that investigate reduction in the STT rate (e.g., Hu 1998; Chou and Wang 2006), we concentrate on the impact of a recent STT reduction for day trading on a variety of market quality and transaction impact measures in the Taiwanese stock market.

Table 1 Summary of Empirical Results of the STT Effects on Market Quality Measures

Study	Country/Period	Tax/Change	Sample	Major Findings
Umlauf (1993)	Sweden/1984-1986	STT/Increase	Stock market	Volatility (+), stock price level (-), turnover (-)
Baltagi, Li, and Li (2006)	China/Nov. 1996-Nov. 1997	Stamp tax/ Increase	Stocks included in the Shanghai A Share Index and the Shenzhen A Share Index	Trading volume (-), volatility (+)
Chou and Wang (2006)	Taiwan/May 1999-Apr. 2001	STT/Decrease	Taiwan stock index futures	Trading volume (+), bid-ask spreads (-), price volatility (no effect)
Liu (2007)	Japan/Apr. 1987-Mar. 1991	STT and capital gains/changes	Stocks included on the Tokyo Stock Exchange	Price level (-), volume (-)
Phylaktis and Aristidou (2007)	Greece/Sep. 1997-Dec. 2003	STT/changes	Stocks included in the All Share Index and the FTSE/ASE 20 Index	Stock returns (no effect), volatility (differential effect during bear and bull periods)
Becchetti, Ferrari, and Trenta (2014)	France/Mar. 2012-Dec. 2012	FTT/Intro	Stocks with market capitalization above €1 billion	Turnover (-), volatility (-), liquidity (not conclusive)
Meyer, Wagener, Weinhardt (2015)	France/Jun. 2012-Sep. 2012	STT/Intro	Stocks included in the Euronext Paris and Chi-X	Trading intensity (-), liquidity (inconclusive)
Capelle-Blancard and Havrylchyk (2016)	France/Feb. 2012-Jan. 2013	STT/Intro	Stocks included in the Euronext 100 or the Next 150 Indexes	Stock trading (-), bid-ask spread (no effect), price impact (no effect), volatility (no effect)

Table 1 Summary of Empirical Results of the STT Effects on Market Quality Measures (Continued)

Study	Country/Period	Tax/Change	Sample	Major Findings
Gomber et al. (2016)	France/6 months before and after Aug. 2012	STT/Intro	Stocks included in the French blue chip index CAC 40	Liquidity (-), trading volume (-), volatility (no effect)
Hvozdyk and Rustanov (2016)	Italy/Dec. 2012-Mar. 2013	STT/Intro	Stocks with market capitalization above €500 million	Liquidity (-), trading costs (+), volatility (no effect)
Capelle-Blancard (2017)	Italy/2011-2013	STT/Intro	Stocks included in the large and mid-caps	The paper also discusses the impact of the order-to-trade ratio (OTR). OTR and STT (insignificant effect on market volatility or liquidity)
Cappelletti et al. (2017)	Italy/ Mar. 2012-Aug. 2013	STT/Intro	Stocks with market capitalization above €500 million	Liquidity (-), volume (no effect), equity return (no effect), volatility (inconclusive)
Colliard and Hoffmann (2017)	France/ Jun. 2012-Oct. 2012	FTT / Intro	Stocks included in the Euronext 100 or the Next 150 Indexes	Trading volume (-), liquidity (-), market quality (-)
Pomeranets and Weaver (2018)	New York State STT/1932-1981. Federal STT /1932-1966	STT/changes	Stocks included on the NYSE and AMEX Exchanges	Individual stock volatility (+), bid-ask spreads (+), price impacts (+), volume (-)

Notes: This table reports the main empirical findings regarding the implementation of the STT. We have arranged the list in chronological order.

3. STOCK MARKET AND STT DESCRIPTIONS

The Taiwanese Stock Exchange (TWSE) was established in 1961. The Taiwan stock market was ranked as the 12th largest financial markets in the world at the end of 1999 (Barber, Lee, Liu, and Odean 2007). A daily price limit of 10% in each direction has been in place since June 1, 2015. The TWSE imposes a maximum commission fee of 0.1425% of the value of a trade. However, some brokers may offer a lower commission fee for online trading or larger traders. There is also a transaction tax levied on the seller of securities of 0.3%.

In the past two decades, the trading value of the stock market has on average been US$ 755.8 billion reaching the highest trading value of US$ 1,008.41 billion in 2007 and the lowest trading value of US$ 513.5 billion in 2016. The turnover rate has declined from its highest of 288.62% in 1999 to its lowest of 64.59% in 2016.[7] As pointed out by Hu (1998), the high turnover rate of the Taiwanese stock market suggests the existence of a larger portion of short-term traders. In earlier years, the government prohibited the purchase and sale of the same stock in the same account within the same trading day to curb speculative trading. It was found that using margin leverage produced a similar effect to that of day trading, in which the margin leverage was permitted to settle the transactions of securities in 1994.

To accommodate the different needs among long-term investors, hedge and arbitrage traders and to boost the economy, the stock market effectively began to permit day trading in the form of buys then sells of the same stock within the same day on January 6, 2014. At this stage, about 200 securities belonging to the FTSE TWSE Taiwan 50 Index, FTSE TWSE Taiwan Mid-Cap100 Index, and GreTai 50 Index were allowed to be traded in this way. An alternative form of sells then buys of the same stock on the same day was also introduced, allowing stock warrants and ETFs to engage in the day trading on June 30, 2014. After that, the regulation expanded the application of day trading to approximately 900 marginable securities on February 1, 2016.[8]

Evidently, the overall volume of trade in the Taiwanese stock market has been gradually shrinking and this has raised some concerns among market participants. In particular, the profitability of broker firms is closely related to the magnitude of trading value. The decline in trading value directly points to an operating loss of brokers and indirectly affects the development of the capital market. In order to improve the quality of

[7] Source: The Taiwan Stock Exchange Corporation. Available at: http://www.twse.com.tw/en/statistics. Accessed: March 26, 2019.

[8] Source: Legislative Yuan, Evaluation report on the amendment of Securities Transaction Tax Article 2-2. Available at: https://www.ly.gov.tw/Engpages/index.aspx. Accessed: March 28, 2019.

the stock market, a reduction in the STT on day trading from 0.3% to 0.15% was proposed and subsequently implemented on April 28, 2017. The issue of the STT is still widely being debated because of its relevance in competitive international capital markets (Campbell and Froot 1994). Most developed countries have removed their transaction taxes in recent years, although certain countries have also proposed implementing an STT, such as France and Italy in 2012 and 2013, respectively.

There are a variety of regimes used to tax securities transactions around the world. The taxes that are levied on transactions such as the sale and purchase of some financial instruments have the generic name of a Financial Transaction Tax (FTT). The different types of FTTs could be a transfer tax, a securities transaction tax, a financial transaction tax, a proposed FTT, or a stamp duty. Only four non-European countries implement the STT regime, and they are India, South Africa, South Korea, and Taiwan.[9]

A particular feature of the Taiwanese stock market involves the levying of a securities transaction tax. The transition of the STT rates has undergone many changes during these years. For instance, the STT began to be implemented with a tax rate of 0.15%, which applied to sellers based on the stock transaction value in 1965. The STT rate was increased to 0.3% because of a desire to reduce speculative trading in 1978. Then, the STT was temporarily removed due to a recession in 1985, but it was restored in 1986. Later, the STT rate was increased to 0.6% as a substitute for the capital gains tax in 1990. In 1993, the STT rate was restored to 0.3% due to the pressure exerted by interested parties until now (Hu 1998).[10]

While day trading activities have been allowed since 2014, the trading value of day trades with respect to the total trading value has, however, been only 10%. This proportion of day trading is apparently lower than those proportions in other well-developed stock markets, such as the 48.5% in the United States, 48.5% in Japan, 36% in the United Kingdom, and 20% in Hong Kong, respectively (Ko, Chou, and Yang 2017). Taiwan's Financial Supervisory Commission issued an evaluation report regarding the effect of the STT reduction on the tax expenditure and proposed adjusting the STT rate to 0.15% for day trading.[11] According to Ko et al.'s (2017) estimation, the elasticity of the tax rate in the Taiwanese stock market is greater than one, such that an increase in trading value could compensate for the negative effect of a decrease in the government's tax revenue.

