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Securities Transaction Taxes and Financial Markets

Karl Habermeier and Andrei Kirilenko

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Securities Transaction Taxes and Financial Markets

Prepared by Karl Habermeier and Andrei Kirilenko[1]

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Abstract

This paper argues that securities transaction taxes "throw sand" not in the wheels, but into the engine of financial markets where the transformation of latent demands into realized transactions takes place. The paper considers the impact of transaction taxes on financial markets in the context of four questions. How important is trading? What causes price volatility? How are prices formed? How valuable is the volume of transactions? The paper concludes that transaction taxes or such equivalents as capital controls can have negative effects on price discovery, volatility, and liquidity and lead to a reduction in the informational efficiency of markets.

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Authors' E-Mail Addresses: khabermeier@imf.org, akirilenko@imf.org

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I. Introduction

Financial markets transform latent demands of investors into realized financial transactions. Securities transaction taxes (STTs) alter this transformation. Proponents of STTs argue that such taxes can reduce market volatility, help to prevent financial crises, and reduce excessive trading.[2] Opponents believe that STTs are difficult to implement and enforce and that they can do great damage to financial markets.

This paper considers the impact of transaction taxes on financial markets in the context of four broad questions. How important is trading? What causes price volatility? How are prices formed? How valuable is the volume of transactions? These questions are at the core of the debate on the role of transaction taxes. The discussion draws on research on market microstructure, asset pricing, rational expectations, and international finance.

Market microstructure studies suggest that trading is essential for price discovery or the process of finding market clearing prices. A large number of markets rely on dealers to provide price discovery as well as liquidity and price stabilization. Levying STTs on the dealers inhibits their ability to assist investors with the transformation of latent demands into realized transactions. The literature also finds that much of the volatility is caused by informed traders as their information is aggregated into transaction prices. Taxing financial transactions does not reduce the volatility due to "noise" trading. Rather, it introduces additional frictions into the price discovery process.

The literature on option pricing under transaction costs shows how frictions on the trading in one asset affects prices and volumes of that and other assets. Using a simple framework based on this literature, we show that in order to avoid replication, a securities transaction tax must be imposed on all financial assets in the model economy. Otherwise, the tax is circumvented. This is done by replicating the payoff on the asset that is subject to the tax by constructing a portfolio of assets that are not. The volume migrates to the assets that are not subject to the tax. Even after extending a transaction tax to all assets, the realized revenue falls well short of the expected revenue target. Moreover, we argue that it is very difficult to design and implement a tax that does not favor one portfolio of assets over another portfolio with exactly the same payoff.

Recent studies on rational expectations question the traditional view that volume is just an outcome of the trading process and is not valuable per se. These studies find that volume can play an informational role. Consequently, if transaction taxes cause the volume to migrate, then they can hamper the informational efficiency of markets.

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[2] For example, Eichengreen, Tobin, and Wyplosz (1995) argue that "transaction taxes are one way to throw sand in the wheels of super-efficient financial vehicles."

International finance provides other interesting examples of volume fragmentation and market segmentation. Volume fragmentation can occur due to restrictions on trading of substitutable securities such as different share classes. This leads to market segmentation and inefficient price discovery.

Overall, there are strong arguments that transaction taxes can have negative effects on price discovery, volatility, and market liquidity. These effects can lead to a reduction in market efficiency and may contribute to increased volatility.

Many of the issues that arise in the debate over STTs are immediately relevant to the debate on controls on international capital flows. Indeed, a number of controls on capital flows have taken the form of implicit STTs, for example the Chilean unremunerated reserve requirement on capital inflows. Moreover, quantitative (or direct) capital controls can be seen to have a tax equivalent, much as quantitative trade restrictions or quotas have a tariff equivalent. A recent study of country experiences with the use and liberalization of capital controls identifies methods of avoiding controls that are very similar to those used to circumvent STTs.[3] The study also points to analogous problems with the enforcement and sequencing of policy measures, and very mixed results in using controls in connection with the prevention or resolution of financial crises.

This paper is organized as follows. Section II reviews the literature on STTs. Section III provides a brief description of the Swedish experience with such taxes. Sections IV-VII deal with the four broad questions specified above. Section VIII reviews international finance evidence on market segmentation and execution costs in different markets. Section IX links transaction taxes with capital controls. Section X summarizes and concludes the paper. A description of transaction taxes in developed economies is in the Appendix.

II. Literature on Securities Transaction Taxes

Opinions on securities transaction taxes are split. Proponents of STTs make the following arguments.[4] First, the contribution of financial markets to economic welfare does not justify the resources they command. During a given time period, the resources that change hands in financial markets far exceed the value of the underlying or "real" transactions. Second, many financial transactions are highly speculative in nature, and may contribute to financial or economic instability. Third, market instability, including crashes, enriches insiders and speculators, while the costs are borne by the general public. Fourth, financial market activity increases inequalities in the distribution of income and wealth. Finally, the large

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[3] See, Ariyoshi et al. (2000).

[4] See, for example, Tobin (1984), Summers and Summers (1989), Stiglitz (1989), and Eichengreen, Tobin, and Wyplosz (1995).

volume of financial transactions in well-developed modern markets allows large amounts of tax revenue to be raised by imposing very low tax rates on a broad range of transactions.

Thus, in order to discourage destabilizing speculation that can threaten high employment and price stability, and to raise revenue, governments ought to tax financial transactions. Higher rates should be levied on short-term transactions, since these seem to benefit primarily market intermediaries and not "real" users.

Opponents of STTs have more faith in the ability of markets to allocate resources efficiently without direct intervention from public policy. However, they also lack a convincing argument to justify the volume of resources flowing through financial markets. Numerous documented anomalies, as well as a history of market crashes, do not lend themselves easily to the idea that financial markets are fully efficient. Neither does the fact that market participants devote considerable resources to analyzing previous transaction prices and volumes. Thus, instead of showing that the allocation of resources to the financial sector is justified on efficiency grounds, or that observed market volatility is optimal,the opponents of STTs have focused on practical shortcomings of the taxes themselves.[5]

There are two dimensions to the difficulties in implementing STTs. First, if an STT is applied in one financial market but not in others, the volume of transactions tends to migrate from the market that is taxed to markets that are not. Effective enforcement of STTs thus requires either a cross-market and perhaps even a global reach or measures to segregate markets. For example, tax authorities in one country may attempt to require payment of the tax on transactions made by their residents not only in financial markets within their own borders, but in other markets as well. Alternatively, they may impose controls on cross-border financial transactions.

