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# *Tax Reforms and Stock Return Volatility: The Case of Japan*

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## Abstract

Japan abolished its stock transaction tax in 1999 and streamlined the capital gains tax in 2003, in order to revitalize its ailing stock market and economy at large during the recession. These tax reforms provide an excellent opportunity to revisit the important issue of stock market stability and taxation in finance, taking advantage of recent advances in modeling stock return volatility. Using a few GARCH-type models incorporating the so-called *leverage effec*t, this paper examines whether and how the tax reforms affected return volatility through a reduction in transaction cost. The estimation yields some evidence that the 1999 reform reduced volatility. Such evidence for the 2003 reform is much stronger. These results are in line with earlier findings based on the concept of historical volatility.

*JEL* codes: G150, G180, H240

Key Words: stock return volatility, taxation, Japan

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# 1. Introduction

The effect of taxation on the stability of stock markets has been one of the most important issues in both policy-making debates and academic discourse in finance. Just after the Black Monday market plunge in 1987, for example, a debate occurred in the United States on whether the country should re-introduce a stock transaction tax, which had been abolished many years earlier. Those supporting the idea claimed that the tax would increase the cost of transaction, keep out noise traders, and stabilize the market [Stiglitz:1989, Summers and Summers (1989)]. Those opposing the tax, on the other hand, argued that such a claim was not grounded in solid empirical evidence and that a higher transaction cost would adversely affect rational traders equally or even more than noise traders [Hakkio:1991]. They claimed, therefore, that the tax would destabilize, rather than stabilize, the market. Similar debates occurred in other countires, such as France, Germany, and Sweden, but eventually faded out as many abolished their transaction taxes, hoping to keep an international competitive edge for their stock markets. Some twenty years later, there seems to be a renewed interest in the issue in the aftermath of the recent global financial crisis, as leaders in industrialized economies discuss the need for a new tax to avoid the recurrence of similar turmoil in the future[3].

It is only natural that these policy debates have initiated academic discourse and prompted research. Focusing on stock return volatility, several studies have been conducted on the subject to date. For example, Roll [1989] examined the issue with cross-country data from 23 countries and found no significant effect. With data from Sweden, Umlauf [1993] concluded that the introduction of a turnover tax in the country did not reduce volatility. Hu [1998] obtained similar findings from tax reform episodes of four Asian countries. Lindgren [1994] used data from 14 countries for 11 years and concluded that a turnover tax of above 0.5% increases volatility, while one with a lower rate has no effect. Noronha and Ferris [1992] took up a capital gains tax and found evidence that an increase in the tax rate leads to an increase in volatility. Although existing studies seem to support the hypothesis that tax cuts have no or possibly a negative effect, on volatility, but not a positive one, they are all based on the concept of historical volatility. Advances have since been made in modeling stock return volatility in finance, establishing a generalized ARCH (GARCH) model and its variants as standard tools of analysis. However, the issue of taxation and return volatility remains largely unexplored in these frameworks[4].

[3] Leading politicians of European countries, such as Angela Merkel, Nicolas Sarközy and Gordon Brown, have repeatedly mentioned the Tobin tax since the G20 financial summit in Pistuburg in September 2009. Pushed by the agreement at the summit, IMF submitted to G20 a report «*Global Financial Stability Report: Meeting New Challenges to Stability and Building a Safer System*», advising a financial activity tax for policy consideration in the Toronto summit in June 2010.

[4] The only exception known to the authors is Saporta and Kan [1997], who examined the UK stamp duty in a standard GARCH model and found no significant effect on volatility. The present study distinguishes itself from

Recent tax reforms in Japan provide an excellent opportunity to explore this issue. As is well known, starting in 1990 the country experienced a severe, prolonged recession over a decade. As the most important cause was generally considered to be an inefficient financial sector, the country has enacted a series of reforms in the past ten years or so, in quest of a more competitive financial sector. Tax reform was a main pillar of the reform. In October 1999 the 40-year-old stock transaction tax (hereafter STT) was abolished, in the hope that a reduction of transaction costs would maintain the Tokyo market's standing as a world financial center. Further, in April 2003, the country streamlined the complicated systems of its capital gains tax, which in a peculiar manner had functioned as a de facto STT. These reforms are believed to have cut the cost of transaction a great deal. Therefore, these reforms are of great relevance in the long debated, unresolved issue of the effect of taxation on stock market stability. A closer examination of the market at the times of the reforms would shed new light on the issue.

The paper is organized as follows. The next section explains the institutional aspects of the Japanese tax reforms in some detail. The third section explains the methodology and data. The fourth section reports the results. The final section concludes the paper with caveats and venues for possible future extensions.

## 2. Japanese Tax Reforms

### 2.1. Background

The Japanese financial sector was one of the country's most heavily regulated sectors before the 1990s. The government was overly concerned with the stability of the financial system and did not, basically, allow financial institutions to compete, lose, and go bankrupt. However, the collapse of the bubble economy in 1990 revolutionized this «philosophy» of the government with respect to administration of the sector. Over-protection over many years had fostered irresponsible attitudes in the management of financial institutions, including a sense that they could never go bankrupt because the government would bail them out in the end; this had led to excessive lending during the bubble period. After rigorous policy debates, in 1996 the government initiated large-scale deregulation, popularly known as the «Financial Big Bang», in order to strengthen the financial sector through greater competition.