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[9] Source: BNY Mellon, 2018. Financial Transaction Taxes (FTT): A Global Perspective. Available at: https://www.bnymellon.com/emea/en/_locale-assets/pdf/our-thinking/ftt-globalperspective-brochure-03-2018.pdf. Accessed: March 29, 2019.

[10] Detailed information about the transitions of the STT can be found in The History of the Ministry of Finance, R.O.C. website. Available at: http://museum.mof.gov.tw/ct.asp?xItem=15580&ctNode=35&mp=1. Accessed: March 29, 2019.

[11] Source: The Financial Supervisory Commission R.O.C. Available at: https://www.sfb.gov.tw/ch/home.jsp?id=769&parentpath=0,2. Accessed: March 31, 2019.

Finally, the Taiwanese stock market reduced its STT from 0.3% to 0.15% for day trading activities on April 28, 2017 for one year, that is, until April 27, 2018. Since the implementation of the STT reduction policy, the government has decided to extend the policy until December 31, 2021 due to the positive effects on the trading activities of the market and an increase in the net tax revenue as well.

4. RESEARCH DESIGN

4.1. Dataset and Sample Selection

To boost the stock market, the STT rate on day trading activities was reduced to 0.15% on April 28, 2017. We extend our sample to one year before (April 28, 2016 to April 27, 2017) and one year after the reduction in the STT (April 28, 2017 to April 27, 2018). We rely on the constituents of the FTSE TWSE Taiwan 50 Index and the FTSE TWSE Taiwan Mid-Cap100 Index in that their stocks must be eligible for margin purchase or short sale and must be permitted to be used in day trading as well. Finally, we choose the 30 most active traded stocks as our treatment sample. Daily data are extracted from the Taiwan Economic Journal (TEJ) Database. We collect data regarding trading value, trading volume, turnover, volatility, and liquidity to proxy for the market quality measures, and data on day trading volume and the margin netting of long and short positions are used to proxy for the transaction impact measures as well.

In the subsequent analysis, we will compare the treatment sample with the control sample. We define the control sample as the constituents of the Exchange Traded Funds (ETF) since the implementation of the STT rate reduction for the transactions in ETFs that were previously set at 0.1% and are not the subject of the tax changes. The traders who perform day trading activities involving ETFs have a similar trading motivation, ability, and profit-making strategy to those stock traders. There are currently 82 types of ETFs in the market. We exclude those ETFs that are passively traded or have missing data, leaving 30 such funds in our analysis as the control sample. A complete list of the stocks and ETFs analyzed in this paper is provided in Appendix 1.[12]

4.2. Market Quality Measures

A large body of literature has examined the effects of the STT initiation or changes on market quality measures. As summarized in Table 1, past empirical studies usually investigated trading volume, volatility, turnover and so on as several aspects of a stock market. We use five indicators to represent the market quality measures as follows:

- Trading value ($Value\_ln_{i,t}$): this is the natural logarithm of the value traded for stock *i* on

[12] The average trading volume of these 30 stocks amounts to approximately 35%~40% of the entire stock market.

day *t*. The value is expressed in thousands of New Taiwan Dollars (NT$). This variable is relevant when assessing the effectiveness of the day trading STT reduction (e.g., Capelle-Blancard and Havrylchyk 2016; Capelle-Blancard 2017).

- Trading volume ($Volume\_ln_{i,t}$): this is the number of shares traded for stock *i* on day *t*. The volume is expressed in thousands of shares (e.g., Capelle-Blancard and Havrylchyk 2016; Capelle-Blancard 2017).
- Turnover ($Turnover\_\%_{i,t}$): this is the ratio of trading volume scaled by the outstanding shares for stock *i* on day *t* (e.g., Becchetti et al.2014; Capelle-Blancard and Havrylchyk 2016; Capelle-Blancard 2017).
- Volatility ($Volatility_{i,t}$): this is the highest-lowest price range scaled by 4 log (2), that is $(\log PH_{i,t} - \log PL_{i,t})^2 / 4 \log(2)$ for stock *i* on day *t* (e.g., Parkinson 1980; Chou and Wang 2006; Cappelletti et al. 2017).
- Liquidity ($Liquidity_{i,t}$): this is the inverse of Amihud's Illiquidity ratio, that is $V_{i,t} / |R_{i,t}|$, where $V_{i,t}$ is the number of shares traded for stock *i* on day *t* and $|R_{i,t}|$ is the absolute stock return for stock *i* on day *t*. The liquidity ratio is expressed in thousands of NT$ for the trade for a price change of 1% and multiplied by 10^5 (e.g., Becchetti et al. 2014; Capelle-Blancard and Havrylchyk 2016; Capelle-Blancard 2017).

The trends of daily trading value, trading volume, turnover, volatility, and liquidity between the treatment sample and control sample during the sample period are illustrated in Fig. 1. Among the five market quality measures, trading value and trading volume exhibit increases in their respective trends after the reduction in the day trading STT (DT STT) period. However, the other three market quality measures, namely, turnover, volatility and liquidity, display indiscernible symmetric movements before and after the DT STT period. Although daily volatility appears to have reached a peak in 2018, the statistical results are left to further empirical examination.

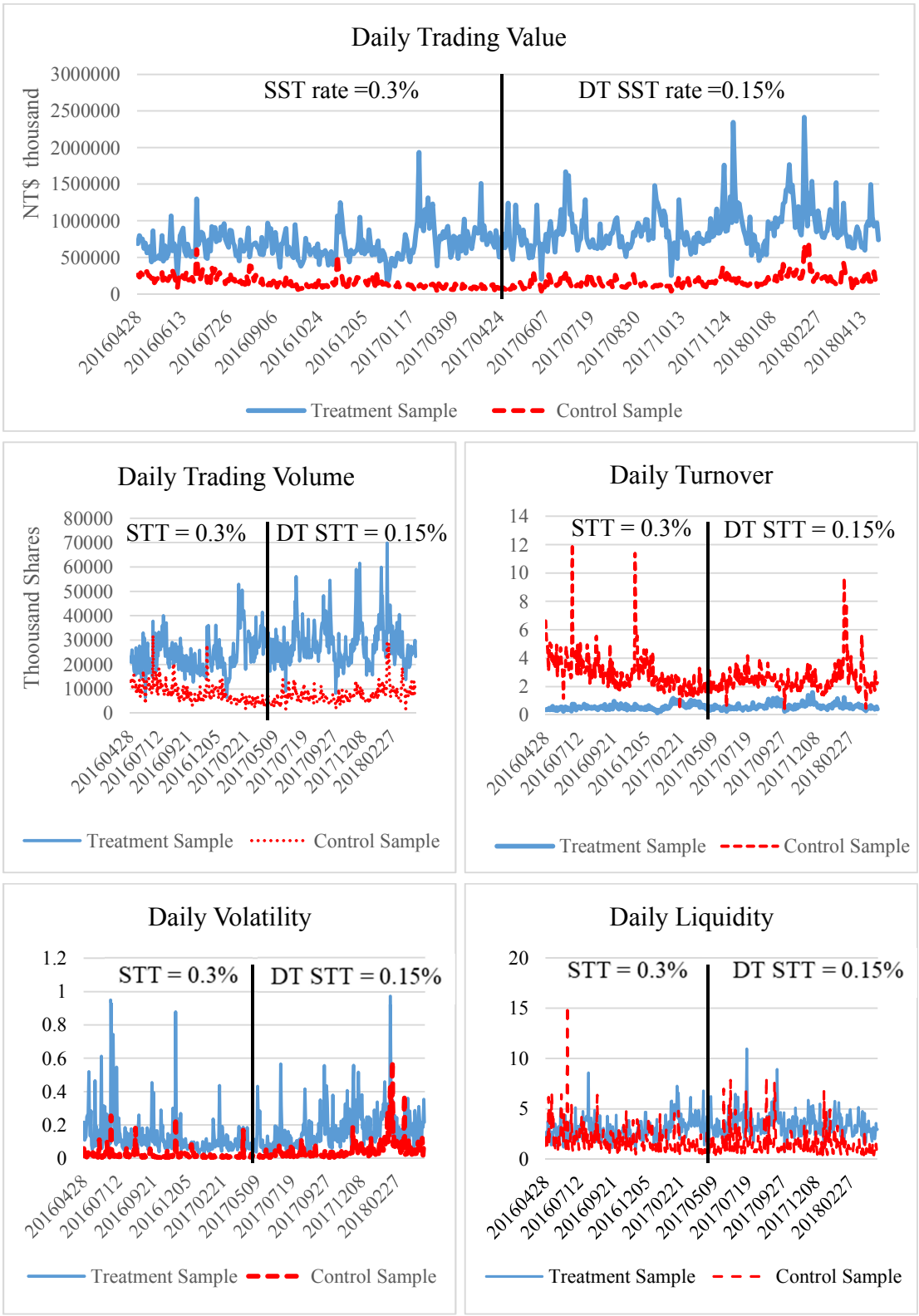

Figure 1 Plots of daily trading value, trading volume, turnover, volatility, and liquidity between the treatment sample and control sample for the period from April 28, 2016 to April 27, 2018. The DT STT denotes the day trading securities transaction tax.