Second, since the composition of the assets used in financial transactions matters less than the distribution of payoffs over time and in uncertain states of the world, the tax base must be defined as a function of the final payoff rather than the assets employed. A securities transaction tax would be considered neutral if it did not favor one portfolio of assets over another portfolio with exactly the same payoff. Since payoffs can be replicated by portfolios consisting of different types of assets, the imposition of an STT can create a greater distortion than it is trying to mitigate. Instead of trading less because of the tax, investors may transact more in assets that are taxed less or not at all. As a result, real resources devoted to financial transactions may in fact increase rather than diminish following the imposition of an STT.

Given the lack of a consensus on the theory, there have been attempts to resolve the debate empirically. A collective volume published by the Catalyst Institute in 1995 reviews

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[5] See, for example, Campbell and Froot (1995).

most of the empirical research on financial transaction taxes. Empirical studies since 1995 have sought to address similar issues by using other datasets.

Empirical studies undertaken so far have not been able to decisively resolve the debate on the effects of transaction taxes on financial markets. Empirical research encountered three major problems. First, the effects of taxes on prices and volume are hard to disentangle from other structural and policy changes taking place at the same time. Therefore, estimates based on the assumption that everything else in the economy is held constant are potentially biased.

Second, it is difficult to separate transaction volume into stable (or "fundamental") and destabilizing (or "noise") components. Thus, it is hard to say which part of the volume is more affected by the tax.

Third, it is hard to differentiate among multiple ways in which transaction taxes can affect asset prices. These ways include changes in expectations about the impact of the taxes, the cost of creating and trading in close substitutes not covered by the tax, and changes in market liquidity.

Empirical studies seek answers to three main questions. The first question is whether transaction taxes have an effect on price volatility. Roll (1989) studies stock return volatility in 23 countries from 1987 to 1989. He finds no evidence that volatility is reliably related to transaction taxes. Umlauf (1993) studies equity returns in Sweden during 1980–87, before and during the imposition of transaction taxes on brokerage service providers. He finds that the volatility did not decline in response to the introduction of taxes. Saporta and Kan (1997) study the impact of the U.K. stamp duty on volatility of securities' prices. They also find no evidence of a relationship between the stamp duty and volatility. Jones and Seguin (1997) examine the effect on volatility of the introduction of negotiated commissions on U.S. national stock exchanges in 1975, which resulted in a permanent decline in commissions. They argue that this event is analogous to a one-time reduction of a tax on equity transactions. They reject the hypothesis that the lowering of commissions increases volatility. Hu (1998) examines the effects on volatility of changes in transaction taxes that occurred in Hong Kong, Japan, Korea, and Taiwan from 1975 to 1994, and does not find significant effects. Finally, Hau and Chevalier (2000) examine the effect on volatility of minimum price variation rules in the French stock market. They argue that minimum price variation rules result in a doubling of transaction costs for stocks priced above a certain threshold (500 francs). They argue that this is analogous to the application of a transaction tax on the stocks above the threshold. They find that the increase in transaction costs results in "a statistically significant, but economically insignificant" reduction in the daily, weekly, and monthly return volatility.

The second question is whether transaction taxes affect trading volume. Umlauf (1993) reports that after Sweden increased its transaction tax from 1 percent to 2 percent in

1986, 60 percent of the volume of the 11 most actively traded Swedish stocks migrated to London. The migrated volume represented over 30 percent of all trading volume in Swedish equities. By 1990, that share increased to around 50 percent. According to Campbell and Froot (1995), only 27 percent of the trading volume in Ericsson, the most actively traded Swedish stock, took place in Stockholm in 1988. Hu (1998) examines 14 tax changes in four Asian markets and finds that differences in turnover before and after changes in the tax level are not statistically significant.

Thirdly, empirical studies seek to find out whether transaction taxes have an impact on securities' prices. Umlauf (1993) reports that the Swedish All-Equity Index fell by 2.2 percent on the day a 1 percent transaction tax was introduced and again by 0.8 percent on the day it was increased to 2 percent. Saporta and Kan (1997) find that on the day stamp duty in the U.K. was increased from 1 to 2 percent, the stock market index declined by 3.3 percent. Hu (1998) finds that on average the return on the announcement date is -0.6 percent in Korea and -1.6 percent in Taiwan, with the result for Taiwan being highly statistically significant.

One of the main reasons for the dispersion and inconclusiveness of results is the lack of appropriate data. Since the questions are essentially of the market microstructure-type, an ideal dataset would consist of transaction frequency data for individual financial instruments. In order to take revisions in expectations into account, the data should start well before the announcement of the transactions tax and include a sufficient number of observations following its imposition. Furthermore, in order to separate volume into meaningful categories, the data should be broken down according to the type of investor, e.g., institutional investors, hedge funds, and mutual funds. In contrast, most empirical studies rely on weekly equity index returns.

III. The Swedish Experience

In order to illustrate the subsequent arguments, we devote this section to a brief description of the Swedish experience with STTs. The Swedish experiment lasted for more than eight years. The first measure was announced in October 1983 and the last one was abolished in December 1991. The analysis in this section is based on the studies by Umlauf (1993) and Campbell and Froot (1995).

The initiative to impose financial transaction taxes came from the Swedish labor sector in 1983. The labor sector did not claim that trading in financial markets led to inefficient outcomes. Rather, according to Umlauf (1993), in the opinion of the labor sector, "the salaries earned by young finance professionals were unjustifiable ... in a society giving high priority to income equality," especially given the seemingly unproductive tasks that they performed. On this basis, the Swedish labor sector proposed to levy taxes directly on domestic brokerage service providers.

Despite the objections of the Swedish Finance Ministry and the business sector, popular support led to the adoption of taxes by Parliament. The taxes became effective on January 1, 1984. They were levied on domestic stock and derivative transactions. Purchases and sales of domestic equities were taxed at 0.5 percent each, resulting in a 1 percent tax per round-trip. Round-trip transactions in stock options were taxed at 2 percent. In addition, exercise of an option was treated as a transaction in the underlying stock and, thus, was subject to an additional 1 percent round-trip charge. The tax coverage and rates reflected a popular perception about the "usefulness" of transactions in different financial instruments, with those involving equity options being the least "useful."