One of the main goals of this reform was to bring more individual investors into the market. It had long been pointed out that Japanese households were disproportionately inclined towards bank deposits. Bringing in more individual investors, thereby expanding the market, was

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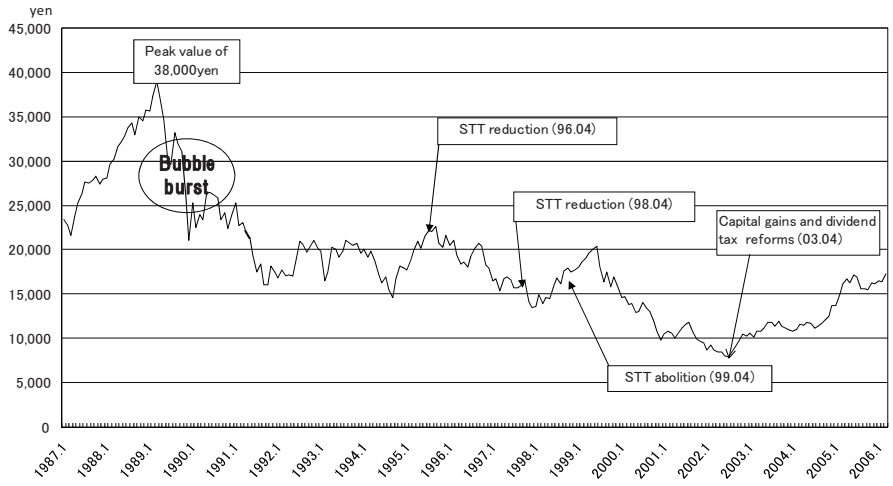
theirs by using an EGARCH model, which incorporates observed asymmetry in the behaviors of stock return volatility.

considered necessary for the success of the reform. One of the factors impeding the participation of individuals was the tax system. Since 1951, the country had had a turnover tax on stock trading (an STT), rasing the cost of trading. The capital gains tax, introduced in 1989, also had very complicated methods of calculating tax liability. These features of the financial taxes were believed to drive individual investors away. Therefore, the government implemented a series of tax reforms. After two minor rate reductions, the government abolished the STT in April 1999. It then streamlined the complicated system of the capital gains tax and greatly reduced the tax rate in April 2003. These reforms were the first serious reforms in financial taxes in many decades in the history of the Japanese tax system. As can be seen in Graph 1, the Japanese stock market made a turn-around just after the capital gains tax reform in April, 2003.

**Graph 1: Stock market and tax reforms in Japan (1987-2006)**




(Note) The vertical axis measures the Nikkei 225 average stock price.

## 2.2. Abolition of STT in 1999

Japan introduced a turnover tax in 1937, but abolished it in 1950 following a de facto order of the allied occupation forces[5]. As early as 1953, however, it was reintroduced, when the newly introduced capital gains tax under Dr. Shoup's advice was abolished on the grounds that it would have an adverse effect on capital accumulation, which was much needed for recovery after the war. In the period following, the STT rate was increased four times: 1957, 1973, 1978, and 1981.

[5] This is referred to as the *Shoup Advisory Opinion*, named after Dr. Carl Shoup of Columbia University, who headed the expert group to formulate the opinion. It covered a wide range of taxes and, when implemented, overhauled the overall tax system. Although termed an *advisory opinion*, it was a de facto order from the occupation forces command.

In the late 1980s, with the stock market booming and the proposed abolition of a tax-free treatment on small-amount savings[6], a strong voice arose claiming that mounting capital gains from stock trading accruing only to a small number of investors should be taxed for the equity of the overall tax system. The securities industry was vehemently opposed, claiming that the addition of this new tax would dampen the stock market[7]. It also argued that the plan would run against the gradually prevailing notion that the high transaction costs of Japan's financial markets must be reduced if they were to become internationally competitive markets[8]. As a political compromise, the STT rate was reduced for the first time when the capital gains tax was reintroduced in 1989 at the peak of the stock investment boom.

When the stock market fell into a great slump in the 1990s, further tax cuts were seriously debated. The industry pushed for it, invoking the aforementioned notion, and politicians in general were supportive; this was because the tax cuts were expected to reduce cost of transaction and thus to boost stock market trading. The Finance Ministry, on the other hand, was against it, arguing that it would aggravate the revenue shortage due to the downfall of the economy. The Ministry also argued that commission fees must be liberalized first to reduce transaction cost. As a result of this debate, which continued throughout the latter half of the 1990s, the STT was cut twice, in 1996 and 1998, before being completely abolished in April 1999. In this reform, the rates for brokerage firms' trading and other trading, including individual trading, were reduced 0.006% and 0.01%, respectively, down to zero[9].

## 2.3. Streamlining of the Capital Gains Tax in 2003

The capital gains tax in Japan was introduced in 1989, in order to cool the overly heated stock market at that time and to bring more equity into the overall tax system by taxing more the emerging "nouveau riche" who were making great profits in stock investments. Since then, the tax has been levied separately from other categories of personal income, with a flat rate different from that applied in the general income tax scheme. The rate was originally 26% (20% for national tax and 6% for local tax). However, before the reform in 2003, unique payment options existed, by which individual investors could choose either to pay the tax in the self-assessed income tax filing at the end of the tax year, or to pay at source with tax withholding *in each*

[6] Known as "Maruyu," this allowed households to hold such assets as bank and postal savings deposits and bonds of up to 3 million yen tax-free at the time of abolition. Households with heads disabled or older than 64 years continued to be eligible even after the 1989 tax reform.

[7] *Nihon Keizai Shinbun*, February 29, 1988, page 5.

[8] See, for example, *Nihon Keizai Shinbun*, December 24, 1986, page 13.

[9] In the following analysis, we take up only the reform in 1999, not the previous two cases, because they were relatively minor and fee liberalization occurred concurrently, so that the pure effect of the tax reform cannot be extracted.

*transaction*. However, if an investor chose the second option, the "pseudo capital gains rule" applied, where 5.25 % of the sales value was automatically considered to be the taxable capital gains, regardless of the price at which the stock was originally purchased. In this case, the local tax was waived. Therefore, 1.05 % of the sales value was automatically withheld as a tax liability. This unusual payment option was introduced because of the strong concern for a payment cost hike voiced among securities dealers and individual investors alike. It is well known within the securities trading community that most individual investors chose this tax withholding option. Note that, in this special scheme, the capital gains tax functioned as a de facto STT, even after the STT was abolished in April, 1999.

The 2003 tax reform streamlined this complex institution. It abolished the tax withholding option *in principle* and unified the payment methods under the self-assessed tax filing[10]. Considering concern that the abolition would lead to an overall tax increase and weaken the about-to-recover stock market, the tax rate was also reduced from 26 % to 10 % until December 2006. Table 1 reports the estimated average tax rate from 1998 to 2004. The rate clearly dropped in 2003.

