Throwing sand in the gears: the Swedish experiment

Daniel Barr and Peter Sellin[1]

Introduction

During the last few decades, globalisation, technological innovations and deregulation have resulted in a dramatic increase in volume of financial transactions, domestically as well as internationally. Most economists agree that this development, on the whole, has contributed to a more efficient economy. However, episodes like the stock market crash in 1987 have made many question the efficient market view that prices on financial markets always reflect fundamental values. Market prices are said to deviate from fundamental values and be characterised by excess volatility, i.e. price fluctuations not attributable to changes in fundamental values.

The efficient market hypothesis has frequently been discussed during the past decade. Shiller (1981) developed a method of comparing stock price volatility with the volatility of fundamental values. He concludes that stock price movements are far too volatile to be explained by the observed volatility in fundamentals. Shiller's study is highly controversial and has been criticised on its statistical assumptions. However, later studies have refined the methods and obtained more clear-cut results. Using other methods, French and Roll (1987) show that factors other than fundamental values may drive stock prices. They find that the volatility between Tuesdays and Thursdays is approximately halved during a period when markets are closed on Wednesdays. An implication of French and Roll's findings is that trading itself is a potential source of volatility.

Many who argue that current financial markets are excessively volatile advocate the imposition of a transaction tax on securities trading - to "throw sand in the gears" of the markets. (See, for example, Keynes (1936), Tobin (1978, 1984) or Summers and Summers (1989).) Two main arguments have been made in support of such a tax. It is said to have the beneficial effect of curbing instability introduced by speculation. Moreover, transaction taxes are said to reduce the diversion of resources into the financial sector of the economy, assuming that more real resources than can be justified by its social function are devoted to the financial industry. In this paper we concentrate on the first argument, i.e. that a transaction tax reduces volatility.

The assumption behind the claim that transaction taxes reduce volatility is that short-term trading strategies, so-called noise trading, are the source of excess volatility. In Summers and Summers (1989) two different types of speculative strategies are identified. The type I investor purchases stocks on the basis of their fundamental value. He sells when the price is rising and buys when it is falling, a behaviour that would reduce price volatility. The type II investor buys when prices rise and sells when they fall - a strategy that increases volatility. The latter strategy includes different kinds of techniques, portfolio insurance schemes and stop-loss strategies. Summers and Summers (1989) assume that a transaction tax would have a larger impact on the type II investor. As a result, price formation is believed to be left to type I investors, reducing volatility to a level better justified by fundamentals. Summers and Summers argue that transfer taxes, as opposed to other tax measures, do not have any adverse effect on incentives to work and invest. A tax on financial transactions may increase social welfare and is, therefore, preferable to taxes on income and wealth.

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The argument in favour of a transaction tax is, however, controversial. Opponents of transaction taxes point out that excessive volatility may very well be attributed to *insufficient* short-term speculation, not excessive speculation. A transaction tax would, according to the opponents, discourage stabilising speculation and arbitrage, cause a drop in market liquidity, increase the cost of market-making and widen bid-ask spreads. Sellers would not be able to find buyers or buyers would not be able to find sellers, except after large price changes. As a result, volatility increases. Illiquid markets, such as art, antiques or real estate, which are known to be extremely volatile, are often taken as examples. Summers and Summers (1989, p. 170) recognise this argument but claim that "it does not follow (from the argument) that once an adequate level of liquidity has been attained .... further increases in liquidity are stabilising".

The theoretical basis for determining the effect of the imposition of a transaction tax on volatility is ambiguous. This is illustrated in a two period, three generation overlapping generation model by Kupiec (1991), where each generation has rational investors and "noise traders" who resemble those of De Long et al. (1991). In Kupiec's general equilibrium model a transaction tax fails to reduce price volatility. Instead risky asset price volatility increases. The tax also fails to align risky asset prices to their underlying fundamental economic values. Kupiec concludes that excess trading is a symptom of inefficient markets and not the cause of it. Therefore, he concludes "the (transaction) tax cannot fix what is broken".

Following the different arguments mentioned above, the effects of transaction taxes on volatility seem to be a purely empirical issue. In this respect, the Swedish experience offers an opportunity to test various hypotheses empirically.

1. The Swedish experiment

The idea of dampening speculation with transaction taxes is old. In Sweden a stamp duty on equity transactions was introduced as early as 1908. It was paid at purchase and bartering of stocks and shares, but not at sales. In the Government's explanatory statements it was said that the duty should impede exaggerated speculative trade in the stock market.

The duty was fixed at 0.3% of the value of the transaction. Dealing on commission, i.e. dealing on someone else's account, was exempt from the duty. If *one* of the parties was dealing on commission, the tax rate was halved to 0.15%. In the case of a transaction between two commissioners, no duty had to be paid. On 1st January 1979 the stamp duty was abolished.

Five years later, on 1st January 1984, a transfer tax was reintroduced in Sweden for stocks and shares, convertible bonds and other kinds and rights to stocks and shares. However, in contrast to the earlier stamp duty, it had to be paid by both buyer and seller.

The main economic rationale behind the introduction of the tax was the need for revenues to reduce the government deficit. However, if the only goal was to raise taxes from stockholders, some form of wealth tax which did not distort the trading pattern might have been preferable. An explanation may be that the financial sector was at the time expanding rapidly, with high wages and high profitability. This caused envy and assertions from trade unions in the manufacturing and public sector that the financial sector was non-productive. It was probably seen as socially desirable to reduce the profitability and hamper the reallocation of resources to this sector by reducing the trading volume by a transfer tax. Notably, the excess volatility argument did not play a significant role in the public debate. Nonetheless, the argument was used, though rather tucked away, in the Government's explanatory statements (government bill; Prop. 1987/88:156, p. 10):

> "Exaggerated fluctuations on the financial markets generate disturbances also in the real sector, e.g. in the manufacturing sector. It would therefore be valuable if the fluctuations could be dampened in the financial markets and a more stable system where long-term behaviour is encouraged at the expense of short-term transactions was created. A turnover tax makes short-term speculation less profitable. A turnover tax increases thereby the

stability on the financial markets and favours industrial investment at the expense of purely speculative financial transactions."