Continuing pressure from the labor sector compelled the Parliament to double the tax rates in July 1986 and broaden its coverage in 1987. Furthermore, following large losses in interest futures and options (most notably by the City of Stockholm, which lost SEK 450 million), the tax was extended to transactions in fixed-income securities, including government debt and the corresponding derivatives in 1989.[6] The maximum tax rate for fixed-income instruments was set at 0.15 percent of the underlying notional or cash amount. In addition, the tax was designed to be "yield-neutral," with longer maturities instruments being taxed at progressively higher rates.

The revenue performance of the tax was disappointing. According to the Finance Ministry of Sweden, the government collected SEK 820 million in 1984, SEK 1.17 billion in 1985, and SEK 2.63 billion in 1986. This accounted for 0.37, 0.45, and 0.96 percent of the total revenue for the corresponding years. After doubling the tax rates the government was able to collect SEK 3.74 billion in 1987 and SEK 4.01 billion in 1988. This accounted for 1.17 and 1.21 percent of the total revenue.[7] Thus, a 100 percent increase in the tax rate resulted in a 22 percent increase in revenue.

Widespread avoidance was one reason for the weak performance of the tax. Foreign investors avoided the tax by placing their orders with brokers in London or New York. Domestic investors avoided it by first establishing off-shore accounts (and paying the tax equal to three times the round-trip tax on equity for funds moved off-shore) and then using foreign brokers.

The scale of avoidance was manifested by a massive migration of stock trading volume from Stockholm to other financial centers. For example, following the doubling of the tax,

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[6] Officially, the extension of the tax to fixed-income instruments was supposed to achieve "neutrality" with the tax on equity transactions. See Campbell and Froot (1995).

[7] By contrast, tobacco taxes accounted for 1.26 and 1.37 percent of the total revenue collected in 1987 and 1988, respectively.

60 percent of the volume of the 11 most actively traded Swedish stocks migrated to London.[8] The migrated volume represented over 30 percent of all trading volume in Swedish equities. By 1990, that share increased to around 50 percent. According to Campbell and Froot (1995), only 27 percent of the trading volume in Ericsson, the most actively traded Swedish stock, took place in Stockholm in 1988.

Broadening the tax to fixed-income instruments resulted in a sharp drop in trading volume in Swedish government bills and bonds and in fixed-income derivatives contracts. Campbell and Froot (1995) estimate that during the first week of the tax, bond trading volume dropped by about 85 percent from its average during the summer of 1987 and trading in fixed-income derivatives essentially disappeared. This significantly undermined the ability of the Bank of Sweden to conduct monetary policy, made government borrowing more expensive, and eroded both popular and political support for the tax. Taxes on fixed-income instruments were abolished in April 1990. Taxes on other instruments were cut in half in January 1991 and abolished altogether in December 1991.

Following the abolition of the tax, some trading volume came back to Sweden. According to Campbell and Froot (1995), 41 percent of the trades in Ericsson took place in Stockholm in 1992. Overall, the proportion of the trading volume in Sweden increased for almost all equities in 1992. That year, 56 percent of all trading volume in Swedish equities took place in Stockholm.

The Swedish experience highlights the following points. First, investors avoid the tax by finding or creating close substitutes. Since the brokerage business is very competitive, finding a close substitute for brokerage services off-shore was not very costly. However, the markets do not necessarily move off-shore, if close substitutes are available domestically. For example, trading in bonds did not move off-shore, but shifted to debentures, forward contracts, and swaps. Second, markets suffer greatly following the imposition of the tax. Even very low tax rates on fixed-income instruments led to an 85 percent decline in volume in the first week after the tax was imposed compared to its pre-tax average. The fixed-income options market virtually disappeared. Third, after the removal of the tax, the trading volume gradually comes back across all previously taxed assets.

IV. How Important Is Trading?

The Swedish labor sector believed that trading in financial markets is an essentially unproductive task. Just how important is trading? The answer to this question depends on how the trading is conducted. In Sweden, investors had to carry out financial transactions mostly through dealers.

[8] See Umlauf (1993).

However, trading does not have be conducted exclusively through dealers. It can be done through other mechanisms. For example, in continuous electronic auctions, buyers and sellers trade directly with each other, bypassing the dealers. Why didn't such an auction develop in Sweden? In fact, under the law, transactions executed without dealers were exempt from taxes.

According to the market microstructure literature, under some circumstances, dealers offer services that cannot be provided by other types of market designs at lower cost. It is especially true for infrequently-traded assets such as most of the Swedish stocks. Perhaps for that reason the order flow migrated not to another trading design, but to dealers in London and New York.

Dealers provide several important services. They provide liquidity and assume substantial risks by contributing their own capital. Accordingly, they demand adequate compensation for the provision of liquidity and the capital that they put at risk. The dealer's compensation is higher for illiquid assets.

In addition, dealers who act as market makers in particular securities must furnish competitive bid and offer quotations on demand and be ready, willing, and able to effect transactions in reasonable quantities at the quoted prices. In other words, a buyer does not have to wait or look for a seller, but can simply buy from a dealer who sells from his inventory. According to Pagano and Roell (1990), "this implies that, in contrast with what happens on auction markets, traders are insured against execution risk, i.e., the risk of finding few or no counterparty to trade." The dealer's compensation is higher for assets with a higher execution risk.

This highlights another important function that dealers play, namely, the provision of price stability. According to Madhavan (2000), "the presence of market makers who can carry inventories imparts stability to price movements through their actions relative to an automated system that simply clears the market at each auction without accumulating inventory."

The provision of liquidity, price discovery, and price stabilization requires inventory management. Inventory management is achieved through the buying and selling of securities. Hasbrouck and Sofianos (1993) examine a set of quote, trade, and inventory data for market makers (specialists) on the New York Stock Exchange. According to their data, the market maker's activity (both purchases and sales) averages to about 26 percent of the total transaction flow (also both purchases and sales). For the most frequently traded stocks, this number is

20 percent, while for the least frequently traded stocks, it rises to 38 percent.[9] Thus, dealers become much more important as liquidity providers in less frequently traded stocks.