4.3. Transaction Impact Measures

Since the policy to reduce the STT policy is imposed on day trading activities, little research has been done on the effects of a reduction in the STT on the volume of day trading and the margin netting of long and short activities. Due to the government's policy being to boost the stock market, the empirical predictions suggest that there is an increase in the volume of day trading, but a decrease in the margin netting of long and short positions. Since traders can save half of the tax after the DT STT reduction period, we predict a positive relationship with the volume of day trading.

Furthermore, the day trading strategy seems to serve as a substitute for the margin netting in the stock market. Margin netting is the settlement by the offsetting of margin purchases and short sales in margin trading of the same kind of securities on the same day. The explicit transaction costs include handling fees but do not involve interest fees related to margin purchases and short sales. However, investors must pay a short sale fee that originated from offsetting the short sales transaction.[13] Investors who implement margin netting must be able to afford the transaction fees which amount to approximately 0.585% from the offsetting of margin purchases and short sales in margin trading plus the STT on short sales (0.1425%×2+0.3%). By contrast, investors who engage in the day trading of securities only incur transaction fees amounting to 0.435% (0.1425%×2+0.3%÷2).[14] Thus, the empirical prediction suggests the existence of a negative relationship after the DT STT reduction period. This paper uses four indicators representing the transaction impact measures as follows:

- Day trading ($DT\_ln_{i,t}$): this is the natural logarithm of the number of day trading shares for stock *i* on day *t*.
- Day trading ratio ($DT\_\%_{i,t}$): this is the ratio of day trading shares scaled by trading volume for stock *i* on day *t*.
- Margin netting ($MNet\_ln_{i,t}$): this is the margin netting of long and short positions for stock *i* on day *t*.
- Margin netting ratio ($MNet\_\%_{i,t}$): this is the margin netting of long and short positions scaled by total trading volume for stock *i* on day *t*.

We also demonstrate the trends of the four transaction impact measures in Fig. 2. The empirical predictions for day trading and the day trading ratio are visually discernible before and after the DT STT reduction period. The volume of day trading activities is positively increasing after the tax rate reduction. By contrast, remarkable declines in daily

[13] Source: Article §2 of the Taiwanese Directions for Settlement by the Offsetting of Margin Purchases and Short Sales in Margin Trading.

[14] The above transaction fee may be granted a discount of 30% to 60% from different brokerage firms according to the magnitude of the transactions and the form of voice or online trading executions.

margin netting and the margin netting ratio because of the substitution effect are apparent indicating a negative relationship after the DT STT reduction period. We further conduct various econometric analyses in the following sections.

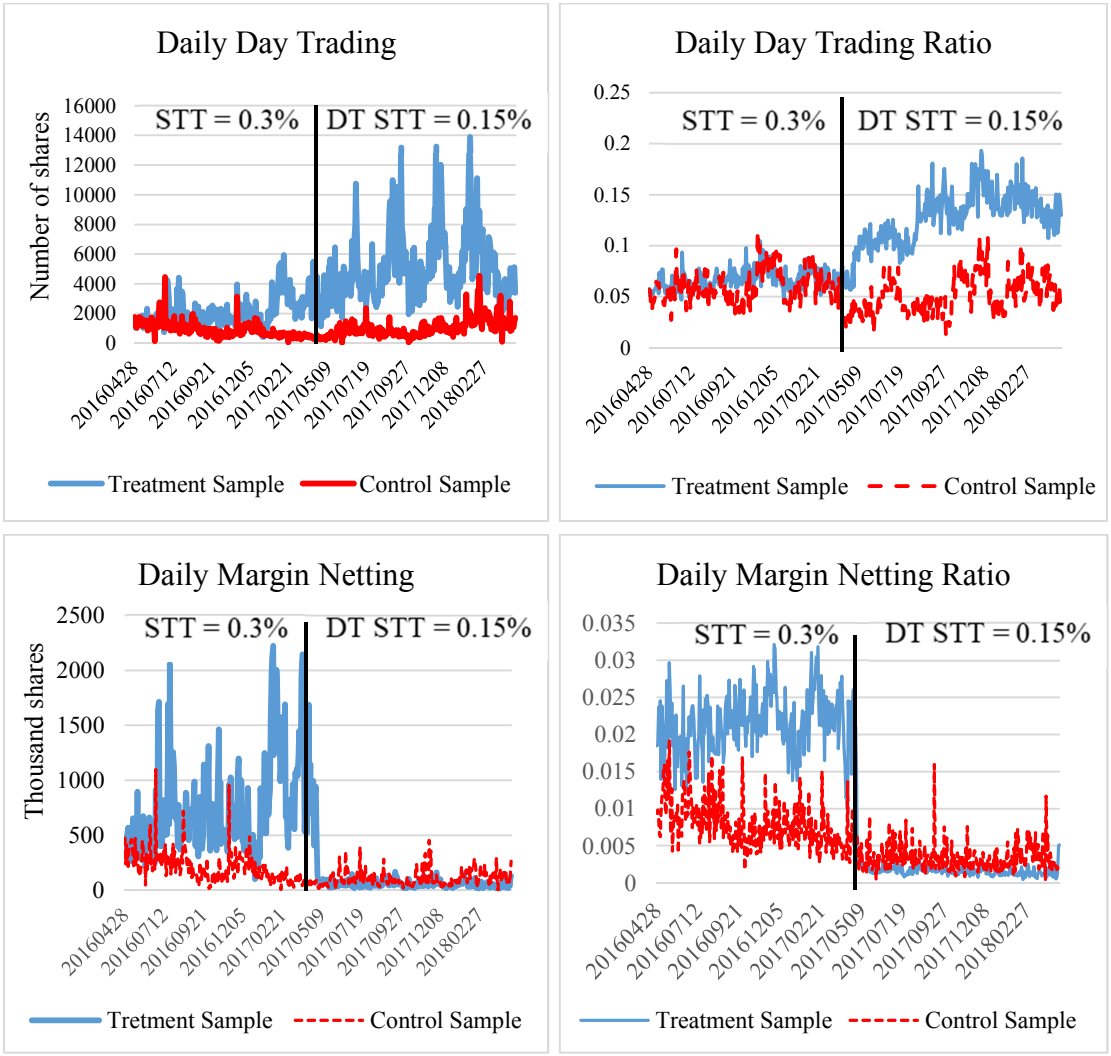

Figure 2 Plots of daily day trading, day trading ratio, margin netting, and margin netting ratio between the treatment sample and control sample for the period from April 28, 2016 to April 27, 2018. The DT STT denotes the day trading securities transaction tax.

4.4. Methodology

4.4.1. The propensity score matching method

There has been an increasing application of the PSM as a method to reduce the bias in the estimation of treatment effects with observational datasets. The PSM is suitable for evaluating the policy intervention in relation to treated and control groups (Rosenbaum and Rubin 1983). In studying nonexperimental data, researchers may face the problems of self-selection or some systematic judgment in assigning units to the treatment group or control group. The PSM implies pairing treatment and control units with similar observable characteristics (Dehejia and Wahba 2002) and has increasingly become a popular technique in accounting research (for a detailed discussion see Shipman, Swanquist, and Whited 2017).