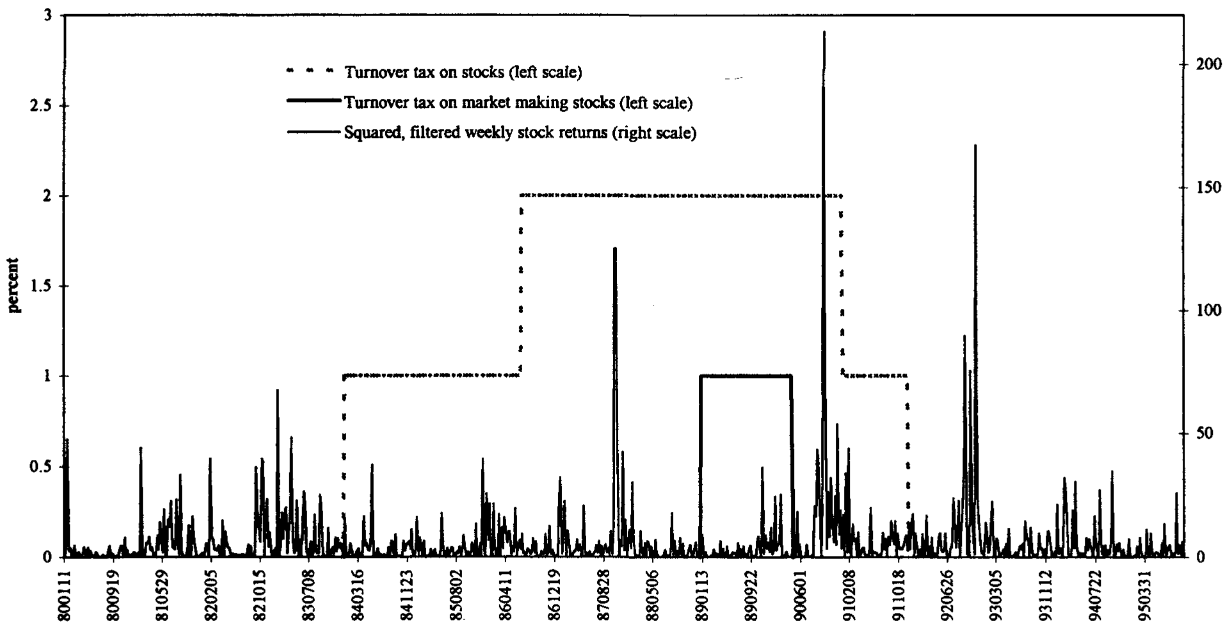
The new tax was imposed directly on brokerage firms (commissioners). All trades between direct investors and brokers were taxed at a rate of 0.5% of the value of the transaction, the brokerage fee excluded. Market-maker transactions were again exempt. A transaction between two investors, using one or more intermediaries, was thus taxed at a total rate of 1%. Investors selling or buying stocks directly, without an intermediary, had to pay tax only if the value of the transactions exceeded S.kr. 500,000 during a calendar year. The transaction tax paid was deductible from the capital gains tax.

The tax rate was altered several times during the 1980s and early 1990s as were the types of assets subject to the tax. In Figure 1 the different tax rates are plotted together with a proxy for weekly volatility. On 1st July 1986 the tax rate was raised as part of a larger budget package from 0.5 to 1% (i.e. 2% per transaction in total). At the same time, the range of assets subject to the tax was widened to include call and put options on stocks and shares - instruments that had been introduced on the Swedish market after the imposition of the tax. On 1st January 1989 the taxable transactions were extended to transfers of debt instruments, corporate as well as governmental. At the same time, the exemption for market-maker trade was abolished. However, the tax rate on market-maker transactions was fixed at half of the normal tax rate, 0.5% (1% in total: see Figure 1).

Figure 1

Tax rates and volatility in the stock market

(1989-95)



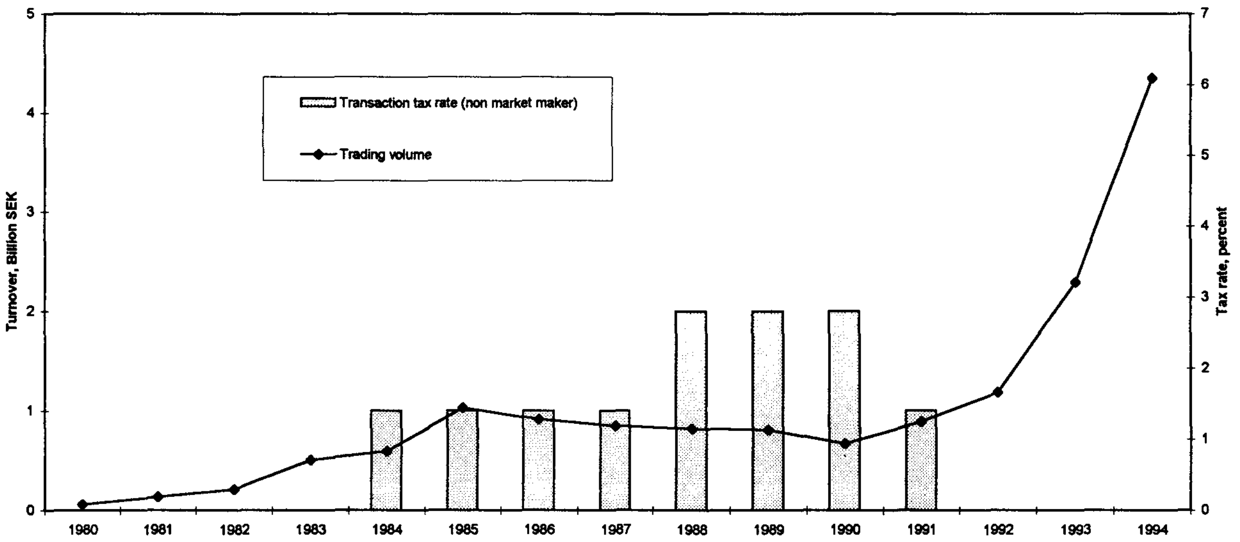
One of the Government's motives for broadening the tax base to include money market transactions was to make the taxation more neutral between different kinds of securities. In order to make the tax effect neutral when buying and holding a long-term bond, on the one hand, and rolling over securities with a shorter maturity, on the other, the tax rate on debt instruments was differentiated according to the instruments' time to maturity. Eleven different tax rates were used. The maximum rate of 0.015% was paid when buying or selling bonds with a remaining time to maturity of at least five years; the minimum rate of 0.0005% when trading debt instruments with less than 45 days to maturity.