Inventory management can involve both customer and interdealer trading. When a competitive interdealer market is available, dealers can adjust their inventory without waiting for a public order flow to arrive. According to the empirical evidence, dealers trade in the interdealer market when they want to manage large inventory positions. Lyons (2001) suggests that interdealer trading in the foreign exchange market currently accounts for about two-thirds of the total volume. Hansch, Naik, and Viswanathan (1998) show that the average size of an interdealer trade on the London Stock Exchange is much larger than the average size of a trade with the general public. They also show that inventory levels at which dealers trade among themselves is about twice as large as those at which they trade with the general public. They find that 38 percent of the variation in interdealer trading is explained by variation in inventory levels. They conclude that "interdealer trading is an important mechanism for managing inventory risks in dealership markets."

Thus, trading is important. It helps manage risks. Dealers demand compensation for the services that they provide and the risks that they take. If trading becomes costly as a result of transaction taxes, dealers cannot manage their risks effectively. Accordingly, they become less willing to put their own capital at risk in order to provide liquidity. Investors cannot carry out their desired trades, their latent demands are not fully satisfied, and resources are not allocated to their best uses.

V. What Causes Volatility?

In the previous section we argue that trading is important. But can it also be the cause of volatility?

French and Roll (1986) conduct an empirical study of the variability of stock returns over trading and non-trading periods. Using data for all stocks listed on the NYSE and AMEX for the period 1963 to 1982, they find that on an hourly basis, the variance of stock returns is between 13 and 100 times larger when markets are open for trading than the variance when the markets are closed, depending on the definition of non-trading period.

They investigate three possible causes for the higher volatility during trading hours. First, higher volatility may be caused by the arrival of more public information during trading hours. Second, it may be caused by informed investors as their private information

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[9] The statistics are calculated by taking the participation rates reported in the paper as a fraction of 50 percent, the rate which implies that the market maker is a counterparty to all trades.

is incorporated into prices. Finally, higher volatility may be caused by the process of trading itself as prices fluctuate due to market frictions and transaction costs.

They also find that the process of trading accounts for at most 12 percent of the daily return variance. The rest of the variance is attributable to the arrival of public and private information during trading hours. While they cannot directly decompose the effects of public and private information on volatility, they conduct a test which suggests that most of the variability in stock returns can be attributed to the arrival of private information during trading hours.

Later studies relied on much more refined transaction-level data to further decompose transaction price volatility. Madhavan, Richardson, and Roomans (1997) develop a stylized, reduced-form model of price volatility and use transaction-level, intraday data on 274 NYSE-listed stocks during 1990 to estimate it.

They argue that price volatility can be explained by the variability of four components: public information, private information, transaction costs, and other market frictions (price discreteness). They estimate that the impact of public information accounts for 46 percent of volatility in the beginning of the trading day and 35 percent at the end. The impact of private information (including the interaction between cost and private information effects) drops from 31 percent in the morning to 26 percent at the closing of trading. Variability in transaction costs increases from 22 percent at the opening to 35 percent at the end of the trading day. Finally, price discreteness accounts for the remaining 1 to 4 percent at the beginning and the end of the trading day, respectively.

Transaction costs in the Madhavan, Richardson, and Roomans (1997) model capture dealers costs for supplying liquidity on demand. They include compensation for inventory costs, putting their capital at risk, and other transaction costs. The model implies that other things being equal, higher transaction costs increase volatility. If transaction costs also include transaction taxes, then introduction of STTs can result in higher rather than lower volatility of transaction prices.

VI. How Are Prices Formed?

In perfect, frictionless markets, asset prices immediately reflect all available information. As the new information arrives, investors rebalance their portfolios of assets. The rebalancing results in an updated set of prices. In the absence of transaction costs, the rebalancing can be done continuously and price discrepancies are eliminated instantaneously. However, in real markets, agents face transaction costs. The presence of even very small transaction costs makes continuous rebalancing infinitely expensive. Therefore, valuable information can be held back from being incorporated into prices. As a result, prices can deviate from their full information values.

The dissatisfaction with the assumption of continuous portfolio rebalancing was the starting argument for the literature on the replication of assets under transaction costs. The literature recognizes that continuous rebalancing is not feasible and formulates discrete rebalancing rules under transaction costs.

In this section we present a simple theoretical framework based on the literature on option pricing with transaction costs. We assume that securities taxes are a source of transaction costs and study the impact of STTs on portfolio rebalancing and price formation.

A. A Simple Example

We consider a simple two-period example. There are three assets in the market: a stock, a bond, and a call option. The starting price of the stock, S_0 is equal to 20. After 3 months, the stock price will be equal to $S_0u = 22$ in state U or $S_0d = 18$ in state D. The probability of either state, p is 0.5. The stock pays no dividends. The strike price of a European call option with three months to expiration is 21. The annual rate of return on a risk free bond, r is 12 percent.

We first compute the value of the option in the absence of transaction taxes by using risk neutral valuation. When the stock price is equal to 22, the option gives a right to buy the stock at 21 and immediately sell it at 22. Therefore, the value of the option is 1. Similarly, when the stock price is 18, the option expires worthless. Let δ be the amount of stock such that a portfolio consisting of long δ shares of stock and a short call has the same return in both future states of nature,

$$22\delta - (22 - 21) = 18\delta. \tag{1}$$

The solution to this equation is $\delta = 0.25$. The value of this portfolio in three months is $18\delta = 18 \times 0.25 = 4.5$. Thus, an amount equal to

$$4.5 \exp^{-0.12 \times \frac{3}{12}} = 4.37 \tag{2}$$

must be invested in a bond in order to get the same rate of return risk free. In the absence of arbitrage, the value of the call option at time zero, C_0, must be such that the portfolio has the same present value as the bond,

$$4.37 = \delta S_0 - C_0 = 0.25 \times 20 - C_0. \tag{3}$$

The solution to this equation is given by $C_0 = 0.63$.

Thus, a portfolio consisting of long $\frac{1}{\delta} = 4$ call options and $B_0 = \frac{1}{\delta}4.37 = 17.47$ invested in a bond will exactly replicate the payoff on the stock. The initial value of this portfolio is equal to

$$\frac{1}{\delta} \times C_0 + B_0 = 20. \tag{4}$$

In state U, the value of the portfolio is $4 \times 1 + 17.47 \exp^{0.12 \times \frac{3}{12}} = 22$. Similarly, in state D it is equal to 18.