**Table 1: Estimated average rates of the capital gains tax**

| Year | (A) Capital gains income in the self-assessed tax | (B) Capital gains income in the withholding tax | (C) Tax revenues in the withholding tax | (D) Estimated tax revenues in the self-assessed tax (A)×26% prior to Dec 2002and (A)×10% afterwards | (E) Average tax rate {(C)+(D)}/ {(A)+(B)} |
|---|---|---|---|---|---|
| 1998 | 307,510 | 506,302 | 101,260 | 79,953 | 22.126 |
| 1999 | 509,596 | 2,082,670 | 416,534 | 132,495 | 21.179 |
| 2000 | 544,080 | 1,927,301 | 385,460 | 141,461 | 21.321 |
| 2001 | 448,347 | 904,052 | 180,810 | 116,570 | 21.986 |
| 2002 | 326,767 | 984,155 | 195,831 | 84,959 | 21.496 |
| 2003 | 880,907 | 766,814 | 76,681 | 88,091 | 10.000 |
| 2004 | 1,356,958 | 1,422,373 | 142,237 | 135,696 | 10.000 |

(Note) Figures in columns (A), (B), and (C) are published in the National Tax Agency Statistical Annuals, except for those in column (C) for 2003 and 2004. They are calculated by multiplying the corresponding values in column (B) by the tax rate of 10%, as the figures covering the national and local taxes were no longer published in and after 2003. Figures in (B) are pseudo capital gains, which is 5.25% of the sales values. Figures for 2003 and 2004 are those for the special purpose accounts.

## 3. Methodology and Data

### 3.1. Methodology

[10] The reform also admitted, for the first time, carryover of losses for up to three years. However, it did not admit gains/losses totaling with other income categories. Furthermore, given deep-rooted concern for the high payment cost, the reform introduced a loophole measure to maintain the tax withholding payment. Investors can open a "special purpose account" and can pay tax at source from it, just as before 2003.

In empirical investigations of stock return volatility, it is now a standard practice to use a GARCH-type model. Within this class, a number of variants have been proposed to incorporate the generally observed asymmetry of the return volatility, known as the *leverage effect*, where bad news, which brings down the price, has a greater impact on volatility than good news. Among such models, we employ the following three models to check the robustness of the results: the exponential GARCH (EGARCH) model first proposed by Nelson [1991], the threshold ARCH (TARCH) model by Zakonian [1994], and the power ARCH (PARCH) model by Ding et al. [1991].

The EGARCH (p, q) model consists of two equations. The *mean equation* is the same as a standard GARCH model:

$$R_t = a + \sum_{i=1}^{m} b_i R_{i-m} + \varepsilon_t , \tag{1}$$

where

$$\varepsilon_t = \sigma_t z_t$$
$$\sigma_t > 0$$
$$z_t \sim i.i.d.(0,1)$$

For simplicity, we set m=1 in the present analysis. Engle et al. [1987] suggested that variance be linearly added to the right hand side of Equation (1) and referred to it as the ARCH-M term. A few variants have been suggested, which add standard deviation or the logarithm of the variance instead of variance. We will estimate the mean equations both with and without an ARCH-M term. We use standard deviation, as it turns out that the estimations for TARCH and PARCH run into problems when variance is used.

The *variance equation* takes the following form:

$$\log(\sigma_t^2) = \omega + \sum_{j=1}^{q} \beta_j \log(\sigma_{t-j}^2) + \sum_{i=1}^{p} \alpha_i \left( |z_{t-i}| - E\left( |z_{t-i}| \right) \right) + \sum_{l=1}^{k} \gamma_l z_{t-l} \tag{2}$$

Here, k is the order of asymmetry, and is set equal to 1 for simplicity in the following analysis. The parameter $\gamma < 0$ picks up the leverage effect. Lamourex and Lastrapes [1990] suggest that the current turnover, denoted as TV, be added to the right-hand side of Equation (2). As it turns out, turnover is generally highly significant when added, so we will always include it in (2) in the following analyses, for omitting such a significant variable would seriously hurt the credibility of the regression results[11].

The TARCH (p, q) and PARCH (p, q) models share the same mean equation (1) with the EGARCH (p, q), but differ in the variance equation. For the TARCH, equation (2) is replaced by:

[11] Karpoff [1987], for instance, confirms a positive relationship between turnover and volatility. Theoretical foundations can be found in, for example, Tauchen and Pitts [1983] and Andersen [1996]. Although, if these theories are correct, there is a concern for the problem of endogeneity, no justification can be made for dropping turnover altogether unless proper treatment is made for the problem.

$$\sigma_t^2 = \omega + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{l=1}^{k} \gamma_l \varepsilon_{t-l}^2 d_{t-l}^{-1} \tag{3}$$

Here, $d^{-1}$ is a dummy variable taking 1 when the stock price fell in the previous day and taking 0 otherwise. The parameter k indicates the order of asymmetry and is again set equal to 1. Note $\gamma$ <0 implies the existence of the leverage effect. For PARCH, equation (2) is replaced by:

$$\sigma_t^2 = \omega + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 + \sum_{i=1}^{p} \alpha_i \left( \left| \varepsilon_{t-i} \right| - \gamma_i \varepsilon_{t-i} \right)^{\delta} \tag{4}$$

Here $\delta$ is the parameter of the power term. While the asymmetry only additively enters into the variance equation in the above two models, here it enters as mixed with a power. This can be estimated together with other parameters. We do so in the following.

It is often argued that stock return volatility exhibits a day-of-the-week effect. That is, for example, on Monday, it is higher than the rest of the week. In order to address this possibility, we create day-of-the-week dummies in the following manner, and add them in the regression.

$$WD_t^k = \begin{cases} 0 & if\ t\ falls\ on\ the\ k\,th\ day\ of\ the\ week \\ 1 & if\ otherwise \end{cases}, \quad k = 1, 2, \ldots 4$$

Here k=1 corresponds to Monday. Note that k is 1 through 4; that is, Friday is the base line of the regression. We will try specifications both with and without this day-of-the week effect.

