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JEL Classification: G14, G24

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The expiration day effect of index options and index futures on the underlying shares

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Abstract

This paper studies the effect of the expiration day of index options and futures on the trading volume, variance and price of the underlying shares. The data consists of all trades for the underlying shares in the FOX-index for expiration days during the period October 1995 to the mid of yer 1999. The main results seem to support the findings of Kan 2001, i.e. no manipulation on a larger scale. However, some indication of manipulation could be found if certain characteristics are favorable. These characteristics include: a) a large quantity of outstanding futures or at/in the money options contracts, b) there exists shares with high index weight but fairly low trading volume. Lastly, there is some indication that manipulation might be more popular towards the end of the examined time period.

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1. Introduction

In the last decades the financial markets have been characterised by the development of derivative securities such as options, swaps and futures. The positive effects of these new securities are due to new risk sharing opportunities and more complete financial markets. On the negative side derivative securities, whose payoffs are a function of some other assets' prices, also offer new opportunities of price manipulation (Boyer and Demange 1999).

This paper studies the effect of the expiration day of index options and futures on the trading of the underlying shares. A trader with a sufficiently large position in an option or a future might be tempted to manipulate the underlying spot price, by buying or selling, before the expiration. The loss in the spot market is covered by the gain in the options or futuress market if the option or future is settled with cash.

Stock price manipulation was formally divided into three categories by Allen and Gale (1992). The first category is named action-based manipulation, i.e manipulation based on actions that change the actual or perceived value of the assets. The second category is information-based manipulation, i.e manipulation based on the release of false information or spreading false rumours. The third category is named trade-based manipulation. It occurs when somebody attempts to manipulate the price of a share by simply buying or selling the share, without any other actions that could alter the price of the share.

A number of authors have considered trade-based manipulation. Allen and Gale (1992) develop a model with asymmetric information where all agents in the market have rational expectations and maximise expected utility. They show that profitable price manipulation is possible given that asymmetric information exists. Investors are uncertain whether a large trader who buys (or sells) a share does so because he knows that the share is undervalued (overvalued) or because he intends to manipulate the price of the share. Jarrow (1992) shows that trade-based manipulation is possible if the price increase caused by a large trader[1] tends to increase prices in the future. Jarrow (1992) also points out that trade-based manipulation is possible if an investor or a group of investors is able to corner the market. The latter case is extended by Chatterjea and Jarrow (1998) to cover the U.S. Treasury securities auction market. They show that manipulation is likely to occur when dealers in the when-issued[2] market use their knowledge of the net order flow to be able to corner the auction, thus generating price bubbles. Empirical support for the model by Chatterjea and Jarrow (1998) is found by Jordan and Jordan (1996) who found the characteristic price bubble in a case study concerning the treasury auction on May 22, 1991.

A model concerning manipulation of the underlying assets on the expiration day of futures was developed by Kumar and Seppi (1992). Their two-period model show that manipulation is feasible given asymmetric information and cash settlement of the futures contracts. The idea is simple, investors earn positive expected profits by establishing a futures position and then trading in the spot market to manipulate[3] the spot price used to calculate the cash settlement at delivery. Cash settlement is crucial because it allows “paper” capital gains to be converted into cash without taking delivery of the mispriced underlying asset. Although the investor makes a loss in the spot market it is more than made up for in the futures market. Kumar and Seppi (1992) also show that as the number of manipulators grows, profits from manipulation fall to zero. The model predicts that spot price variance is larger before settlement since manipulators tries to manipulate in different directions. Trading volume should also be larger before settlement than on an average day. Furthermore, if manipulation is successful in the sense that the spot price is moved away from the true value, a price reversal should be observed after the settlement when prices return to their true level.

The expiration day effects on volume, volatility and price have been empirically tested by academic researchers on various stock exchanges. Stoll & Whaley (1987, 1990)

[1] A large trader is defined as a trader whose trades change prices (Jarrow 1992).

[2] The “when-issued market” refers to trading in forwards before a treasure bill auction

[3] In order to move the price the investor has to be a large trader (in the Jarrow 1992 sense) or has to be mistaken for an informed trader with private information.

examined the effect of the last hour of trading on simultaneous expiration days of the S&P 500 futures and S&P 100 options contracts, known as the “triple-witching” hour. They found clear evidence of higher volume, volatility and price reversal though the price effect on the spot market was not economically significant. The volatility effect was also reported by Day & Lewis (1988) for the period 1983-1986 and Aggrawal (1988) for the period 1981-1987.

In an attempt to mitigate the concern of the abnormal stock price reactions at the expiration the Chicago Mercantile Exchange, the New York Stock Exchange and the New York Futures Exchange changed the settlement of their S&P 500 and NYSE index futures from the close to the open in June 1987, while the options expiration remained untouched.