B. A Simple Example with Transaction Costs

Suppose now that a transaction tax, t of 1 percent is introduced on all period-one transactions in the stock. Again, when the stock price is equal to 22, the option gives a right to buy the stock at 21 and sell it at 22. However, now this round-trip transaction is subject to transaction taxes. To buy the stock, the option's holder must pay $21 \times (1 + t) = 21.21$ instead of 21. In addition, proceeds from selling the stock, amount to only $22\,(1 - t) = 21.78$ instead of 22. Accordingly, the terminal value of the three month call option is 0.57 in state U and zero in state D. The expected revenue target is $0.5\,((21.21 - 21) + (22 - 21.78)) + 0.5\,(18 - 17.82) = 0.31$.

Let $\hat{\delta}$ be the amount of stock in the risk neutral valuation portfolio adjusted for the transaction tax. Then, $\hat{\delta}$ must solve,

$$21.78\hat{\delta} - (21.78 - 21.21) = 17.82\hat{\delta}. \tag{5}$$

The value of $\hat{\delta}$ is equal to 0.144 and the value of the portfolio in three months is $17.82\hat{\delta} = 2.57$. The present value of this amount is equal to 2.49. In the absence of arbitrage the present value of the call option, $\hat{C}_0 = 0.39$ solves

$$2.49 = \hat{\delta} S_0 - \hat{C}_0. \tag{6}$$

A portfolio consisting of long $\frac{1}{\delta} = 6.94$ call options and $B_0 = \frac{1}{\delta}2.49 = 17.28$ invested in a bond will replicate the after tax payoff on the stock. The initial value of this portfolio is equal to 20.

Several changes take place following the introduction of a transaction tax. First, the demand for call options increases from 4 to 6.94. Second, the demand for bonds declines from 17.47 to 17.28. Finally, the realized revenue is zero. Since the value of the call option accounts for the tax, there is no need to actually buy or sell the stock for rebalancing purposes. In a market where trading in the stock is subject to a transaction tax, but trading in other assets is not, a portfolio consisting of a call option and a bond can exactly replicate the after tax payoff on the stock. While the portfolio is rebalanced in order to account for the tax, since the assets in the portfolio are not subject to the tax, the rebalancing does not result in any revenue.

Suppose now that a 1 percent tax is also levied on transactions in the call option. Then, the after tax value of the call option is $0.57\,(1-t) = 0.56$ in state U and zero in state D. Using the same algorithm, the values for δ, C_0 and B_0 are 0.143, 0.386, and 17.293, respectively. Total tax revenue raised from taxing the call option is given by the number of options in the portfolio times the revenue collected from each option, $\frac{1}{0.143} \times 0.386 \times 0.01 = 0.03$. The total revenue collected amounts to only 10 percent of the original expected revenue target. The demand for the call option increases and the demand for the remaining untaxed asset, the bond, also goes up.

Finally, let us also consider extending the 1 percent tax to the bond. The tax will be levied on the current rate of interest so that instead of paying 12 percent per annum, the bond will yield 99 percent of that amount. Using the risk free valuation algorithm, we find that the demand for both the call and the bond increase, since more of those instruments are now needed to replicate the stock. However, the revenue from the tax on the bond will only amount to 0.005, increasing the total revenue to 0.035, still well below the expected target.

The above example illustrates several changes following the introduction of a transaction tax. First, the demand for derivatives goes up substantially. Second, the demand for bonds decreases. Third, since the valuation of the rebalancing portfolio accounts for the transaction tax without actual trading in the stock, there is no need to trade in the stock. Finally, even after extending the 1 percent transaction tax to all assets, the realized revenue accounts for around 11 percent of the expected revenue target.

Furthermore, even in this simple example, it is quite difficult to design and even more difficult to implement a tax that does not favor one portfolio of assets over another portfolio with exactly the same payoff (e.g. a stock versus a bond and a call option). Certainly, a uniform transaction tax is not payoff-neutral. Under a uniform 1 percent transaction tax, the revenue from taxing a stock is about ten times higher than that from taxing a portfolio consisting of a bond and a call option that generates exactly the same payoff as the stock. For a tax to be payoff-neutral, the tax rates must be such that a change in the value of a replicating portfolio is exactly equal to the change in the price of the underlying asset. In other words, the tax rates must depend on the "delta" of the replicating portfolio. Since in practice, "delta" changes as more information is revealed about the (unknown) underlying stochastic process, a payoff-neutral tax would have to be frequently adjusted. This would make it very difficult to implement.

C. A Generalized Model

Boyle and Vorst (1992) generalize the simple two-period example to $T+1$ periods, $t = 0, 1, ..., T$ according to an algorithm proposed by Cox, Ross, and Rubinstein (1979).

Cox, Ross, and Rubinstein (1979) define by Δt, the length of each rebalancing interval of the $T+1$ period. During each period, the stock price, S_t can move either up with probability p or down with probability $1-p$. If the stock moves up, then its new value is $S_t u$, $u > 1$. If it moves down, then its value becomes $S_t d$, $d < 1$.

The values of u and d are defined in terms of the stock volatility, σ, are equal to:

$$u = \exp^{\sigma\sqrt{\Delta t}} \tag{7}$$

and

$$d = \exp^{-\sigma\sqrt{\Delta t}}, \tag{8}$$

or $d = \frac{1}{u}$.

From the risk neutral valuation, the expected value and variance of the stock price for $t = 0, 1, ..., T-1$ are equal to:

$$S_t \exp^{r\Delta t} = pS_t u + (1-p)\, S_t d, \tag{9}$$

and

$$S_t^2 \exp^{2r\Delta t} \left(\exp^{\sigma^2 \Delta t} - 1\right) = pS_t^2 u^2 + (1-p)\, S_t^2 d^2 - S_t^2 \left(pu + (1-p)\, d\right), \tag{10}$$

respectively.