To examine the effect of tax reforms, we add a dummy variable representing the reform, which takes the values of 0 and 1 before and after the date when the change was put into effect. To examine the abolition of STT and the streamlining of the capital gains tax, we represent them by:

$$D_t^s = \begin{cases} 0 & if\ t \le t_0 \\ 1 & if\ otherwise \end{cases}, \quad s = 1, 2$$

We assign s=1 to the abolition of the STT in April 1999; so, $t_0$ is March 31, 1999 for s=1. We assign s=2 to the streamlining of the capital gains and dividend tax; so, $t_0$ is March 31, 2003 for s=2.

To summarize, the mean equation with *both* ARCH-M term and the day-of-the-week effect takes the form:

$$R_t = a + bR_{i-1} + c\sigma_t^2 + dD_t^s + \sum_{k=1}^{4} f_k WD_t^k + \varepsilon_t .$$

The variance equation with the day-of-the week effect, in the case of the EGARCH, is

$$\log(\sigma_t^2) = \omega + \sum_{j=1}^{q} \beta_j \log(\sigma_{t-j}^2) + \sum_{i=1}^{p} \alpha_i \left( \left| z_{t-i} \right| - E\left( \left| z_{t-i} \right| \right) \right) + \gamma z_{t-1} + \delta D_t^s + \sum_{k=1}^{4} \theta_k WD_t^k + \lambda TV_t .$$

The variance equations for TARCH and PARCH are defined similarly. We selectively restrict c and all $f_k$ and $\theta_k$, to be zero (k = 1, 2, 3, and 4). In the analysis below, we vary the values of p

and q from 1 to 5, and examine the overall tendency to draw some implications[12], in the following four specifications:

Spec. I: $c = f_k = \theta_k = 0$ (no ARCH-M or day-of-the-week effect)

Spec. II: $f_k = \theta_k = 0$ (no day-of-the week effect)

Spec. III: $c = 0$ (no ARCH-M term)

Spec. IV: no restriction

### 3.2. Data

For return, we use daily closing prices of the Nikkei average, which covers 225 common stocks traded in the First Section of the Tokyo Stock Exchange; R is calculated as a log difference of the prices. We obtain TV from the same source.

The estimation period is selected to cover the longest possible period that is not affected by other relevant institutional changes, before and after the date of the concerned tax change. That would make the estimation period six months before and after the reform for the abolition of the STT, because the government completely deregulated commission fees charged to customers by securities companies on October 1, 1999. It is considered that the liberalization further reduced the transaction cost. For the streamlining of the capital gains tax, the estimation period is a little longer, from July 1, 2002 to December 31, 2004, because a law was amended to tax mutual funds on January 1, 2004[13]. A longer period may be preferred for both reforms, but doing so includes other institutional changes in the estimation, making it difficult to judge whether the results are due purely to the tax reforms in focus.

## 4. Estimation Results

### 4.1. The Abolition of STT in 1999

Table 2 reports the summary statistics for R, and Graph 2 is the graphical presentation. As mentioned, we vary both p and q from 1 to 5 for each of the four specifications; so there are altogether 100 regression results and, due to space limits, it is not possible to report the detailed

[12] Alternatively, one can choose a specific value for each value of p and q, based on AIC or some other information criteria. However, we did not take that approach because AIC did not vary enough with this particular data to allow for any meaningful considerations.

[13] As of January 1, 2004, the proceeds from mutual funds are treated as equivalent of stock dividends rather than interest receipts from bonds and bank deposits.

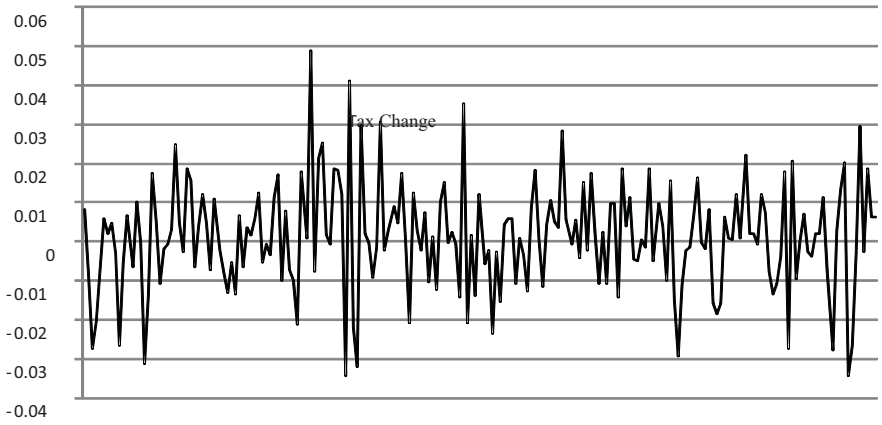
results of all regressions in full. Therefore, we only report the estimated coefficients, *d*, of our primary interest, $D^s$, and the associated levels of significance[14].

**Table 2: Summary statistics for stock return: Oct. 1, 1998 to Sep. 30, 1999**

| | | | |
|---|---|---|---|
| Mean | 0.001196 | Minimum | -0.05957 |
| Median | 0.000812 | Standard Dev. | 0.01556 |
| Maximum | 0.05991 | No. of observations | 246 |

(Note) Stock return is calculated as a log difference of the daily closing price of the Nikkei average stock price.

**Graph 2: Stock return movement: Oct. 1, 1998 to Sep. 30, 1999**




(Note) See the note for Table 2.

Table 3 reports the results for EGARCH. In observing it, one should note that the coefficients are all of negative sign across the four specifications. In terms of significance, in almost all cases, the coefficients are significant at least at the 10% level; there are many cases where they are so even at the 1% level. These tendencies are strongest in Spec III. These results are suggestive that the tax reform in 1999 decreased, rather than increased, return volatility.