The effect on the trading volume of the transaction tax was rather substantial. The liquidity on the Stockholm Stock Exchange dropped significantly, with the largest effect on small and medium-sized companies' stocks (see Figure 2). Market-maker trade plunged and a large part of the trade in Swedish shares was driven offshore, mainly to New York, London and Oslo. This became especially evident after Sweden lifted capital controls. Empirical estimates on Swedish stock data by Lindgren and Westlund (1990) show that a cut of the transaction tax from 2 to 1% would result in an increase in transaction volume by 50 to 70% depending on model specifications.

Figure 2

Trading volume and the end-of-year transaction tax rate in the Swedish stock market

(1980-94)



The effect on activity in the money market was not less dramatic. The annual turnover decreased from about S.kr. 1,750 billion in 1988 to S.kr. 532 billion 1989. The drop was to a large extent attributable to the transfer tax. The low turnover made it difficult to uphold a reasonable level of market-maker activity. Figure 3 shows the annual trading volume in Treasury bills. The market for interest rate options was wiped out by the transfer tax. Partly owing to the reduced trading volumes one of Sweden's two option exchanges, the Sweden Option and Futures Exchange, had to close down.

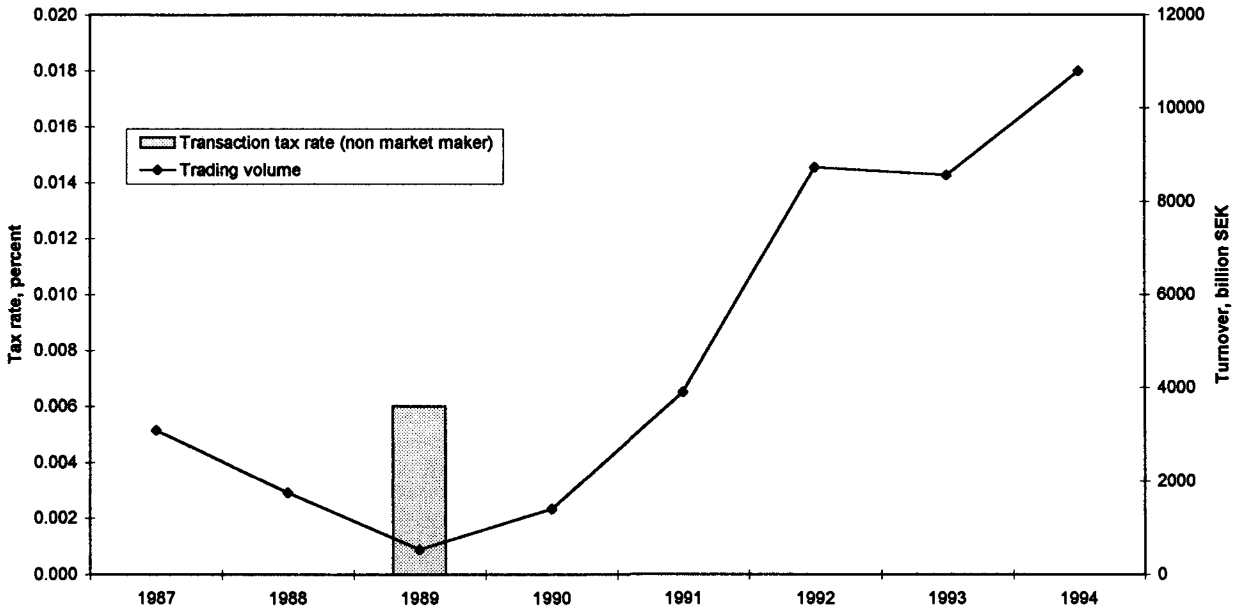
On 15th April 1990 the taxes on both debt instrument and market-maker transactions were abolished, fifteen months after their introduction. The Government pointed out in a bill to Parliament that the turnover on the money and bond markets had dropped and that the markets were now "more mature in some respects". Moreover, the abolishment of capital control had, according to the Government, reinforced the need for a national money and bond market. The Government also stressed the need for active market-maker trade in order to uphold the service for small investors.

Eight months later, on 1st January 1991, the tax rate on stocks was halved and finally abolished on 1st December 1991. The Government now stressed the negative effect of the low liquidity on small investors and small and medium-sized companies. Small and medium-sized firms' access to the equity market was hampered by the tax. Another important argument behind the Government's policy was the international integration of financial markets. At that time Sweden was about to enter the European Economic Area agreement and negotiated for membership of the European Union. The Government noted in the bill to Parliament that a proposal obliging member states to abolish all transaction taxes on securities had been discussed by the Commission of the European Union. Also, the general European development of strengthening the competitiveness of national stock exchanges in order to prepare for the European single market was recognised in the bill.