Cox, Ross, and Rubinstein (1979) show that the risk neutral probability that solves the system of equations ((7))-((10)) when the terms of higher order than Δt are ignored, is:

$$p = \frac{\exp^{r\Delta t} - d}{u - d}. \tag{11}$$

Using the algorithm, possible realizations of the stock price can be defined for every period. If at time zero the stock price is equal to S_0, then at time Δt, it is either $S_1 = S_0 u$ or $S_1 = S_0 d$. At time $2\Delta t$, the stock price, S_2 can take one of the three possible values, $S_0 u^2$, $S_0 d^2$, or $S_0 ud = S_0$. In general, at time $i\Delta t$, the stock price can take $i + 1$ possible values described by,

$$S_i = S_0 u^j d^{i-j}, \quad j = 0, 1, .., i. \tag{12}$$

After the terminal realizations of the stock price, S_T are determined, the value of the option at each node is calculated by going backwards. At time T, the value of the option, C_T is equal to $max\left\{S_T - K, 0\right\}$ for each of the $T + 1$ realizations of the stock price. At time $T - 1$, the value of the option at node $(T - 1, j)$, $j = 1, 2, ..., T$ is equal to

$$C_{T-1,j} = \exp^{r\Delta t}\left(pC_{T,j} + (1 - p)\, C_{T,j+1}\right), \tag{13}$$

and so on.

Values of δ_t are computed by applying the formula,

$$\delta_t = \frac{C_{t+1} - C_t}{S_{t+1} - S_t}, \tag{14}$$

at every node.

The amount invested in bonds is equal to,

$$B_t = \frac{1}{\delta_t} \exp^{-r\Delta t}\left(S_{t+1}\delta_t - C_{t+1}\right), \quad t = 1, 2, ..., T - 1. \tag{15}$$

As in the simple example, a portfolio consisting of long $\frac{1}{\delta_t}$ call options and B_t invested in a bond will exactly replicate the payoff on the stock in every state. At time zero, the value of this portfolio is equal to the initial value of the stock, S_0.

In order to derive a parsimonious extension to the Cox, Ross, and Rubinstein (1979) model, Boyle and Vorst (1992) make two assumptions. First, they assume that rebalancing rules are exogenous. This means that they do not let the agents design their own optimal rebalancing strategies. Second, they assume that the binomial multiplicative process is unaffected by transaction costs. It means that the agents do not respond to transaction taxes in a way that leads to an adjustment in latent demands of investors manifested through the behavior of u or d. However, it also means that the transaction tax adds a permanent component to asset prices, because neither u nor d can adjust in response to the tax.

Boyle and Vorst (1992) show that under transaction costs, the call option can be priced by applying the Cox, Ross, and Rubinstein (1979) algorithm with a modified variance. If σ^2 is the original variance, the modified variance, $\hat{\sigma}^2$, is given by,

$$\hat{\sigma}^2 = \sigma^2 \left[1 + k\frac{2}{\sigma\sqrt{\Delta t}}\right], \tag{16}$$

where k is the rate of the transaction cost and Δt is the exogenous length of the rebalancing period. Intuitively, the modified variance is greater than the original variance by a fraction which is positively related to the rate of the tax and negatively related to the length of the rebalancing period.[10] When the number of portfolio revisions increases, the long call price can be approximated by the Black-Scholes formula.[11]

VII. How Valuable Is the Volume of Transactions?

According to the example presented in the previous section, demand for assets changes following the introduction of a transaction tax on a stock. The demand for derivatives goes up and the demand for both stocks and bonds decreases. Changes in demand translate into changes in the volume of realized transactions. Was anything lost as a result of this change in volume? Does it matter if transaction volume migrates to other instruments, markets, or countries? It does not, if the volume is not valuable. But how valuable is the volume of realized transactions?

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[10] Reinhart (2000) argues that the introduction of STTs may also make asset prices more variable in the general equilibrium setting.

[11] Leland (1985) develops an extension to the Black-Scholes continuous-time model and shows how to modify the variance in order to price call options in the presence of transaction costs. In Leland's model, the variance inceases in the presence of transactions costs, reflecting the discontinous rebalancing of portfolios necessitated by transactions costs.

According to standard rational expectations models with supply uncertainty, trading orders have both informational (or "signal") and "noise" components. Without the noise, aggregate supply uncertainty is resolved, and prices adjust to their full information level. Otherwise, the informational component is aggregated into prices and the "noise" is left in volume. Thus, volume is just an outcome of the trading process. It does not have any information about the fundamentals or the trading process and, therefore, lacks value.

According to this view, the migration of volume to other instruments, markets, or countries does not result in any loss of value or efficiency. It just means a reallocation of supply uncertainty. In other words, if transaction volume moves from Stockholm to London, investors in Stockholm become exposed to less uncertainty associated with "noise" trading and investors in London to more of it. Thus, if following the imposition of a transaction tax, volume migrates from the taxed asset, the policy makers should perhaps just change their revenue projections and not worry about any fundamental market effects.

The long-held view that volume is not valuable per se has recently come under scrutiny. Blume, Easley, and O'Hara (1994) investigate the informational role of volume. In their model, the source of "noise" is not supply uncertainty, but the precision of private information about the signal. Prices aggregate information about the average level of private information. Trading volume contains information about the precision of individual private signals. Thus, volume does not just contain "noise," but has a non-trivial informational role to play. Price-volume sequences are more informative than prices alone. This role becomes especially important for infrequently traded stocks which often do not get much analyst coverage.

In addition, Easley, O'Hara, and Srinivas (1998) investigate the informational role of transaction volume in options markets. They develop a model where informed traders can trade in stock or options markets. They empirically test the model and find that option volume data contains information about future stock prices. Thus, they conclude that "volume plays a role in the process by which markets become efficient." Consequently, a migration of volume from the derivative market may also result in the loss of informational efficiency.

This view represents a fundamentally different perspective on the role of volume. Volume matters. The migration of volume results in lower informational efficiency of instruments and markets from which it migrated. If transaction taxes cause the volume to migrate, then they do affect the ability of markets to aggregate information and prevent a more efficient allocation of resources.

VIII. International Finance Evidence

The international finance literature provides examples of market segmentation and execution costs in different markets. Market segmentation can result from direct restrictions on foreign ownership, exchange and capital controls, and regulatory and accounting aspects including disclosure rules, settlement practices, and investor protection rights. Bekaert (1995) studies 19 emerging markets and finds that exchange and capital controls (and taxes that have a similar effect) as well as regulation and accounting practices are significant in explaining market segmentation. Restrictions on foreign ownership are apparently being circumvented by the closed-end country funds.