**Table 3: Summary of results for STT abolition in 1999 (EGARCH)**

| Spec I | | q | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -0.670** | -0.672*** | -0.170** | -0.235** | -0.278** |
| | 2 | -0.911*** | -0.882*** | -0.866** | -0.243 | -0.778** |
| | 3 | -0.912*** | -0.878*** | -0.861** | -0.224 | -0.330** |
| | 4 | -0.833*** | -0.765** | -0.832** | -0.649** | -0.347* |
| | 5 | -0.846*** | -0.873*** | -0.377** | -0.399* | -0.275* |

[14] Following Bollerslev, Engle and Nelson [1994], we specify the distribution of z by student's t distribution.

| Spec II | | q | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -0.824*** | -0.785*** | -0.132* | -0.236** | -0.287** |
| | 2 | -0.882*** | -0.712*** | -0.405* | -0.995** | -0.333* |
| | 3 | -0.872*** | -0.781** | -0.655*** | -0.221 | -0.620* |
| | 4 | -0.815*** | -0.744** | -0.854** | -0.461** | -0.641** |
| | 5 | -0.798*** | -0.783** | -0.623* | -0.738* | -0.292*** |
| Spec III | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -0.875** | -0.919*** | -0.263** | -0.264* | -0.839** |
| | 2 | -1.041*** | -1.042*** | -0.829** | -0.862** | -0.751** |
| | 3 | -1.022*** | -1.007*** | -0.839** | -0.887** | -0.809** |
| | 4 | -1.211*** | -1.259*** | -0.902** | -0.888*** | -0.735** |
| | 5 | -1.109*** | -1.128*** | -0.677*** | -0.790*** | -0.650** |
| Spec IV | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -1.101*** | -1.216*** | -0.240* | -0.643* | -0.447* |
| | 2 | -1.065*** | -1.022*** | -0.871*** | -0.926** | -0.781** |
| | 3 | -1.031*** | -1.005*** | -0.885*** | -0.916** | -0.766** |
| | 4 | -1.121*** | -1.092*** | -0.751*** | -0.848* | -0.804* |
| | 5 | -1.081*** | -1.120*** | -0.709 | -0.736 | -0.791** |

Note: The value in each entry is the coefficient for the tax reform dummy, D, in the variance equation. One, two, and three asterisks mean that the estimated coefficient is significant at the 10%, 5%, and 1% levels, respectively.

Table 4 reports the results for TARCH. The tendencies observed in Table 3 are more or less evident here too. The coefficients are negative in all cases, and significant in many cases. One may say that evidence of the negative effect of the tax reform on volatility is a little weaker, because there are more cases of an insignificant coefficient. While that may be true, in our judgement the evidence is firm enough to conclude that the tax reform reduced volatility or at least to reject the hypothesis that the reform increased it.

**Table 4: Summary of results for STT abolition in 1999 (TARCH)**

| Spec I | | q | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -1.38E-05*** | -1.97E-05** | -3.20E-05*** | -4.37E-05** | -5.29E-05*** |
| | 2 | -1.10E-05** | -1.88E-05** | -3.71E-05*** | -5.05E-05*** | -4.40E-05** |
| | 3 | -0.000164*** | - | -3.88E-05*** | -4.60E-05*** | -5.51E-05*** |
| | 4 | -0.000161*** | -0.000138*** | -7.17E-09 | -5.55E-05** | -8.78E-09 |
| | 5 | -6.37E-05 | -7.08E-09 | -7.84E-09 | -8.66E-09 | -4.93E-05*** |
| Spec II | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -9.31E-05** | -1.90E-05* | -4.20E-05*** | -3.84E-05*** | -4.16E-05*** |
| | 2 | -1.12E-05** | -1.15E-05 | -6.22E-06 | -1.56E-05 | -6.79E-05*** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 3 | -1.30E-05* | -1.64E-05 | -3.68E-05**** | -2.04E-05* | -5.70E-05*** |
| | 4 | -6.58E-05* | -7.24E-05* | -6.38E-09 | -7.06E-09 | -5.02E-05*** |
| | 5 | -5.67E-09 | -6.32E-09 | -5.09E-05* | -4.71E-05 | -1.27E-05 |
| Spec III | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -4.64E-05*** | -4.69E-05** | -5.40E-05*** | -5.43E-05** | -6.35E-05*** |
| | 2 | -0.000149*** | -7.57E-05*** | -5.05E-05*** | -5.37E-05*** | -6.50E-05*** |
| | 3 | -0.000154*** | -0.000160*** | -6.81E-05*** | -5.79E-05*** | -1.70E-08 |
| | 4 | -0.000128*** | -8.31E-05*** | -5.86E-05*** | -1.68E-08 | -1.79E-08 |
| | 5 | -0.000114** | -8.59E-05** | -7.29E-05*** | -8.29E-05** | -7.31E-05** |
| Spec IV | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -6.50E-05** | -6.75E-05*** | -4.84E-05*** | -3.72E-05** | -4.79E-05** |
| | 2 | -2.67E-05** | -3.69E-05** | -2.44E-05* | -3.66E-05* | -5.10E-05*** |
| | 3 | -1.93E-05*** | -2.40E-05* | -1.28E-08 | -1.37E-08 | -1.46E-08 |
| | 4 | -2.46E-05*** | -1.35E-08 | -1.45E-08 | -4.44E-05*** | -4.44E-05*** |
| | 5 | -1.25E-08 | -1.34E-08 | -3.82E-05*** | -2.77E-05*** | -3.47E-05*** |

Note: The value in each entry is the coefficient for the tax reform dummy, D, in the variance equation. One, two, and three asterisks mean that the estimated coefficient is significant at the 10%, 5%, and 1% levels, respectively.

Finally, the results for PARCH are reported in Table 5. The evidence for the negative effect of the tax reform on volatility is weakest of all. That is particularly so in the estimation without the day-of-the-week ettect (Spec I and II); there are only a few cases when the estimated coefficients are significant even at the 10% level. However, note that even in the cases of insignificant coefficients, their signs are all negative. In the estimation with the day-of-the week effect (Spec III and IV), there are more cases for significant coefficients. They are all of the negative sign whether significant or not.