Figure 3

Trading volume and the end-of-year transaction tax rate in the Swedish Treasury bill market

(1987-94)



The fact that the Government's budget balanced at the time was, of course, an important factor behind the abolishment. After the abolishment of the tax, the turnover on the stock market as well as on the money market increased dramatically. This is illustrated in Figures 2 and 3.

In summary, the history of the Swedish transaction tax during the last few decades is probably as close to a "controlled experiment" as one could come in the field of economics. Transaction taxes on stock market transfers as well as on money market transactions were introduced at different times. The tax rate was changed on several occasions during a short period of time and the tax was eventually abolished. In this paper we use this unique data set to empirically test the hypothesis put forward by Tobin and Summers and Summers (and others) that a transaction tax on financial market transactions reduces price volatility. We also test the hypothesis derived from Kupiec's (1991) model, that the tax increases volatility.

2. The data

The data set consists of daily and weekly returns on the six-month Treasury bill and Affärsvärlden's Generalindex, AFGX, which is a value-weighted stock index maintained by Findata. We use daily data on AFGX from 1975 until 13th October 1995, and weekly data from 1970. The six-month Treasury bill series runs from 2nd January 1985 to 30th December 1994.

AFGX measures only capital gains, excluding dividends. For the period 1975-79 daily records of AFGX were collected by hand from microfilmed issues of Dagens Nyheter, the largest daily morning paper in Sweden. Weekly index records were collected from the business weekly Affärsvärlden for the period 1970-74 and collated to the weekly returns of the daily data series for 1975 to 13th October 1995.

The reason we have chosen the six-month bill is that this is the maturity that has been traded in Sweden for the longest period of time along with the twelve-month Treasury bill. Quotations starting on 3rd January 1983 are available for the six-month Treasury bill and starting on 2nd January 1984 for the twelve-month Treasury bill. Since the bills were only issued once a month to begin with, there are several days each month when there are no quotations for the twelve-month Treasury bill (no bill close to that maturity was being traded). This is not the case with the six-month Treasury bill.

However, up until the end of 1984 trading in Treasury bills was rather thin. Quotations sometimes remain unchanged for several days. This is the reason why we do not use data before 1st January 1985. These data were obtained from the Sveriges Riksbank interest rate database.

3. Estimating conditional variance models with transaction taxes

The ARCH class of models introduced by Engle (1982) has been successfully used in empirical finance. The GARCH model of Bollerslev (1986) has been especially successful in modelling high frequency financial time series. It captures the alternating periods of high and low volatility found in financial markets.

In the GARCH model the conditional variance is modelled as an ARIMA process. We let the transaction tax rate enter linearly in this conditional variance equation. We limit our analysis to the effects of the transaction tax and do not consider other costs of transacting. Our null hypothesis is that the tax has no effect on volatility. The alternative hypothesis is that it has an effect. This effect could be negative (Tobin (1978, 1984), Summers and Summers (1989)) or positive (Kupiec (1991)).

Since our focus is on the conditional variance we concentrate on the unpredictable part of the returns. In the daily return series we filter out the day-of-the-week effects. In both daily and weekly returns we also filter out autocorrelation. Some summary statistics for the resulting unpredictable return series are given in Table 1.

3.1 The Treasury bill market

The descriptive statistics for the six-month Treasury bill are given in Panel A of Table 1. The Bera-Jarque statistic clearly indicates that the returns are non-normal. Because of the high excess kurtosis the measure of skewness is not very meaningful. It will simply reflect the position of a few large outliers. The Ljung-Box test statistic for the levels indicates that we have managed to filter out all of the autocorrelation in the original series. The Ljung-Box for the squared series strongly suggests the presence of time-varying volatility. This is corroborated by the ARCH(6) test statistic of Engle (1982) for the presence of ARCH effects, except for the weekly returns when the 1992 crisis is excluded.

The reason for excluding the autumn of 1992 is that the unconditional variance was much higher during this period, due to a currency crisis that eventually led to the abandonment of the fixed exchange rate. This is evident from Figure 4, where we have plotted the recursive estimates of the unconditional variance of the weekly returns on the six-month Treasury bill against time t. The recursive estimates are computed as in Pagan and Schwert (1990):

$$\mu_2(t) = t^{-1} \sum_{k=1}^{t} u_k^2, \tag{1}$$

where u_k is the filtered return series. The estimate converges quickly to around 1.3e-6 (cf. Table 1) but in September 1992 it jumps to more than twice that level. Thus the filtered return series does not seem to be covariance stationary. If we omit the autumn of 1992 from the sample the jump disappears and there is no evidence of non-stationarity.

In Table 2 we report the estimates of a GARCH(1,1) model for the daily and weekly returns of a six-month Treasury bill. The model for the conditional volatility is

$$h_t = \omega + \alpha u_{t-1}^2 + \beta h_{t-1} + \theta \tau_t, \tag{2}$$

where τ is the transaction tax rate. The transaction tax is allowed to linearly influence the conditional volatility. The tax rate is 0.006% for the period 1st January 1989 to 15th April 1990 and 0.000 before and after this period. We find that we nearly have $\alpha + \beta = 1$, i.e. an integrated GARCH model. This seems to be a common result in studies of high frequency financial data, and implies a high degree of persistence. Most of the estimated parameters are significant at the 1% level. The tax influence parameter, θ, is negative for both the daily and weekly returns, and significantly so for the daily returns. But note that it is significant under the assumption of normality. However, the normality assumption is rejected by the diagnostic tests to which we turn next.