Domowitz, Glen, and Madhavan (2000) use a comprehensive database of execution costs (including transaction taxes) for 42 countries from September 1996 to December 1998. They use panel data techniques to study the interaction between cost, liquidity, and volatility across countries and through time.

They find that except for North America, explicit equity trading costs such as brokerage commissions, taxes, and fees account for about two-thirds of total execution costs. In the US average explicit one-way trading costs are the smallest for the countries in their study, accounting for 8.3 basis points or a fraction of 2.2 percent of mean return (374 basis points) for the period 1990–98. In other words, a complete rebalancing of the portfolio once a year results in an average explicit cost of 2.2 percent of its annual mean return. The largest explicit cost of 106 basis points is in Ireland, which has the stamp duty of 1 percent. In Ireland, the explicit costs of turning over a portfolio of equities just once a year accounts for a full 25 percent of the annual mean return.

They also find that over time, with the exception of transition economies, costs have generally declined, and that higher trading costs are positively related to increased volatility and lower volume.

IX. Transaction Taxes and Capital Controls

Many arguments have been advanced for the use of controls on international capital flows. According to these arguments, controls can be used as a policy response to financial market imperfections arising from informational asymmetries and other sources. In addition, controls can be applied as a means of reconciling conflicting monetary and exchange rate policy objectives. Furthermore, controls can be utilized as a tool to prevent and manage balance of payments and financial crises either by seeking to discourage volatile short-term inflows that could later be reversed, or by seeking to stem outflows during a crisis.

International capital flows are, to some extent, a direct counterpart to the real transactions recorded in the current account of the balance of payments, but are often and to a much larger extent a reflection of portfolio allocation decisions. They are, in other words, the result of financial transactions that happen to involve parties on different sides of national borders. Such transactions can in principle be subject to general taxes on financial transactions or to taxes that specifically target cross-border transactions.

Controls on international capital flows have taken many forms, but are conventionally classified as price-based (indirect) controls and quantity-based (direct) controls. As with STTs, capital controls may differ substantially in the types of transactions they apply to: inflows versus outflows, short-term versus long-term, all markets or assets or only a subset of them.

Price-based controls typically take the form of explicit or implicit transactions taxes. For a wide range of models, tax equivalents may be found for quantity-based controls. This point can be illustrated in the context of a standard mean-variance preference structure. Suppose that a small representative agent chooses an optimal asset portfolio in order to maximize expected return for a given variance. Suppose also that allocations must satisfy known quantitative constraints for each asset.[12] For example, no more than 20 percent of the portfolio can be allocated to a particular stock. Intuitively, the tighter the quantitative constraints, the smaller is the area bounded by the efficient frontier. In order to show the equivalency between transaction taxes and quantity-based controls, we must prove that for a given set of quantitative restrictions, there exists a (system of) transaction taxes such that the states of the world excluded from the agent's optimization problem are exactly the same under the taxes and quantitative controls.[13] The main difference between the two cases is that while quantitative restrictions do not affect means and variances of assets, transaction taxes reduce mean returns.[14] Intuitively, it is possible to design a system of transaction taxes which for a given variance exclude specified mean returns (by making them sufficiently unattractive) from the agent's maximization problem. For example, tax rates can be specified as a linear function of three factors: a common base rate, an adjustment for the maximum desired variance of the portfolio, and an asset-specific residual.

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[12] For tractability, we assume that at least one asset is unconstrained, so that available funds could always be allocated among the given instruments.

[13] Formally, we must prove the existence of a mapping from the set bounded by the unrestricted efficient frontier to the set bounded by the restricted efficient frontier such that the mapping is linear in the mean.

[14] For simplicity, we assume that the variance-covariance structure is not affected by the presence of transaction taxes.

The problems that beset STTs in general also affect capital controls in particular. Selective controls on a targeted range of transactions, while possibly effective in limiting those specific transactions, tend to be quickly circumvented as market participants find ways to achieve their desired means through unrestricted (untaxed) channels. More specifically, the ability to circumvent capital controls reflects the high substitutability of various financial instruments in the sense that the state-contingent payoffs of one instrument can be closely replicated by combinations of other instruments. In many cases, the cost of such replicating transactions is low compared with the implicit tax represented by the controls.

When capital controls (or STTs) are made more comprehensive in order to reduce the scope for avoidance, the distortions they give rise to tend to grow also. As discussed earlier, taxing a broad range of financial transactions can reduce trading, impede price discovery, and possibly increase market volatility.

As with STTs in general, the effectiveness of capital controls and the degree to which they have adverse side effects depends on the level of financial market development. When financial markets are already well developed, capital controls will be easier to circumvent. When markets are not so well developed, controls may initially be effective for a longer period of time. Depending on the strength of the incentives for circumvention, however, development of more sophisticated financial markets and instruments may actually be accelerated in countries in which this development might otherwise have taken much longer; and lead to the devotion of a greater volume of resources to financial market activity than might otherwise have been the case.

The administrative sophistication and capability of the public authorities also plays a role. When enforcement is weak, evasion is more widespread and the controls are relatively ineffective both in raising revenues and in achieving any allocational or macroeconomic objectives. In addition to enforcement capacity, the public authorities will also need a degree of sophistication to close off avenues for the avoidance of the controls, for example through the replication of payoffs through unrestricted channels. However, such sophistication will inevitably lead to more comprehensive and hence more distortionary controls. Unlike STTs, capital controls are usually not intended to generate revenue. Moreover, while the imposition of capital controls is often motivated on the grounds of "buying time" needed for the implementation of a consistent macroeconomic policy mix, STTs are not usually intended for this purpose.

X. Summary and Conclusions

This paper examines the impact of securities transaction taxes on financial markets. We conclude that in most circumstances, transaction taxes or their equivalents like capital controls can have negative effects on price discovery, volatility, and liquidity and lead to a reduction in market efficiency.

The arguments made in this paper may be summarized as follows. First, in dealership markets, trading facilitates the provision of liquidity, price discovery, and price stabilization. Trading also helps to manage risks. If investors cannot carry out their desired trades, their latent demands are not fully satisfied and resources are not allocated to their best use.

Second, price volatility can be explained by the variability of four components: public information, private information, transaction costs, and other market frictions. Other things being equal, higher transaction costs increase volatility. Consequently, the introduction of STTs can increase the volatility of transaction prices.