**Table 5: Summary of results for STT abolition in 1999 (PARCH)**

| Spec I | | q | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -5.90E-06 | -8.51E-06 | -7.20E-06 | -2.13E-05** | -3.71E-05** |
| | 2 | -7.57E06 | -1.18E-05 | -8.46E-06** | -2.79E-05*** | -4.93E-05*** |
| | 3 | -8.66E-05 | -4.21E-05* | -4.48E-05 | -8.27E-11 | -9.10E-11 |
| | 4 | -6.65E-11 | -0.000166 | -1.35E-05 | -8.97E-11 | -9.84E-11 |
| | 5 | -7.28E-11 | -8.03E-11 | -8.84E-11 | -4.64E-05 | -4.23E-05*** |
| Spec II | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -1.41E-11 | -6.87E-06 | -1.21E-05 | -6.70E-06** | -1.44E-05*** |
| | 2 | -1.02E-05 | -1.36E-05 | -1.84E-05 | -8.35E-06 | -1.66E-05 |
| | 3 | -2.09E-05 | -1.68E-05 | -1.59E-05 | -1.30E-05 | -8.03E-11 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 4 | -7.30E-05 | -6.07E-05 | -7.22E-11 | -7.95E-11 | 2.76E-05 |
| | 5 | -6.46E-11 | -7.15E-11 | -6.07E-05 | -6.04E-05 | -1.08E-05 |
| Spec III | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -3.93E-05** | -4.80E-05*** | -4.03E-05*** | -3.09E-05*** | -6.51E-05 |
| | 2 | -5.03E-05*** | -5.62E-05*** | -3.47E-05 | -4.34E-05** | -6.45E-05** |
| | 3 | -0.000108 | -7.91E-05*** | -5.71E-05** | -6.91E-05*** | -6.09E-05** |
| | 4 | -9.12E-05*** | -9.01E-05 | -1.72E-10 | -1.82E-10 | -5.14E-05*** |
| | 5 | -1.60E-10 | -1.69E-10 | -6.50E-05 | -5.95E-05 | -7.72E-05** |
| Spec IV | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -2.97E-05*** | -1.95E-05*** | -6.56E-05*** | -1.73E-05*** | -3.48E-05 |
| | 2 | -1.41E-05 | -2.50E-05 | -2.99E-05 | 2.80E-05 | -2.52E-05*** |
| | 3 | -1.98E-05 | -2.75E-05*** | -2.05E-05*** | -2.76E-05 | -1.59E-10 |
| | 4 | -3.22E-05 | -3.03E-05*** | -1.48E-10 | -1.58E-10 | -2.48E-05* |
| | 5 | -1.37E-10 | -4.66E-05 | -6.57E-05 | -1.11E-05* | -4.36E-05* |

Note: The value in each entry is the coefficient for the tax reform dummy, D, in the variance equation. One, two, and three asterisks mean that the estimated coefficient is significant at the 10%, 5%, and 1% levels, respectively.

Overall, the conclusion one can draw from these results would be: there is firm evidence that the 1999 tax reform reduced volatility. The strength of evidence for this case varies somewhat among the three estimation models, but they are unanimous in rejecting the hypothesis that the volatility is increased, as the coefficients are negative in all cases. This conclusion is in line with those of the previous studies based on the traditional concept of historical volatility.

## 4.2. The Tax Reform in 2003

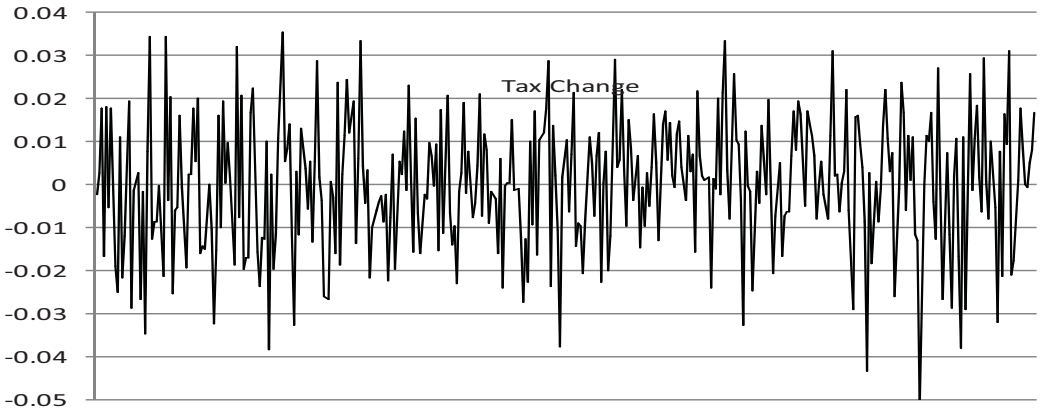
We conduct the analysis similarly for the streamlining of the capital gains tax in 2003. Table 6 reports the summary statistics for R, and Graph 3 is the graphical presentation. Tables 7 through 9, as before, report the coefficient $D^s$ and their associated levels of significance for each of the three estimation models.

**Table 6: Summary statistics for stock return: Jul. 1, 2003 to Dec. 31, 2004**

| | | | |
|---|---|---|---|
| Mean | 0.000014 | Minimum | -0.052258 |
| Median | 0.000081 | Standard Dev. | 0.015188 |
| Maximum | 0.035373 | No. of observations | 371 |

(Note) Stock return is calculated as a log difference of the daily closing price of the Nikkei average stock price.

**Graph 3: Stock return movement: Oct. 1, 1998 to Sep. 30, 1999**




(Note) See the note for Table 2.

First, let us look at the results for EGARCH in Table 7. One can observe that again the signs of the coefficients are all negative. In terms of significance, in almost all cases across the four specifications, the coefficients are significant at least at the 10% level; many are so even at the 1% level. Therefore, one can draw a similar conclusion to that of the previous section: the tax reform in 2003 contributed to the reduction of return volatility. This is also in line with the previous studies. It especially compares to the results of Noronha and Ferris [1992], who used the traditional concept of historical volatility to address the issue of tax reform and return volatility.