Table 1

Summary statistics for the unpredictable holding period returns on six-month Treasury bills and Affärsvärlden's stock index

Panel A: Six-month Treasury bills; daily and weekly data 1985-94

Summary statistics	Daily returns		Weekly returns	
	whole period	excluding 1992 crisis	whole period	excluding 1992 crisis
Number of observations	2,391	2,343	490	477
Mean	0.0000	- 0.0000	0.0000	- 0.0000
Variance	8.9e-7	2.7e-7	2.7e-6	1.3e-6
Coefficient of skewness	2.56**	- 7.16**	- 0.34**	- 1.32**
Coefficient of excess kurtosis	168.21**	155.25**	34.20**	10.64**
Bera-Jarque	2.8e+6**	2.4e+6**	2.3e+4**	2.3e+3**
Ljung-Box for the levels	13.16	25.33	10.25	23.97
Ljung-Box for the squares	1,045.79**	76.39**	157.71**	27.42*
ARCH(6)	352.90**	73.65**	116.71**	3.98

Panel B: Affärsvärlden's stock index; daily data 1975-95 and weekly data 1970-95

Summary statistics	Daily returns		Weekly returns	
	whole period	excluding 1987 crash	whole period	excluding 1987 crash
Number of observations	5,231	5,216	1,341	1,338
Mean	- 0.0000	0.0047	- 0.0000	0.0215
Variance	0.979	0.908	5.2092	5.0028
Coefficient of skewness	- 0.05	- 0.02	- 0.18**	- 0.01
Coefficient of excess kurtosis	9.32**	6.81**	3.31**	2.87**
Bera-Jarque	1.9e+4**	1.0e+4**	609.0**	450.9**
Ljung-Box for the levels	18.04	32.51	20.14	25.44*
Ljung-Box for the squares	3,189.8**	1,281.6**	321.5**	328.5**
ARCH(6)	859.4**	479.9**	158.3**	141.0**

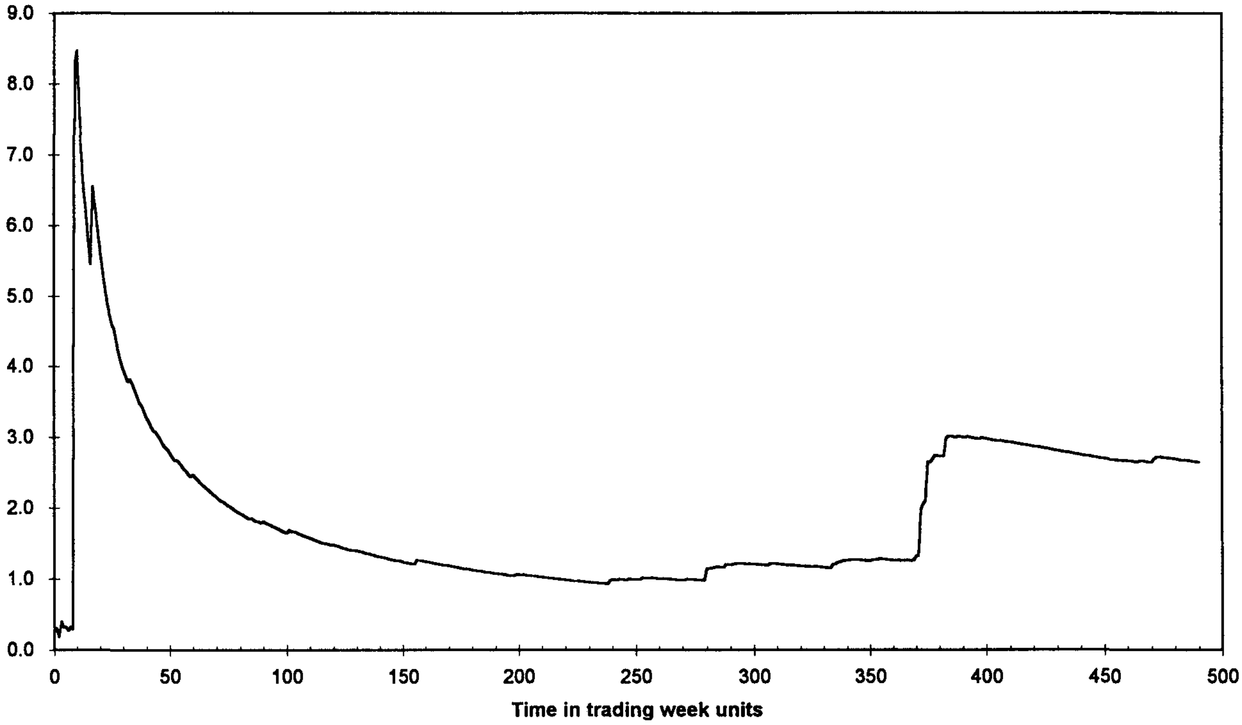
Note: This table reports summary statistics on demeaned returns from which day-of-the-week effects have been filtered out (in the case of daily returns), and an autocorrelation filter has also been applied to both daily and weekly returns to yield a time series of unpredictable holding period returns. Bera-Jarque is a joint test of skewness and kurtosis. Ljung-Box is a test of autocorrelation. ARCH(6) is the test proposed by Engle (1982) for the presence of ARCH effects (six lags have been used). An asterisk (double asterisk) denotes significance at the 5% (1%) level.

The Ljung-Box for the squares and ARCH(6) test statistics both indicate that there is no remaining heteroskedasticity in the standardised residuals $(u_t/\sqrt{h_t})$. The excess kurtosis has been reduced dramatically compared to Table 1. However, there is still a substantial amount of excess kurtosis. Hence, our GARCH model has not been able to account for all of the observed unconditional kurtosis presented in Table 1. For this reason we re-estimate the model under the assumption that the unpredictable returns follow a conditional Student-t distribution with "degree of freedom" parameter ν, rather than a conditional normal distribution.[2] These results are also given in Table 2.