Third, a simple theoretical framework based on the literature on option pricing with transaction costs was used to study the effect of STTs on portfolio rebalancing and price formation. It was shown that following the introduction of a transaction tax, the demand for derivatives goes up substantially. In addition, the demand for stocks and bonds decreases. Moreover, even after extending the transaction tax to all assets, the realized revenue accounts for only one tenth of the expected revenue target.

Fourth, transaction volume has an informational content. Consequently, a migration of volume results in lower informational efficiency of instruments and markets from which it migrated. If transaction taxes are the cause of volume migration, then they can inhibit the informational efficiency of markets.

Fifth, the international finance evidence on market segmentation and execution costs in different markets suggests that except for North America, explicit equity trading costs such as brokerage commissions, taxes, and fees account for about two-thirds of total execution costs. The conclusion was that higher trading costs, some of which are due to STTs, are positively related to increased volatility and lower volume.

Finally, there are broad similarities between STTs and capital controls. Both measures are intended to influence investors' behavior in order to reduce market volatility (which in the case of capital flows may have macroeconomic consequences). In addition, both STTs and capital controls suffer from similar implementation and enforcement problems.

Transaction taxes can thus have a substantial effect on the transformation of investor demands into transactions. STTs can obstruct price discovery and price stabilization, increase volatility, reduce market liquidity, and inhibit the informational efficiency of financial markets.

These observations give rise to a serious policy question. If the costs of financial transaction taxes are likely to outweigh their benefits, what makes them so attractive to some policy-makers? Are there alternative policies that might be more effective and welfare-enhancing, notably prudential policies for the financial sector and generally improved macroeconomic and structural policies? These issues are a subject for future work.

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SECURITIES TRANSACTION TAXES IN DEVELOPED ECONOMIES

Six countries that belong to the Group of Ten developed economies have STTs. The United States has a 0.003 percent transaction tax levied on the majority of stock transactions. The tax which is known as a Section 31 fee was introduced in the Securities Exchange Act of 1934 to cover the annual operating costs of the Securities and Exchange Commission (SEC). The federal government collected $1.8 billion in revenue from these fees in 1998, which was approximately five times the annual operating costs of the SEC.

The United Kingdom charges a 0.5 percent stamp duty and stamp duty reserve tax (SDRT) on equity and other financial transactions. The stamp duty is levied on a document specifying a financial transaction. The SDRT is levied on a verbal, electronic, or other agreement to transact (dematerialized) financial assets. Trades in U.K. registered shares outside the U.K. are liable to stamp duty only after the document enters the U.K. The SDRT has no territorial restrictions. The stamp duty and SDRT are payable by the purchasing party.[15] According to the Stamp Office, 2.1 billion pounds was collected from securities transactions during the 1998–99 fiscal year.[16]

Belgium has 0.17 percent transaction tax on stocks and a 0.07 tax on bonds. Transactions in other financial instruments are also subject to taxes of varying rates. Both buyers and sellers are subject to the tax, but the tax base is calculated differently. For the buyers, the tax base includes brokers' commissions, while for the sellers it does not. There is a ceiling of 10,000 Belgian francs on the joint amount payable. Financial intermediaries trading on their own behalf, some institutional investors, and nonresidents are exempt from the tax. In addition, transactions done without a professional intermediary are exempt from the tax.

France has a 0.15 percent transaction tax on equity trades exceeding 1 million francs. For transaction below 1 million francs the rate is 0.3 percent. The tax is payable by both parties. An allowance of 150 francs is applied to the tax due on each trade. This means that transactions valued below approximately 50 thousands francs are effectively exempt from the tax. There is also a ceiling of 5,000 francs on the total amount of tax payable. Shares of companies listed on the Nouveau Marché and former regional exchanges are exempt from the tax. Non-residents are also exempt from the tax when trading on the Paris Bourse.

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[15] The rationale for the imposition of the stamp duty and SDRT on the purchasing and not the selling party was that only the purchasing party has the need to prove the legal title to an asset in the event of a dispute.

[16] The stamp duty is also levied on property-related transfer of legal ownership. The amount collected from property-related transactions during the 1998–99 fiscal year was approximately 2.5 billion pounds.

Italy has a 0.14 percent stamp duty on domestic off-exchange transactions. The tax is collected by the brokers and then remitted to the government. Domestic transactions instituted abroad are exempt from the tax.

Switzerland has a stamp duty on transactions in which one of the parties is a certified domestic securities broker. The tax rate is 0.15 percent for transactions in Swiss securities and 0.3 percent for those in foreign securities. However, members and remote members of the Swiss exchange pay a 0.15 percent tax on trades in foreign securities. The tax is split evenly between the buyer and the seller. The broker is liable to the tax. The exchange calculates the tax and the settlement system collects it. Transactions in Swiss shares outside the country and trading in Eurobonds are exempt from stamp duty. In addition, starting January 2001, foreign institutional investors such as state and central banks, investment funds, social security organizations, pension funds, life insurance companies as well as domestic investment funds and domestic participants of a foreign exchange are exempt from stamp duty. In addition to stamp duty, the Swiss exchange levies a share turnover fee of 0.0001 percent. The fee is also split evenly between the parties. A portion of collected fees covers operational costs of the Federal Banking Commission. Authorized official dealers are exempt from the fee.

Japan eliminated securities transaction taxes in April 1999. Previously, individuals and corporations were liable to differentiated securities transaction taxes. The tax was levied on the seller only. The tax rates varied according to the type of security and the type of seller. Lower tax rates applied to licensed securities companies. Transactions in stocks were subject to a tax of 0.3 percent of the sale price for sellers that are not licensed securities companies and 0.12 percent for those with a license. Trades in debentures were taxed at 0.16 percent and 0.06 percent, respectively. Transactions in bonds were subject to a tax of 0.03 percent and 0.01 percent, for the non-licensed and licensed sellers. Taxes were either collected by the securities companies and remitted to the government or were paid directly by the seller.

The trend in developed countries has been toward lowering or eliminating the STTs. For example, Sweden and Finland experimented with STTs and decided to eliminate them in the early 1990s. Germany abolished the stock exchange turnover tax and the tax on bills and notes in 1991. Canada and the Netherlands do not have STTs.