The two treatment effects based on the PSM method include the average treatment effect on the treated (ATT) group and the average treatment effect for the entire sample (ATE) (Garrido, Kelly, Paris, Roza, Meier, Morrison, and Aldridge 2014). We separately estimate the ATT for a specific sample rather than the entire sample for two reasons. First, the treated sample and control sample differ systematically in terms of trading volume, market capitalization, and turnover. The treated sample is composed of listed stocks, whereas the control sample consists of ETF stocks. Accordingly, based on the attributes of a listed stock, it is difficult to find exact matches for an ETF stock.

Second, examining the effect of the subpopulation of treated units is often of greater interest and more important than the effect of the entire population (Heckman, Ichimura, and Todd 1997; Imbens 2004). Specifically, if the reduction in the STT solely applies to the stocks of listed firms, the effect of the STT on ETF stocks becomes of lesser importance. Nonetheless, for the comparative purpose of evaluating the effect before and after the STT reduction, we analyze the ATT of the treated sample and control sample as well,[15] following the regression similarly used in Foucault, Sraer, and Thesmar (2011) as follows:

$$Y_{i,t}\text{-}Y_{i,t}^{match}=\alpha+\delta_1 Post_t+\varepsilon_{i,t}\,. \tag{1}$$

where $Y_{i,t}$ is one of the variables of interest, and $Y_{i,t}^{match}$ is the value of the measure for the match of stocks (ETFs) before the STT reduction period. Estimates of the effect of the STT reduction (δ_1) are reported. Weekday effects are included in the above regression (1).

[15] The estimates of the PSM on the treated sample can be regarded as the ATT (average treatment effects on the treated), while those on the control sample can be deemed as the ATU (average treatment effects on the untreated).

4.4.2. The difference-in-differences method

Another econometric method that has become increasingly popular in evaluating a specific policy intervention is the DID method. The application of DID is usually derived from Ordinary Least Squares (OLS) for a panel of data on units in the treatment and control groups for a period of time both before and after a specific intervention (Bertrand, Duflo, and Mullainathan 2004). We follow the DID regression specification used in prior studies (e.g., Bertrand et al. 2004; Foucault et al. 2011) and estimate the baseline model and the extended model in equations (2) and (3), respectively, as follows:

$$Y_{i,t}=\alpha+\beta_0 Treated_i+\beta_1 Post_t+\beta_2 Treated_i\times Post_t+\varepsilon_{i,t}. \quad (2)$$

$$Y_{i,t}=\alpha+\beta_0 Treated_i+\beta_1 Post_t+\beta_2 Treated_i\times Post_t+\beta_\gamma Controls+\varepsilon_{i,t}. \quad (3)$$

where $Y_{i,t}$ is one of the variables of interest, $Treated_i$ is equal to one if stock *i* is included in the treatment sample, and $Post_t$ is a dummy variable equal to one after April 28, 2017. As argued by Foucault et al. (2011), $Treated_i$ controls for differences in the attributes of the two samples which are fixed over time, and $Post_t$ controls for factors common to all stocks that have an effect on the evolution of the dependent variable around the time that the policy to reduce the STT policy is introduced. The coefficient (β_2) is the difference-in-differences estimate of the effect of the STT reduction. The control variables include the market value, percentage of shares held by foreign institutional investors, mutual funds, and broker dealers. Weekday effects are included in the above two equations. We calculate the robust standard errors clustered by firm.

5. EMPIRICAL RESULTS

5.1. Descriptive Statistics

Table 2 reports the descriptive statistics of the main variables of interest. We distinguish the treatment sample from the control sample. As for the market quality measures, the treatment sample, on average, has a higher trading value of NT$ 357.539 million and a trading volume of 17.396 million shares after taking the antilogarithm of those and for the control sample, which has a trading value of NT$ 22.159 million and trading volume of 1.089 million shares, respectively. Since the ETFs have smaller outstanding shares, their turnovers are higher than those of the treatment sample. The treatment sample reports a higher average volatility and standard deviation than those for the control sample. This result suggests that the range between the daily highest and lowest price is more pronounced for the treatment sample than for the control sample. Finally, the liquidity measure also shows a higher value for the treatment sample. For a price change in the denominator, the treatment sample has an average volume of 3.212 and is higher than the 1.742 for the control sample.

Table 2　Summary Statistics

Variable	Treatment Sample [*N*=14,730]				Control Sample [*N*=14,730]			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Market Quality Measures								
Value_ln	12.787	1.202	0.000	17.211	10.006	2.419	0.000	15.704
Volume_ln	9.764	0.909	0.000	13.158	6.993	2.355	0.000	12.910
Turnover_%	0.582	1.003	0.000	19.109	2.759	3.920	0.000	82.842
Volatility	0.151	0.658	0.000	20.968	0.033	0.190	0.000	10.274
Liquidity	3.212	5.047	0.000	182.393	1.742	6.906	0.000	230.811
Transaction Impact Measures								
DT_ln	6.864	1.678	0.000	12.011	3.377	2.759	0.000	11.151
DT_%	0.099	0.103	0.000	0.654	0.055	0.090	0.000	0.958
MNet_ln	3.266	2.453	0.000	10.799	1.407	2.250	0.000	9.477
MNet_%	0.011	0.025	0.000	0.244	0.006	0.015	0.000	0.345
Control Variables								
MV_ln	11.712	1.268	8.630	15.747	7.556	1.849	4.564	11.410
Foreign	0.333	0.145	0.104	0.802	0.036	0.054	0.000	0.457
MFund	0.005	0.005	0.000	0.045	0.001	0.004	0.000	0.081
BDealer	0.002	0.006	0.000	0.040	0.146	0.261	0.000	2.146

Notes: This table reports the descriptive statistics of the main variables used in our analysis. The sample period is from April 28, 2016 to April 27, 2018. The treatment sample consists of 30 listed stocks on the Taiwanese Stock Exchange. The control sample comprises of 30 ETF stocks. Market quality measures are: trading value, trading volume, turnover, volatility, and liquidity. Transaction impact measures are: day trading volume, day trading ratio, margin netting, and margin netting ratio. *MV_ln* is the natural logarithm of market value. *Foreign* is the percentage of shares held by foreign institutional investors. *MFund* is the percentage of shares held by mutual funds. *BDealer* is the percentage of shares held by broker dealers.

We also introduce the market value and the percentage of shares held by institutional investors as control variables, because institutional investors sometimes act as market makers in the stock market. As reported in Table 2, the stocks belonging to the treatment sample are larger in terms of market capitalization (mean=NT$ 122.027 billion) than those ETFs in the control sample (mean=NT$ 1.912 billion) after taking the antilogarithm. The stocks also attract more attention from foreign institutions and mutual fund investors in that they exhibit a higher percentage of shareholdings as compared to those ETFs. There is only one exception and that concerns the broker dealers' investments. The mean shareholding percentage for the control sample is 14.6%, which is higher than the 0.2% for the treatment sample.

We further decompose the treatment sample into before and after the DT STT reduction. Table 3 provides the descriptive statistics for the two market aspect measures. The first one concerns the five indicators of market quality measures. We divide the treatment sample into two evaluation periods. In particular, the average values of the trading value, trading volume, turnover, volatility, and liquidity are higher than in the prior tax reduction period. We conduct the difference of means tests and find that the differences between these two DT tax change periods are positive and statistically significant. These findings are consistent with our empirical predictions regarding the effect of a tax reduction on the market quality measures.

The other four indicators of the transaction impact measures are used to evaluate the substitution effect of STT reduction. Since the STT reduction is imposed on daily day trading, the difference of means tests over the volume of day trading (*DT_ln*) and the day trading ratio (*DT_%*) before and after the tax policy exhibit both positive and statistically significant results. This finding is consistent with our empirical predictions because the advantage of an STT reduction applies only to day trading activities. Investors who engage in day trading can save part of the transaction cost.

The other two measures of the transaction impact are margin netting (*Mnet_ln*) and the margin netting ratio (*MNet_%*). The margin netting of long and short positions was used as a mechanism to imitate the day trading effect before being permitted by the regulations. However, the regulations impose more restrictions on margin purchase and short sell activities. Investors conducting margin trades involving securities must satisfy the minimum margin requirement, and they must pay interest on a margin loan. The transaction costs for margin trades are expected to be higher than those for day trading. Thus, there is a substitution effect from margin trades to day trading following the introduction of the DT STT reduction policy. The difference of means tests reveal that the margin netting and the margin netting ratio are negatively and statistically significant. These findings are consistent with our empirical predictions.