Figure 4

Recursive estimates of the unconditional variance of the return on six-month Treasury bills

(weekly data, 1985-94)



An unrestricted GARCH(1,1)-t model was estimated for the daily returns, but the parameters α and β added up to 1.12, which violates the restriction that their sum should be less than one. It then seemed appropriate to try and estimate an integrated GARCH(1,1), i.e. with the restriction that the parameters sum to unity. Compared to the unrestricted model, the estimate of the ARCH parameter is forced down from 0.3970 to 0.2740, while the estimate of the GARCH parameter was changed only at the third decimal place.

If the degree of freedom parameter ν is greater than 0.25 the conditional t-distribution has infinite kurtosis. This is the case in our implied excess kurtosis estimates for both the daily and the weekly data. These estimates are not in accordance with the sample analogues of 66.29 and 21.12 for the daily and weekly series respectively. However, the estimates can be forced down to these levels with the help of a penalty function without affecting the qualitative results. It seems that the estimated parameters and standard errors are not very sensitive to high versus very high estimates of kurtosis.

2 This approach was pioneered by Bollerslev (1987). We also employed the alternative Quasi Maximum Likelihood approach of Bollerslev and Wooldridge (1992). The robust standard errors that we computed rendered all parameters, except for the GARCH parameter, insignificant.

Table 2

Estimates of the GARCH(1, 1) model for daily and weekly returns of the six-month Treasury bill
(1985-94, excluding the 1992 crisis)

Coefficient	Daily returns		Weekly returns	
	Normal	**Student-t**	**Normal**	**Student-t**
ω	0.0094** (0.0011)	0.0238** (0.0062)	0.2256** (0.0832)	0.0465 (0.0394)
α	0.1630** (0.0181)	1 - β	0.0600* (0.0237)	0.0933* (0.0444)
β	0.8349** (0.0126)	0.7260** (0.0400)	0.7800** (0.0644)	0.8809** (0.0494)
θ	- 0.0045** (0.0012)	- 0.0049 (0.0043)	- 0.0161 (0.0088)	- 0.0001 (0.0051)
ν^{-1}		0.4019** (0.0121)		0.3388** (0.0475)
Ljung-Box for the squares	3.12	2.44	10.84	2.38
ARCH(6)	0.47	0.39	0.37	0.49
Coefficient of skewness	- 3.91**	- 4.71**	- 1.94**	- 2.89**
Coefficient of excess kurtosis	49.19**	66.29**	13.74**	21.12**
Implicit excess kurtosis		∞		∞

Note: This table reports estimates of the conditional variance model

$$h_t = \omega + \alpha u_{t-1}^2 + \beta h_{t-1} + \theta\tau_t \ ,$$

where u_t is the unpredictable holding period return assumed to follow a conditional normal distribution, $u_t \sim n(O, h_t)$, or alternatively a conditional Student-t distribution with "degree of freedom" parameter ν, $u_t \sim t(O, h_t, \nu)$, and τ is the transactions tax. Standard errors are reported in parentheses below the estimated coefficients. An asterisk (double asterisk) denotes significance at the 5% (1%) level.

Under the assumption of conditionally t-distributed returns the tax influence parameter is still negative for both the daily and weekly data, but it is no longer significantly different from zero. Thus, we cannot reject the null hypothesis that the transaction tax has no effect on the volatility of the Treasury bill market.