**Table 7: Summary of estimation results for capital gains tax reform in 2003 (EGARCH)**

| Spec I | | q | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -0.507* | -0.560* | -0.462 | -0.582* | -0.536 |
| | 2 | -0.522 | -0.639* | -0.202*** | -0.585* | -0.138*** |
| | 3 | -0.101*** | -0.141*** | -0.168*** | -0.165** | -0.172*** |
| | 4 | -0.476 | -0.182*** | -0.248*** | -0.176*** | -0.198*** |
| | 5 | -0.089*** | -0.183*** | -0.219*** | -0.198** | -0.238** |
| Spec II | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| | 1 | -0.580* | -0.753** | -0.581* | -0.600* | -0.571* |
| | 2 | -0.606* | -0.794** | -0.648* | -0.632* | -0.713* |
| | 3 | -0.657** | -0.175*** | -0.217*** | -0.200*** | -0.221*** |
| | 4 | -0.612* | -0.176*** | -0.231*** | -0.216*** | -0.221*** |
| | 5 | -0.458 | -0.177*** | -0.229*** | -0.236*** | -0.294*** |
| Spec III | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -0.679** | -0.828** | -0.692* | -0.596 | -0.618* |
| | 2 | -0.711** | -0.916** | -0.869* | -0.679 | -0.634 |
| | 3 | -0.741** | -0.153*** | -0.194*** | -0.166** | -0.176** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 4 | -0.719** | -0.167*** | -0.212*** | -0.198*** | -0.187*** |
| | 5 | -0.703** | -0.163*** | -0.209*** | -0.241*** | -0.560* |
| Spec IV | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -0.705*** | -0.851** | -0.888** | -0.643* | -0.717* |
| | 2 | -0.726** | -0.884** | -0.992** | -0.682* | -0.650* |
| | 3 | -0.769** | -0.899** | -0.642* | -0.352*** | -0.637* |
| | 4 | -0.768** | -0.609 | -0.544* | -0.650* | -0.495* |
| | 5 | -0.792** | -0.605* | -0.614* | -0.586* | -0.568** |

Note: The value in each entry is the estimated coefficient for the tax reform dummy, $D^s$, in the variance equation (2). One, two, and three asterisks mean that the estimated coefficient is significant at the 10%, 5%, and 1% levels, respectively.

Table 8 contains the results for TARCH. The evidence for the tax reform reducing volatility is somewhat weaker than for EGARCH. This is particularly evident in the most restrictive model, Spec I. There are only three cases where the coefficient is significant. However, in the other three models, there are many more significant coefficients. In the least restrictive model, with the ARCH-M term and the-day-of-the-week effect, Spec IV, there is only one case where the coefficient is insignificant at the 10% level. In fact, they are significant at the 1% level in 18 out of 25 cases. In all 100 cases, the signs are negative. Therefore, it is reasonable to read these results as indicating that the volatility is reduced, certainly not increased, by the tax reform.

**Table 8: Summary of estimation results for capital gains tax reform in 2003 (TARCH)**

| Spec I | | q | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -8.73E-05* | -5.54 E-05* | -8.02 E-05 | -1.07 E-05 | -5.78 E-05 |
| | 2 | -4.48 E-05 | -4.95 E-05 | -5.05 E-05 | -5.03 E-05 | -5.25 E-05 |
| | 3 | -4.80 E-05 | -6.53 E-05** | -5.77 E-05 | -5.41 E-05 | -5.72 E-05 |
| | 4 | -5.77 E-05 | -5.83 E-05 | -5.68 E-05 | -5.37 E-05 | -5.87 E-05 |
| | 5 | -4.77 E-05 | -5.25 E-05 | -5.35 E-05 | -0.000105*** | -4.63 E-05 |
| Spec II | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -6.35 E-05*** | -5.45 E-05** | -5.50E-05** | -4.65 E-05** | -7.11 E-05*** |
| | 2 | -5.61 E-05** | -5.43 E-05*** | -8.48 E-05*** | -6.29 E-05** | -6.42 E-05** |
| | 3 | -7.49 E-05*** | -8.17 E-05*** | -6.13 E-05*** | -7.11 E-05 | -6.04 E-05 |
| | 4 | -7.54 E-05 | -8.24 E-05** | -6.88 E-05 | -6.66 E-05 | -7.97 E-05** |
| | 5 | -6.32 E-05 | -7.17 E-05** | -6.15 E-05** | -7.40 E-05*** | -6.67 E-05 |
| Spec III | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -5.33 E-05** | -7.25 E-05*** | -7.20 E-05* | -6.67 E-05*** | -7.32 E-05*** |
| | 2 | -6.26 E-05 | -5.47 E-05 | -7.12 E-05** | -7.54 E-05** | -7.36 E-05*** |
| | 3 | -8.31 E-05*** | -8.12 E-05* | -7.71 E-05 | -6.79 E-05 | -8.52 E-05*** |
| | 4 | -7.30 E-05 | -4.91 E-05 | -8.63 E-05*** | -6.92 E-05*** | -7.94 E-05*** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 5 | -6.94 E-05 | -3.15 E-05 | -3.93 E-05 | -7.13 E-05 | -5.34 E-05 |
| Spec IV | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -5.84 E-05*** | -6.40 E-05** | -7.25 E-05*** | -6.03 E-05 | -6.86 E-05*** |
| | 2 | -6.81 E-05*** | -9.97 E-05*** | -6.58 E-05** | -7.53 E-05*** | -7.45 E-05*** |
| | 3 | -8.17 E-05*** | -7.96 E-05*** | -7.37 E-05*** | -5.53 E-05*** | -7.80 E-05* |
| | 4 | -8.12 E-05** | -8.47 E-05*** | -7.02 E-05*** | -8.08 E-05** | -7.13 E-05*** |
| | 5 | -7.11 E-05*** | -7.73 E-05*** | -8.11 E-05*** | -7.43 E-05*** | -7.83 E-05** |

Note: The value in each entry is the estimated coefficient for the tax reform dummy, $D^s$, in the variance equation (2). One, two, and three asterisks mean that the estimated coefficient is significant at the 10%, 5%, and 1% levels, respectively.