Table 3　Summary Statistics for the Treatment Sample

Variable	Before DT STT Reduction (2016/4/28~2017/4/27) [*N*=7,320]		After DT STT Reduction (2017/4/28~2018/4/27) [*N*=7,410]		Difference of Means Test	
	Mean	SD	Mean	SD	Differences	*t*-value
Market Quality Measures						
Value_ln	12.635	1.220	12.937	1.165	0.302***	15.39
Volume_ln	9.716	0.867	9.812	0.946	0.096***	6.46
Turnover_%	0.551	0.997	0.613	1.008	0.062***	3.81
Volatility	0.129	0.680	0.173	0.634	0.044***	4.04
Liquidity	3.009	4.851	3.413	5.226	0.404***	4.86
Transaction Impact Measures						
DT_ln	6.416	1.610	7.306	1.626	0.890***	33.38
DT_%	0.067	0.076	0.130	0.116	0.063***	39.47
MNet_ln	4.420	2.348	2.125	1.976	-2.295***	-64.24
MNet_%	0.021	0.032	0.002	0.003	-0.019***	-52.83

Notes: This table reports the descriptive statistics of the main variables of interest for the treatment sample. The sample period is from April 28, 2016 to April 27, 2018. Market quality measures are: trading value, trading volume, turnover, volatility, and liquidity. Transaction impact measures are: day trading volume, day trading ratio, margin netting, and margin netting ratio. The superscripts ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

5.2. The Propensity Score Matching Method

We apply the PSM method to investigate the average treatment effect in relation to the treated stocks. Panel A of Table 4 reports the coefficients of the five indicators of market quality measures. The model (1) PSM uses the standard PSM technique to find a matched untreated stock that has the closest score. The coefficient of trading value (*Value_ln*) is found to have the highest statistical significance, and is followed by trading volume (*Volume_ln*), liquidity, volatility, and turnover, respectively. The signs of these coefficients are positive and statistically significant as predicted in our empirical formulation.

The model (2) NNM employs the nearest-neighbor matching technique to ensure that the results are robust to different matching methods. Because PSM matches on a single continuous covariate, it does not need bias correction. However, the NNM uses a bias-correction term when matching on more than one continuous covariate. We limit the number of matches per observation to 2. We also use the market value as the bias-correction term and the Mahalanobis distance by default. The coefficients reported in Panel A of Table 4 (2) NNM show that the statistical significance order is different from the column (1) PSM.[16] Interestingly, the highest significant coefficient is still the trading value, which is then followed by turnover, volatility, liquidity, and trading volume.

Day trading (*DT_ln*) and the day trading ratio (*DT_%*) which represent the two transaction impact measures also exhibit positive and statistically significant estimators under the (1) PSM and (2) NNM methods. The other two proxy variables are margin netting (*MNet_ln*) and the margin netting ratio (*MNet_%*), which are shown to be negative and statistically significant as our empirical predictions of the substitution effect. The results are consistent and robust to the difference means of tests analyzed and discussed in the previous subsection.

Panel B of Table 4 reports the average treatment effect for the control sample. Since the STT rate for the ETFs is maintained at 0.1%, they are unaffected by the tax reduction policy. In the standard (1) PSM examination, the coefficients exhibit significantly negative estimators for the trading value, trading volume, turnover, and liquidity, suggesting a decrease in each of these four measures after the application of the DT STT reduction. By contrast, only the coefficient for the volatility exhibits a significant positive estimator indicating an increase in the DT STT reduction period. In the (2) NNM analysis, we also use the market value as the bias-correction term. The results are qualitatively similar to those for the (1) PSM method, except for the liquidity that becomes marginally insignificant.

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[16] The different empirical results between the PSM and NNM are due to the setting on the number of matches per observation. The PSM matches on a single continuous covariate, whereas the NNM matches on two continuous covariates.

Table 4 The Effect of the STT Reduction on Market Quality Measures and Transaction Impact Measures: PSM Method

Variable	Panel A: Treatment Sample [*N*=14,730]		Panel B: Control Sample [*N*=14,730]	
	(1) PSM	(2) NNM	(1) PSM	(2) NNM
Market Quality Measures				
Value_ln	0.302***	0.162***	-0.268***	-0.170***
	(15.45)	(8.87)	(-6.74)	(-5.11)
Volume_ln	0.097***	0.040***	-0.381***	-0.289***
	(6.51)	(2.74)	(-9.88)	(-8.79)
Turnover_%	0.063***	0.120***	-0.487***	-0.525***
	(3.82)	(7.51)	(-7.55)	(-8.19)
Volatility	0.044***	0.030***	0.027***	0.027***
	(4.05)	(2.79)	(8.61)	(8.59)
Liquidity	0.405***	0.228***	-0.312***	-0.175
	(4.87)	(2.75)	(-2.75)	(-1.58)
Transaction Impact Measures				
DT_ln	0.890***	0.907***	-0.406***	-0.315***
	(33.51)	(34.26)	(-8.97)	(-7.91)
DT_%	0.064***	0.068***	-0.007***	-0.006***
	(39.56)	(44.55)	(-4.44)	(-4.17)
MNet_ln	-2.296***	-2.192***	-0.700***	-0.634***
	(-64.26)	(-62.47)	(-19.10)	(-18.30)
MNet_%	-0.020***	-0.017***	-0.005***	-0.004***
	(-52.48)	(-42.82)	(-18.14)	(-17.13)

Notes: This table reports the coefficients of the average treatment effect on the treated based on the propensity score matching method. The sample period is from April 28, 2016 to April 27, 2018. In Panel A, the treatment sample consists of 30 listed stocks on the Taiwanese Stock Exchange. In Panel B, the control sample comprises 30 ETF stocks. Market quality measures are: trading value, trading volume, turnover, volatility, and liquidity. Transaction impact measures are: day trading volume, day trading ratio, margin netting, and margin netting ratio. We estimate the (1) PSM (propensity-score matching) and (2) NNM (nearest-neighbor matching) models as $Y_{i,t}$-$Y_{i,t}^{match}$=α+δ_1 $Post_t$+ $\varepsilon_{i,t}$, where $Y_{i,t}$ is one of the variables of interest, and $Y_{i,t}^{match}$ is the value of the measure for the match of stocks (ETFs) before the STT reduction period. Estimates of the effect of the STT reduction (δ_1) are reported. Weekday effects are included in the above analyses. The *t*-statistics based on robust standard errors are shown in the parentheses. The superscripts ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

We find consistent negative signs for the four transaction impact measures shown in Panel B of Table 4. To be specific, the day trading and margin netting activities of the ETFs are diminishing after the DT STT reduction period. One possible explanation is that investors may change their day trading from trading in ETFs to stocks after the STT reduction, resulting in a decrease in the ETFs' day trading and margin netting activities.[17]

[17] Anecdotal evidence from a news article reported on April 13, 2018 reflects the substitution effect of day trading transactions instead of margin netting in the stock market after the reduction in the STT. Since margin netting transactions were not entitled to a tax cut benefit, several brokerage firms complained about the requests from investors to change the type of transaction types to enjoy the tax benefit. The government has, however, declined to reduce the STT on margin netting because of its margin trading nature and small trading volume. Available at: https://news.cnyes.com/news/id/4095380. Accessed: July 12, 2019.

The aforementioned PSM results are estimated using the code integrated within the statistical software STATA 15. However, the code does not check the balancing property of the propensity score (Garrido et al. 2014). We provide robust empirical results using user-written commands *pscore* (Becker and Ichino 2002), which are found to be qualitatively similar to those of Table 4, especially the results of (1) PSM. More detailed information on the calculation of the PSM results is provided in Appendix 2.[18]

5.3. The Difference-in-Differences Method

The DID method is suitable for evaluating the effect of a policy intervention. In this case this is the DT STT reduction imposed on April 28, 2017, and we compare the effects of several aspects of the market both before and after the tax reduction policy. Table 5 reports the coefficients β_2 for the five market quality measures. Column (1) shows the positive and statistically significant results for the trading value (*Value_ln*) with a coefficient β_2 of 0.570 in the baseline regression and a coefficient β_2 of 0.288 in the extended regression. The *R*-squared has greatly improved from the baseline (35.3%) to the extended regression (68.5%) with the inclusion of the market value and shareholdings of the three types of institutional investors. The empirical findings indicate support for the effectiveness of the government in implementing the STT rate reduction on day trading activities because of an increase in trading value after the tax reduction period.