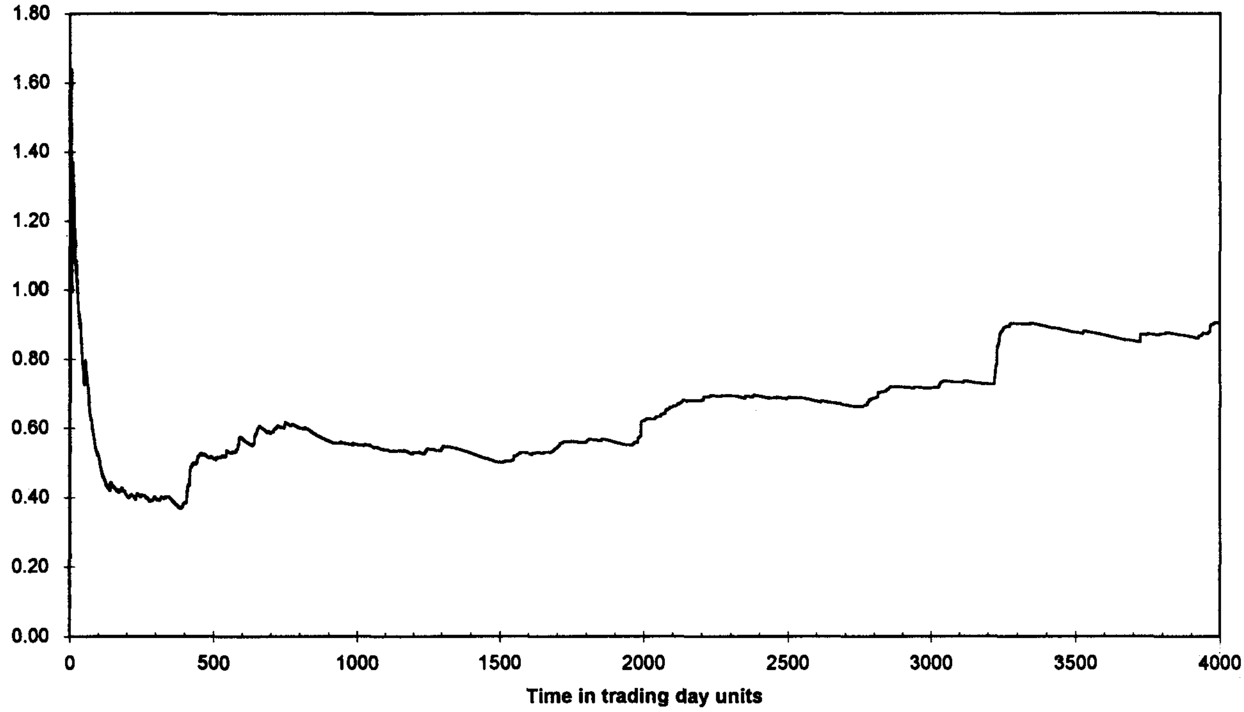
3.2 The stock market

In Panel B of Table 1 we report some descriptive statistics for the unpredictable stock index returns. These statistics are similar to those reported in Panel A. The evidence of ARCH effects in the stock index returns is even stronger than it was for the Treasury bill returns. A recursive estimate of the unconditional variance of the weekly returns on the stock index did not show any conspicuous jumps. Instead we have depicted the recursive estimates of the unconditional variance of the daily returns in Figure 5. The estimate rapidly converges to a stable unconditional variance, although there is perhaps some evidence of a trend in the series - the unconditional variance seems to increase over our sample period. However, of more importance is the jump in the variance at the time of the stock market crash in 1987. For this reason we will conduct our analysis of the daily data after excluding the period of the crash from the stock index return series.

Figure 5

Recursive estimates of the unconditional variance of the return on Affärsvärlden's stock index

(daily data, 1975-90)



In Table 3 we report the estimates of a conditional variance model for daily and weekly returns on the stock market index. The conditional variance has been modelled as

$$h_t = \omega + \alpha u_{t-1}^2 + \beta h_{t-1} + \theta_1 \tau_{1t} + \theta_2 \tau_{2t}, \qquad (3)$$

where τ_1 is the tax rate for ordinary transactions, while τ_2 is the tax rate of 1% that brokers had to pay for market-maker trade during the period 1st January 1989 to 14th April 1990. The τ_1 tax rate is 0.3% from the start of the sample period to 31st December 1978, 0% from 1st January 1979 to 31st December 1983, 1% from 1st January 1984 to 30th June 1986, 2% for the period 1st July 1986 to 31st December 1990, 1% between 1st January and 1st December 1991, and 0% thereafter (cf. Figure 1).

The ARCH and GARCH parameters are all significant at the 1% level. Under the normality assumption the coefficients in both tax rates are significantly different from zero at the 1% level for the daily data. The effect is *positive,* i.e. the transaction taxes increase volatility in line with what Kupiec hypothesised. However, this inference is incorrect since the normality assumption is violated according to the coefficient of excess kurtosis. Under the alternative assumption that the unpredictable returns are conditionally t-distributed none of the tax parameters are significant, either for the daily or for the weekly data. Hence, we cannot reject the null hypothesis that the transaction taxes have no effect on volatility.[3]

Taking a look at the diagnostics, we can see that there is no evidence of any remaining heteroskedasticity in the residuals according to the Ljung-Box and ARCH(6) statistics. In addition, the implied estimate of the conditional excess kurtosis, $3(\hat{v} - 2)/(\hat{v} - 4) - 3$, is in fairly close accordance with the sample analogue for both the daily and especially the weekly data.

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3 Kupiec (1989) has used a similar approach to test whether initial margin requirements have had a dampening effect on the volatility in the S&P 500 index portfolio's excess returns. He could find no margin-volatility relationship.

Table 3

Estimates of the GARCH(1, 1) model for the returns on Affärsvärlden's stock index
(daily data 1975-95 and weekly data 1970-95, excluding the 1987 stock market crash)

Coefficient	Daily returns		Weekly returns	
	Normal	**Student-t**	**Normal**	**Student-t**
ω	0.0211** (0.0092)	0.0242 (0.0139)	0.3633** (0.0927)	0.3034** (0.0979)
α	0.1192* (0.0104)	0.1532** (0.0426)	0.1212** (0.0187)	0.1191** (0.0214)
β	0.8557** (0.0120)	0.8451** (0.0439)	0.8042** (0.0281)	0.8204** (0.0307)
θ_1	0.0075** (0.0024)	0.0011 (0.0074)	0.0432 (0.0480)	0.0288 (0.0574)
θ_2	0.0461** (0.0107)	- 0.0058 (0.0403)	- 0.1576 (0.1321)	- 0.1060 (0.1524)
v^{-1}		0.2188** (0.0352)		0.1148** (0.0230)
Ljung-Box for the squares	2.51	1.14	4.92	4.69
ARCH(6)	2.57	1.17	3.15	2.93
Coefficient of skewness	- 0.59**	- 1.33**	- 0.12	- 0.13*
Coefficient of excess kurtosis	5.19**	17.28**	1.38**	1.42**
Implicit excess kurtosis		10.51		1.27

Note: This table reports estimates of the conditional variance model

$$h_t = \omega + \alpha u_{t-1}^2 + \beta h_{t-1} + \theta_1 \tau_{1t} + \theta_2 \tau_{2t} ,$$

where u_t is the unpredictable holding period return assumed to follow a conditional normal distribution, $u_t \sim n(0, h_t)$, or alternatively a conditional Student-t distribution with "degree of freedom" parameter v, $u_t \sim t(0, h_t, v)$, τ_{1t} is the transaction tax, and τ_{2t} is the broker transaction tax. Standard errors are reported in parentheses below the estimated coefficients. An asterisk (double asterisk) denotes significance at the 5% (1%) level.