Finally, Table 9 reports the results for PARCH. The evidence for the reduced volatility is weakest. In the most restrictive model of Spec I, no significant coefficient is obtained. The evidence is weaker in the other specifications even compared with TARCH. Looking at this table *alone*, one may conclude that there is only weak evidence that the tax reform reduced volatility. However, the hypothesis that the volatility is increased can be strongly rejected as there is no single case where the coefficient is of the positive sign.

**Table 9: Summary of estimation results for capital gains tax reform in 2003 (PARCH)**

| Spec I | | q | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -4.47 E-05 | -6.61 E-05 | -4.35 E-05 | -6.49 E-05 | -4.53 E-05 |
| | 2 | -4.67 E-05 | -5.22 E-05 | -5.09 E-05 | -5.92 E-05 | -5.47 E-05 |
| | 3 | -6.01 E-05 | -6.01 E-05 | -6.38 E-05 | -5.82 E-05 | -5.87 E-05 |
| | 4 | -6.15 E-05 | -6.23 E-05 | -5.99 E-05 | -7.61 E-05 | -6.32 E-05 |
| | 5 | -7.47 E-05 | -4.66 E-05* | -6.57 E-05 | -5.60 E-05 | -3.32 E-05 |
| Spec II | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -3.72 E-05** | -4.62 E-05** | -5.03 E-05* | -4.69 E-05** | -6.13 E-05*** |
| | 2 | -4.94 E-05* | -6.03 E-05** | -7.12 E-05 | -4.58 E-05 | -5.17 E-05*** |
| | 3 | -1.24 E-11 | -6.00 E-05** | -6.93 E-05*** | -5.64 E-05** | -6.62 E-05 |
| | 4 | -7.26 E-05 | -7.26 E-05*** | -8.05 E-05* | -7.52 E-05 | -9.26 E-05 |
| | 5 | -6.69 E-05 | -6.81 E-05** | -6.19 E-05 | -7.90 E-05** | -8.00 E-05** |
| Spec III | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| p | 1 | -4.36 E-05* | -4.53 E-05 | -5.69 E-05 | -2.91 E-11 | -6.42 E-05 |
| | 2 | -6.21 E-05 | -6.06 E-05 | -7.60 E-05*** | -6.75 E-05 | -6.31 E-05 |
| | 3 | -7.66 E-05*** | -7.65 E-05 | -9.14 E-05*** | -7.40 E-05 | -6.87 E-05 |
| | 4 | 0.000108*** | -8.60 E-05 | -9.63 E-05*** | -8.54 E-05** | -8.88 E-05*** |
| | 5 | -7.03 E-05 | -7.03 E-05 | -7.19 E-05 | -7.19 E-05 | -9.05 E-05 |
| Spec IV | | q | | | | |
| | | 1 | 2 | 3 | 4 | 5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| p | 1 | -4.94 E-05** | -6.73 E-05 | -6.58 E-05*** | -4.98 E-05** | -6.15 E-05 |
| | 2 | -6.53 E-05** | -7.20 E-05*** | -7.60 E-05 | -6.86 E-05 | -6.34 E-05*** |
| | 3 | -6.64 E-05*** | -8.65 E-05*** | -5.77 E-05** | -6.77 E-05** | -8.03 E-05*** |
| | 4 | -6.71 E-05*** | -8.89 E-05*** | -7.70 E-05*** | -7.77 E-05 | -6.52 E-05** |
| | 5 | -7.71 E-05*** | -6.74 E-05 | -7.46 E-05*** | -9.12 E-05 | -8.36 E-05 |

Note: The value in each entry is the estimated coefficient for the tax reform dummy, $D^s$, in the variance equation (2). One, two, and three asterisks mean that the estimated coefficient is significant at the 10%, 5%, and 1% levels, respectively.

## 5. Conclusions

Whether taxation of stock trading contributes to or aggravates the stability of the market has a long history in policy-making debates as well as academic discourse. Earlier studies on the subject seem to suggest that taxes do not increase return volatility, but rather decrease it. These studies, however, use the concept of historical volatility and do not take advantage of recent advances in modeling return volatility. In view of this, this paper revisits the issue by employing variants of the GARCH type model that incorporate the widely observed asymmetry in the behavior of stock return volatility known as the leverage effect, namely EGARCH, TARCH and PARCH models. To do so, the paper exploits the recent tax reforms in Japan, which are thought to have decreased transaction cost considerably.

We examined the dummy variable, representing the two tax reforms, in the variance equation for four different specifications varying the ARCH orders of (p, q) in each of the three models. The estimation yields more or less similar results for both tax reforms. The results for EGARCH constitute firm evidence to support the view that the tax reform reduced volatility. Those for TARCH and PARCH are somewhat weaker as such evidence, but are strong enough to draw the above conclusion when viewed in total. The hypothesis that the tax change increased volatility is strongly rejected because the sign of the coefficient is negative literally in all of the 600 cases across models and specifications. These results are in line with earlier findings based on the concept of historical volatility.

At the end of the paper, it may be worth mentioning the shortcomings of the present analysis and venues for future extension. First, this paper used variants of GARCH type models. While these models are relatively new, other concepts of volatility have been suggested more recently in the finance literature, such as stochastic volatility and realized volatility. Therefore, further investigation of the issue using the most recent developments in the literature may be an interesting line of future research. This paper also focuses on Japan, but many other countries still hold a turnover tax and other related taxes. These include growing economies in East Asia[15]. Examining the experiences of those countries, thereby bringing a broader perspective, would be

[15] Examples include South Korea, Singapore, Hong Kong, Taiwan and China.

beneficial in quest of appropriate policies for taxation of stock trading in this age of globalization, especially in a time of recurrent interest in financial taxation.

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