Column (2) of Table 5 reports the empirical results for the trading volume (*Volume_ln*). Despite the positive and statistically significant coefficient in the baseline (β_2=0.478), the significance is reduced from 1% to 5% in the extended regression (β_2=0.315) after introducing the relevant control variables. The *R*-squared also improves from 38.3% to 62.7% in the extended specification. Although most empirical studies have examined the effect of an increase in the STT rate, our empirical findings regarding the reduction in the STT rate are consistent with those of Chou and Wang (2006), who investigate a reduction in the tax levied on futures transactions.

Column (3) of Table 5 displays marginally and positively statistically significant results for the turnover ratio (*Turnover_%*) in both the baseline and extended regressions. Column (4) reveals that volatility is statistically insignificant in both the baseline and extended regressions. The empirical result of there being no effect of the STT on volatility is consistent with the findings of Chou and Wang (2006), Capelle-Blancard and Havrylchyk (2016), Gomber et al. (2016), Hvozdyk and Rustanov (2016), and Capelle-Blancard (2017). Finally, column (5) provides the coefficients of liquidity under the DID estimation. The coefficient β_2 is only statistically significant at the 5% level in the baseline regression, while it becomes marginally insignificant after controlling for several relevant variables in the extended regression.

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[18] The authors thank an anonymous referee for providing this insight that led to the analysis of Appendix 2.

Table 5 The Impact of the DT STT Reduction on Market Quality Measures: DID Method

	Dependent Variables									
	(1) *Value_ln*		(2) *Volume_ln*		(3) *Turnover_%*		(4) *Volatility*		(5) *Liquidity*	
Treat (β_0)	2.494***	-1.081***	2.531***	-0.023	-2.453***	-1.607***	0.110	-0.175	1.110	-2.811
	(5.73)	(-3.02)	(6.25)	(-0.05)	(4.62)	(-2.78)	(1.65)	(-1.14)	(1.40)	(-1.67)
Post (β_1)	-0.268	-0.188*	-0.382***	-0.337***	-0.486	-0.513	0.027*	0.041**	-0.313	-0.272
	(-1.63)	(-1.74)	(-2.79)	(-3.08)	(-1.55)	(-1.54)	(1.89)	(2.59)	(-1.45)	(-1.23)
Treat×*Post* (β_2)	0.570***	0.288**	0.478***	0.315**	0.549*	0.603*	0.017	-0.026	0.717**	0.481
	(2.94)	(2.16)	(3.08)	(2.30)	(1.70)	(1.79)	(0.34)	(-0.60)	(2.45)	(1.67)
MV_ln		0.843***		0.729***		-0.368**		0.012		1.143***
		(8.49)		(6.23)		(-2.07)		(0.79)		(3.15)
Foreign		0.478		-1.554		1.944*		0.911*		-2.139
		(0.59)		(-1.27)		(1.71)		(1.98)		(-0.93)
MFund		29.418**		19.828		42.728**		-1.617		4.752
		(2.21)		(1.53)		(2.38)		(-0.24)		(0.16)
BDealer		0.326		0.077		0.621		0.044		0.633
		(0.73)		(0.15)		(0.73)		(0.88)		(1.57)
Constant	8.972***	2.483***	6.073***	0.578	1.948***	4.564***	-0.029	-0.161	0.511	-8.155***
	(20.67)	(2.69)	(14.69)	(0.56)	(4.88)	(3.10)	(-1.60)	(-1.24)	(0.88)	(-3.46)
F-statistic	68.64***	75.26***	60.86***	70.84***	4.83***	3.53***	2.93***	2.16**	10.34***	9.03***
R-squared	0.353	0.685	0.383	0.627	0.131	0.171	0.016	0.063	0.017	0.095

Notes: This table reports the effect of the STT reduction based on the difference-in-differences method. The sample period is from April 28, 2016 to April 27, 2018. The market quality measures are: trading value, trading volume, turnover, volatility, and liquidity. We estimate the following (1) baseline regression as: $Y_{i,t}=\alpha+\beta_0 Treated_i+\beta_1 Post_t+\beta_2 Treated_i\times Post_t+\varepsilon_{i,t}$ and (2) extended regression as $Y_{i,t}=\alpha+\beta_0 Treated_i+\beta_1 Post_t+\beta_2 Treated_i\times Post_t+\beta_\gamma Controls+\varepsilon_{i,t}$, where $Y_{i,t}$ is one of the variables of interest, $Treated_i$ is equal to one if stock i is included in the treatment sample, $Post_t$ is a dummy variable equal to one after April 28, 2017. The coefficient (β_2) is the difference-in-differences estimate of the effect of the STT reduction. The control variables are market value, percentage of shares held by foreign institutional investors, mutual funds, and broker dealers. Weekday effects are included in the above analyses. The *t*-statistics based on robust standard errors clustered by firm are shown in the parentheses. The superscripts ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 6 provides the DID estimates for the four transaction impact measures. Column (1) examines the coefficients β_2 of the day trading shares (*DT_ln*), which are found to be positively and statistically significant in both the baseline (β_2=1.296) and the extended (β_2=1.150) regressions, respectively. The *R*-squared value greatly improves from 38.6% to 50.5% after introducing the control variables. Column (2) reports the results for the day trading ratio (*DT_%*) showing statistical significance at the 1% level for both the baseline (β_2=0.071) and the extended (β_2=0.073) regressions. The signs of the coefficients β_2 of *DT_ln* and *DT_%* are consistent with the prior analyses of the PSM methods.

In column (3) of Table 6, the margin netting of long and short positions (*MNet_ln*) demonstrates negative and statistically significant coefficients in both the baseline (β_2= -1.595) and the extended regressions (β_2=-1.645), respectively. Finally, column (4) reports similar results for the margin netting ratio (*MNet_%*). Specifically, *MNet_%* also has negative coefficients in both the baseline (β_2=-0.015) and the extended (β_2=-0.014) regressions, respectively. To sum up, our empirical predictions find support and the results of the DID analyses are qualitatively consistent with those of the PSM method.

5.4. Economic Implications of the STT Reduction

The objectives of the STT reduction are to stimulate the trading activities in the stock market and to elevate the economic competitiveness within the international capital market. Prior research has shown that changes in the STT convey a clear policy direction and mainly affect speculative short-term trading (e.g., Stiglitz 1989; Campbell and Froot 1994). The empirical findings of this paper are by and large consistent with those of the short-term effect on the trading volume of the STT reduction (e.g., Chou and Wang 2006; Huang, Lin, and Lien 2013). To evaluate the economic implications around the STT reduction, we further analyze the STT revenue and three dimensions of the stock market in the aggregate.[19]

We collect monthly STT revenue from the website of the Ministry of Finance in Taiwan and stock market facts from the TEJ Database. Comparisons of 3, 6, 9, 12 months before and after the reduction in the STT are conducted based on four dimensions. Panel A of Table 7 shows that the average STT revenue after the tax reduction reaches NT$ 8.279 billion in 9 months as compared to that for the pre-tax reduction period of NT$ 6.920 billion in 3 months. The difference in means is indiscernible over 3 months, but is statistically significant over 6-, 9-, and 12-month evaluation periods.

In Panel B of Table 7 we evaluate the trends of the aggregate TWSE monthly trading value. The statistically significant results of the difference means are consistent with those of the STT revenue since the transaction tax is imposed according to the magnitude of the

[19] The authors thank an anonymous referee for the constructive suggestions that led to this analysis.

trading value. Thus, the effect of the STT reduction is more pronounced after 3 months. By contrast, the difference means test on the aggregate day trading value is statistically significant after 9 and 12 months, as displayed in Panel C of Table 7. One possible explanation is that not all stocks are targeted to implement day trading by investors, but only a subset of stocks in the market. Finally, the effect of the STT reduction on the aggregate market capitalization is evident in which it is shown to be statistically significant over the four evaluation periods in Panel D of Table 7. The market capitalization of the TWSE reveals an average of NT$ 31.523 trillion following the tax reduction compared to the NT$ 27.224 trillion before the STT was cut over the 12-month evaluation period.