To summarise, we have estimated models of the conditional variance of returns on the six-month Treasury bill and Affärsvärlden's stock index. The inference problems to which leptokurtic financial time series give rise have been dealt with. We have found no evidence that transaction taxes have had any effect on the volatility of the Swedish Treasury bill market or stock market.

Conclusions

In this paper the effect of a transaction tax on asset price volatility is empirically tested. Several authors, among them Summers and Summers (1989), suggest that a transaction tax should reduce excessive speculation, so-called noise trading, and thereby also stock price volatility. On the other hand, opponents point out that excessive volatility may be attributed to *insufficient* speculation and arbitrage, not excessive speculation. According to this argument transaction taxes would increase volatility.

Swedish stock and money market data from the last few decades are used in the study. During this period, transaction taxes were introduced on the Swedish stock market as well as on the money market. The transaction tax rate was changed several times during the sample period and the tax was finally abolished. The data set from this period provides us with unique opportunities to test various hypotheses about the effect of transaction taxes.

A GARCH(1, 1) model is fitted to the data to take care of the well-known time series characteristics of financial data with alternating periods of high and low volatility. The transaction tax is added as an independent variable to the variance equation. However, no significant effect on price volatility is found, i.e. there is no support for the hypotheses made by Summers and Summers (1989) that a transaction tax reduces volatility.

On the other hand, no evidence of increased price volatility is found either. This is perhaps somewhat surprising, especially if one believes in a negative relationship between volatility and liquidity and considers the remarkable drop in trading volume as due to the turnover tax. The lack of effect on volatility provides some support for the idea put forward in Summers and Summers (1989) of a liquidity level above which no effect on volatility should be expected.

Summers and Summers (1989) argue that a transaction tax should have the advantage over most other taxes in that it has "the desirable economic effect of curbing speculation" when most other measures only have adverse effects on incentives to work and save. This study does not provide any support for the Summers and Summers view. Instead, the negative effects on investment caused by the transaction tax should be compared with the effects of other types of taxes that yield the same revenue.

However, there may be other motives for imposing a transaction tax. As noted previously, Tobin (1984) and Summers and Summers (1989) argue that more resources are devoted to the financial industry than is socially desirable and that "a transaction tax is a natural policy for alleviating this market failure" (Summers and Summers (1989), p. 174). As pointed out earlier, this article makes no attempt to prove whether resources were "over-allocated" to the financial industry during the tax period. Instead, our focus has been on volatility. However, if one assumes that the amount of resources directed to the financial industry is excessive and that the aim is to reduce the size of the industry, it is evident from the Swedish experiment that a transaction tax is a very efficient way to reduce intermediators' business opportunities and to stimulate an offshore flight of activity.

References

Bera, A.K. and M.L. Higgins (1993): "ARCH models: properties, estimation and testing", *Journal of Economic Surveys* 7, pp. 305-366.

Bollerslev, T. (1986): "Generalized autoregressive conditional heteroskedasticity", *Journal of Econometrics* 31, pp. 307-327.

Bollerslev, T. (1987): "A conditionally heteroskedastic time series model for speculative prices and rates of return", *The Review of Economics and Statistics* 69, pp. 542-547.

Bollerslev, T., R.Y. Chou and K.F. Kroner (1992): "ARCH modelling in finance: a review of the theory and empirical evidence", *Journal of Econometrics* 52, pp. 5-59.

Bollerslev, T. and J. Wooldridge (1992): "Quasi-maximum likelihood estimation and inference in dynamic models with time-varying covariances", *Econometric Review* 11, pp. 143-172.

DeLong, J.B., A. Schleifer, L.H. Summers and R.J. Waldman (1991): "The survival of noise traders in financial markets", *Journal of Business* 64, pp. 1-19.

Engle, R. (1982): "Autoregressive conditional heteroskedasticity with estimates of the variance of U.K. inflation", *Econometrica* 50, pp. 987-1008.

French, K. and R. Roll (1987): "Stock return variances: the arrival of information and the reaction of traders", *Journal of Financial Economics*, pp. 5-26.

Keynes, J.M. (1936): *The General Theory of Employment Interest and Money,* New York, Harcourt Brace.

Kupiec, P.H. (1989): "Initial margin requirements and stock returns volatility: another look", *Journal of Financial Services Research* 3, pp. 189-211.

Kupiec, P.H. (1991): Noise Traders, Excess Volatility and a Securities Transaction Tax. FED Working Paper No. 166, Board of Governors of the Federal Reserve System, July.

Lindgren, R. and A. Westlund (1990): "Transaction costs, trading volume and price volatility on the Stockholm stock exchange", mimeo, Stockholm School of Economics, June.

Pagan, A.R. and G.W. Schwert (1990): "Alternative models for conditional stock volatility", *Journal of Econometrics* 45, pp. 267-290.

Shiller, R.J. (1981): "Do stock prices move too much to be justified by subsequent changes in dividends?", *American Economic Review* 71, pp. 421-435.

Summers, L. and V. Summers (1989): "When financial markets work too well: a cautious case for a securities transaction tax", *Journal of Financial Services Research* 3, pp. 261-286.

Tobin, J.: "A proposal for international monetary reform," *Eastern Economic Review.*

Tobin, J. (1984): "On the efficiency of the financial system", *Lloyds Bank Review,* July.

Reports from the Swedish Government:

SOU 1969:16 Stämpelskatter på värdepapper (Stamp duties on securities. In Swedish)

Ds Fi 1987:9 Översyn av skatten på omsättning av värdepapper (Survey of the turnover tax on securities)

The Government's bills to Parliament (in Swedish):

Prop. 1978/79:165

Prop. 1983/84:48

Prop. 1985/86:140

Prop. 1987/88:156

Prop. 1989/90:111

Prop. 1989/90:83

Prop. 1991/92:34