The STT reduction has a remarkable effect on the stock market based on the evaluation over a period of one year. The government has decided to extend the reduction in the STT on day trading until 2021. The reasons for extending the STT policy for 3 years are twofold. First, the reduction in the futures transaction tax has also been extended for 3 years. Second, the length of the business cycle reported by the Taiwanese National Development Council is 35 months, which is close to 3 years.[20]

How much time is needed for the implementation of the DT STT reduction? The earlier literature indicates that the daily tax revenue fell in the first year after the tax on futures transactions was reduced on the Taiwan Futures Exchange. However, the tax revenues increased significantly during the second and the third years following the tax reduction (Chou and Wang 2006). On the other hand, Huang et al. (2013) showed that the reduction in the tax on futures transactions indeed stimulated the trading volume of futures transactions in the short-term, but the volume diminished as time passed. The tax revenues declined by 36.4% after the tax reduction in 2006.

It is worth noting that the STT revenue, trading value and day trading value reported in Table 7 display their highest average values over 9 months and exhibit a slight decline over 12 months. Recent news reports indicate that for the first half of 2019, the STT collected only amounted to NT$ 41.1 billion, revealing a decline of NT$ 12.1 billion (22.7%) as compared with the same period in the previous year. Only 36.4% of the STT's budgeted revenue was achieved for the first 6 months of 2019 and was mainly caused by the decrease in trading volume and an increase in day trading activities in the stock market.[21] The period examined in Table 7 has just taken place during the China-US trade war. Thus, the effect of reducing the STT to stimulate trading volume is likely to have been affected by the vicissitudes of the international economy.

[20] Anecdotal evidence reveals that practitioners, such as the Stock Exchange and the Taiwan Securities Association, have sought a relaxation of the implementation deadline. The financial regulator expects to extend the tax policy for 7 years. Scholars propose a period of 2 to 5 years. Available at: https://www.nownews.com/news/20180328/2725566/. Accessed: July 12, 2019.

[21] News article available at: https://www.chinatimes.com/newspapers/20190711000246-260202?chdtv. Accessed: July 12, 2019.

Table 6 The Effect of the DT STT Reduction on Transaction Impact Measures: DID Method

	Dependent Variables							
	(1) *DT_ln*		(2) *DT_%*		(3) *MNet_ln*		(4) *MNet_%*	
Treat (β_0)	2.835***	0.656	0.008	0.030	2.661***	1.898**	0.014***	0.021**
	(6.13)	(0.90)	(0.53)	(1.15)	(5.70)	(2.11)	(2.73)	(2.65)
Post (β_1)	-0.406**	-0.346**	-0.007	-0.008	-0.700***	-0.654***	-0.005***	-0.005***
	(-2.18)	(-2.07)	(-1.13)	(-1.11)	(-4.48)	(-4.63)	(-3.70)	(-3.60)
Treat×*Post* (β_2)	1.296***	1.150***	0.071***	0.073***	-1.595***	-1.645***	-0.015***	-0.014***
	(5.84)	(5.39)	(5.90)	(6.01)	(-7.60)	(-7.93)	(-3.52)	(-3.52)
MV_ln		0.623***		-0.005		0.263		-0.001
		(3.95)		(-0.92)		(1.40)		(-0.52)
Foreign		-1.866		-0.037		-1.935		-0.023**
		(-1.14)		(-0.65)		(-1.16)		(-2.02)
MFund		40.179*		2.118		37.788		0.121
		(1.77)		(1.44)		(1.18)		(0.57)
BDealer		-0.398		-0.007		-0.826*		-0.007**
		(-0.55)		(-0.27)		(-1.95)		(-2.31)
Constant	2.339***	-2.298**	0.044***	0.087*	1.112***	-0.736	0.006***	0.012*
	(5.99)	(-2.03)	(5.10)	(1.98)	(3.61)	(-0.60)	(3.45)	(1.71)
F-statistic	76.97***	93.57***	6.72***	6.91***	62.20***	43.26***	5.68***	5.11***
R-squared	0.386	0.505	0.101	0.116	0.248	0.288	0.139	0.160

Notes: This table reports the effect of the STT reduction based on the difference-in-differences method. The sample period is from April 28, 2016 to April 27, 2018. The transaction impact measures are: day trading volume, day trading ratio, margin netting, and margin netting ratio. We estimate the following (1) baseline regression as: $Y_{i,t}=\alpha+\beta_0 Treated_i+\beta_1 Post_t+\beta_2 Treated_i\times Post_t+\varepsilon_{i,t}$ and (2) extended regression as $Y_{i,t}=\alpha+\beta_0 Treated_i+\beta_1 Post_t+\beta_2 Treated_i\times Post_t+\delta_\gamma Controls+\varepsilon_{i,t}$, where $Y_{i,t}$ is one of the variables of interest, $Treated_i$ is equal to one if stock i is included in the treatment sample, $Post_t$ is a dummy variable equal to one after April 28, 2017. The coefficient (β_2) is the difference-in-differences estimate of the effect of the STT reduction. The control variables are market value, percentage of shares held by foreign institutional investors, mutual funds, and broker dealers. Weekday effects are included in the above analyses. The *t*-statistics based on robust standard errors clustered by firm are shown in the parentheses. The superscripts ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 7 Economic Implications of the STT Reduction on Tax Revenue and the Stock Market

	Evaluation Period			
	3 Months	6 Months	9 Months	12 Months
Panel A: STT Revenue (NT$ Thousands)				
After (a)	6,823,464	7,700,625	8,278,500	8,123,402
Before (b)	6,919,767	6,234,681	6,073,647	6,037,117
Diff. (a) – (b)	-96,303	1,465,944*	2,204,853***	2,086,285***
t-value	(-0.14)	(2.07)	(3.85)	(4.33)
Panel B: Trading Value (NT$ Millions)				
After (a)	2,022,322	2,279,766	2,461,769	2,439,905
Before (b)	1,864,164	1,629,366	1,590,233	1,599,450
Diff. (a) – (b)	158,158	650,400***	871,536***	840,455***
t-value	(0.87)	(3.31)	(5.09)	(5.93)
Panel C: Day Trading Value (NT$ Millions)				
After (a)	105,573	103,259	122,091	119,531
Before (b)	99,020	92,084	86,009	88,743
Diff. (a) – (b)	6,553	11,175	36,082*	30,788**
t-value	(0.65)	(0.82)	(2.09)	(2.25)
Panel D: Market Capitalization (NT$ Millions)				
After (a)	30,454,867	30,868,886	31,284,060	31,523,049
Before (b)	28,942,576	28,135,424	27,739,167	27,223,963
Diff. (a) – (b)	1,512,291**	2,733,462***	3,544,893***	4,299,086***
t-value	(3.78)	(5.57)	(7.76)	(9.33)

Notes: This table reports the average monthly STT revenue in Panel A, the average monthly TWSE's stocks trading value in Panel B, the average monthly TWSE's day trading value in Panel C, and the average monthly TWSE's market capitalization in Panel D. Months starting from May 2017 are regarded as being after the evaluation period. ***, ** and * denote significance at the 1%, 5%, and 10% levels, respectively, for the t test difference of means.

6. CONCLUSION

The STT has constituted an important policy issue that has been used to achieve certain policy objectives. Past theoretical works develop models to postulate the influences of the STT on the financial market. Several empirical studies directly investigate the effects of countries applying the STT, which relate to a variety of market quality measures. The introduction of the STT or an increase in the STT rate is usually used to curb short-term speculative trading. On the other hand, when policy-makers strive to boost the stock market by reducing the tax rate, they do not expect to reduce the tax revenue at the same time. However, few empirical studies examine the effects of a reduction in the STT on market quality measures because such reductions do not frequently take place in the real world. Thus, this paper seeks to contribute to the existing empirical literature on the effects of an STT reduction on the market.

The Taiwanese stock market began to implement a reduction in the STT for day trading activities on April 28, 2017. We examine this issue over a period of one year before and one year after the effective date of the tax reduction. Among the market quality measures examined in this paper, all five indicators exhibit significant increases when matched with their prior untreated stocks in the PSM estimation. When we apply the DID method, we find that trading value, trading volume, turnover, and liquidity exhibit positive significant coefficients. One exception is for volatility which has an insignificant effect. The empirical findings are consistent with the formulated predictions and some of the indicators examined in this paper find support from the prior literature.

This paper also examines the effects of the day trading STT reduction on the transaction impact measures. Due to the peculiar feature of only reducing the STT on day trading activities, there is limited empirical evidence on this tax policy in the literature. We find that while the day trading activities have increased, the margin netting has decreased when matching with their prior untreated stocks takes place in the PSM analysis. We reach qualitatively similar conclusions in the DID estimation. The direct tax saving on day trading activities triggers the involvement of more day-traders. On the other hand, the reduction in the STT on day trading gives rise to a substitution effect that results in the margin netting decreasing significantly. Overall, the empirical findings are consistent with the formulated predictions and are robust to different econometric estimates. Since the implementation of the STT reduction policy in the market has been found to be effective, the government has decided to extend the implementation until the end of 2021. Thus, the continuation of the reduction in the STT provides promising avenues for research in the future.

Appendix 1 Complete List of Stocks and ETFs Analyzed in this Study

Treatment Sample (Ticker Symbol)	Control Sample (Ticker Symbol)
• China Petrochemical Development Corp. (1314)	• Yuanta/P-shares Taiwan Top 50 ETF (0050)
• Walsin Lihwa Corp. (1605)	• Yuanta/P-shares Taiwan Dividend Plus ETF (0056)
• China Steel Corp. (2002)	• W.I.S.E. Yuanta/P-shares CSI 300 ETF (0061)
• United Microelectronics Corp. (2302)	• Cathay FTSE China A50 ETF (00636)
• Compeq Manufacturing Corp. (2313)	• Fubon SZSE 100 ETF (00639)
• Hon Hai Precision Industry Corp. (2317)	• Capital SZSE SME Price Index ETF (00643)
• Compal Electronics Inc. (2324)	• Fubon TOPIX ETF (00645)
• Pan-International Industrial Corp. (2328)	• Fubon NIFTY ETF (00652)
• Taiwan Semiconductor Manufacturing Corp. (2330)	• Fubon SSE180 ETF (006205)
• Winbond Electronics Corp. (2344)	• Yuanta/P-shares SSE50 ETF (006206)
• Acer Incorporated (2353)	• Fuh Hwa CSI 300 A Shares ETF (006207)
• Tatung Company (2371)	• Fubon FTSE TWSE Taiwan 50 ETF (006208)
• AU Optronics Corp. (2409)	• W.I.S.E. - SSE 50 China Tracker (008201)
• Epistar Corp. (2448)	• Yuanta Daily Taiwan 50 Bull 2X ETF (00631L)
• High Tech Computer Corp. (2498)	• Yuanta Daily Taiwan 50 Bear -1X ETF (00632R)
• China Airlines (2610)	• Fubon SSE 180 Leveraged 2X Index ETF (00633L)
• China Life Insurance Co. (2823)	• Fubon SSE 180 Inversed Index ETF (00634R)
• Fubon Financial Holding Co. (2881)	• Yuanta S&P GSCI Gold ER Futures ETF (00635U)
• Cathay Financial Holding Co. (2882)	• Yuanta Daily CSI 300 Bear -1X ETF (00638R)
• China Development Financial Holding Co. (2883)	• Fubon TOPIX Leveraged 2X Index ETF (00640L)
• E.Sun Financial Holding Co. (2884)	• Fubon TOPIX Inversed-1X Index ETF (00641R)
• Yuanta Financial Holding Co. (2885)	• Yuanta S&P GSCI Crude Oil ER Futures ETF (00642U)
• Mega Financial Holding Co. (2886)	• Yuanta Daily S&P 500 Bear 1X ETF (00648R)
• Taishin Financial Holding Co. (2887)	• Fuh Hwa Daily Hang Seng Leveraged 2X ETF (00650L)
• Shin Kong Financial Holding Co. (2888)	• Fuh Hwa Daily Hang Seng Inversed ETF (00651R)
• Sinopac Financial Holding Co. (2890)	• Fubon NIFTY 2X Leveraged Index ETF (00653L)
• CTBC Financial Holding Co. (2891)	• Fubon NIFTY -1 Inverse Index ETF (00654R)
• First Financial Holding Co. (2892)	• Cathay FTSE China A50 Daily Leveraged 2X ETF (00655L)
• Wistron Corp. (3231)	• Cathay FTSE China A50 Daily Inversed ETF (00656R)
• Innolux Corp. (3481)	• Yuanta Daily CSI300 Bull 2X ETF (00637L)

Notes: We sort the list according to the ticker symbol.

Appendix 2 The Effect of the STT Reduction on Market Quality Measures and Transaction Impact Measures: PSM Results Using *pscore* Commands

Variable	Panel A: Treatment Sample [N=14,730]		Panel B: Control Sample [N=14,730]	
	(1) NNM with Analytical Standard Errors	(2) NNM with Bootstrapping Standard Errors	(1) NNM with Analytical Standard Errors	(2) NNM with Bootstrapping Standard Errors
Market Quality Measures				
Value_ln	0.302***	0.302***	-0.268***	-0.268***
	(15.38)	(15.82)	(-6.72)	(-7.05)
Volume_ln	0.097***	0.097***	-0.381***	-0.381***
	(6.46)	(7.24)	(-9.86)	(-10.49)
Turnover_%	0.063***	0.063***	-0.487***	-0.487***
	(3.81)	(3.86)	(-7.54)	(-6.58)
Volatility	0.044***	0.044***	0.027***	0.027***
	(4.05)	(3.82)	(8.63)	(9.52)
Liquidity	0.405***	0.405***	-0.312***	-0.312***
	(4.88)	(5.06)	(-2.74)	(-2.43)
Transaction Impact Measures				
DT_ln	0.890***	0.890***	-0.406***	-0.406***
	(33.36)	(37.73)	(-8.95)	(-9.32)
DT_%	0.064***	0.064***	-0.007***	-0.007***
	(39.56)	(35.59)	(-4.45)	(-4.29)
MNet_ln	-2.296***	-2.296***	-0.700***	-0.700***
	(-64.18)	(-64.15)	(-19.09)	(-20.20)
MNet_%	-0.020***	-0.020***	-0.005***	-0.005***
	(-52.51)	(-57.16)	(-18.14)	(-21.55)

Notes: This table reports the coefficients of the average treatment effect on the treated from the user-written commands *pscore* of the propensity score matching method. The sample period extends from April 28, 2016 to April 27, 2018. In Panel A, the treatment sample consists of 30 listed stocks on the Taiwanese Stock Exchange. In Panel B, the control sample comprises 30 ETF stocks. Market quality measures are: trading value, trading volume, turnover, volatility, and liquidity. Transaction impact measures are: day trading volume, day trading ratio, margin netting, and margin netting ratio. We estimate the (1) NNM (nearest-neighbor matching) models with analytical standard errors and (2) NNM models with robust standard errors from bootstrapping 100 replications as $Y_{i,t}$-$Y_{i,t}^{match}=\alpha+\delta_1 Post_t+\varepsilon_{i,t}$, where $Y_{i,t}$ is one of the variables of interest, and $Y_{i,t}^{match}$ is the value of the measure for the match of stocks (ETFs) before the STT reduction period. Estimates of the effect of the STT reduction (δ_1) are reported. Weekday effects are included in the above analyses. The number of observations N=14,730 is split into the pre-STT reduction (N=7,320) and post-STT reduction (N=7,410). The region of common support is [0.464, 0.542] based on the stock return to estimate the propensity score. The final number of blocks is 3. The test of the balancing property is satisfied. The *t*-statistics are shown in the parentheses. The superscripts ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Appendix 2 provides the PSM results based on the nearest-neighbor matching random draws where all treated units find a match. The results are close to those of (1) PSM in Table 4 but slightly different from (2) NNM because of the number of matching units.

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