The effect of moving the S&P 500 expiration quickly become a popular research area. Stoll and Whaley (1991) compared the pre-June 1987 with the post-June 1987 periods and found that the effects on volume, volatility and price reversal merely shifted from the close to the opening. Two papers by Herbst and Maberly (1990, 1991) confirmed the findings of Stoll and Whaley concerning volatility and price reversal. Hancock (1993) used minute-by-minute S&P 500 index values and confirmed that moving the expiration point of time did not reduce volatility to normal levels.

In contrast to the above studies Kan (2001), who studied the stock market of Hong Kong for the period March 1989 to December 1992, did not find any evidence of an expiration day effect, neither on the whole expiration day nor immediately before close. Kan suggests that the difference in market microstructure between North America and Hong Kong could explain the discrepancy in the results. The difference in the market microstructure includes different expiration days, the difference in the calculation of the settlement price, the difference in the trading mechanisms of futures contracts, the difference in the trading mechanism of the underlying spot markets, the difference in short selling restrictions and the lack of programme trading in Hong Kong. Lastly, Kan suggests that distinct macroeconomic factors could be the reason for the different results.

There are several motives for this paper. First and foremost, in order for the financial markets to work efficiently the expiration day price for the underlying instruments should reflect the fair value of the instruments. If this is not the case, due to price manipulation or some other reason, then the market does not function efficiently. This directly calls for empirical tests of whether or not the price formation on expiration days is normal. Second, although there is a fair number of theoretical models concerning manipulation, actual empirical tests are done mainly on the US market. It is possible that the reported expiration day effects are caused by the market microstructure in the US. If this is the case, then these negative effects might be avoided by changing the market microstructure, i.e. the calculation of settlement price, market transparency, short selling restrictions etc. Third, we believe that manipulation is not equally likely to occur at every expiration day, there probably are charcteristics, such as the number of open contracts, that make manipulation likelier to occur on some expiration days. However, we have not found a single study which would look at such characteristics.

The rest of the paper is organised as follows. In chapter two the Finnish market structure and the data are presented. In chapter three the empirical tests are presented. The empirical results are presented in chapter four. The paper ends with a summary and conclusions in chapter five.

2. Institutional setting and data

Both FOX-futures and FOX-options are based on the FOX-index. The FOX-index is a value weighted index, consisting of the 25[4] most traded stocks on the Helsinki exchange. The FOX-portfolio is re-constructed every half year, february the 1st and august the 1st. The weight of one company[5] is limited to 20 % of the index[6].

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[4] On two of the expiration days there were only 24 stocks in the index, 27.6.1996 and 22.4.1999. The reason was that in 1996 two companies, Kymmene and Repola, were merged and in 1999 the two Nokia series were joined into one.

[5] Before 25th of august 1995 the limitation was 20 % of one stock. This ment that if a company had several series of stocks the weight of one company could be very high. This problem was accentuated by Nokia which at times had a weight of nearly 50 % of the FOX-index.

The FOX-futures and FOX-options expires every two months, in February, April, June, August, October and December. The expiration day is the fourth Thursday in the month[7]. The expiration day price of the FOX-index is based on the volume weighted average price of the underlying shares for all trades, consisting of at least one round lot, done in the continuous limit order book or at the opening call[8].

Since limitations of the weights changed dramatically in August 1995, the examined time period is October 1995 to mid of 1999. The data consists of alla trades done during this period of time exept for odd lot trades and after hours trades. This gives 21 expiration days, the actual dates are shown in appendix 1.

3. Hypotheses and empirical tests

The hypotheses rest on the theoretical model by Kumar and Seppi (1992). They predict that immediately before expiration the volatility and volume of the underlying spot price should be higher than normally and, if the manipulation is successful, a price reversal should be observed after expiration. The way the expiration price of the FOX-index is calculated modifies these theoretical hypotheses. Since the expiration day price is based on the volume weighted average price we do not expect the volume and volatilty effects to be found before the expiration day. Instead we expect to observe these effects during the expiration day[9]. The price reversal tests should be executed using the volume weighted average price instead of the price at a fixed time.

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[6] The weight limitation is controlled, and new weights issued if necessary, every three months.

[7] If the fourth Thursday is not a trading day then the closest preceeding trading day is chosen as the expiration day.

[8] This rules out odd lot trades and after hour trading. The HETI (Helsinki exchange automated trading and information system) is a continuous open limit order book trading system. Trading starts with a closed call which is followed by a continuous trading session. The continuous trading is followed by after hours trading in wich trades can be done at the prices ruling at the end of continuous trading. During the continuous trading bilaterally negotiated (pre-arranged) trades can be done at the current continuous trading prices.

[9] It is possible that no effects will be found since the way the expiration price is calculated makes it more costly to manipulate the expiration day price. On the other hand it is easier to manipulate on a thin

The effect of the expiration day on trading volume is tested by the following simple test

$$\mathrm{VOLEF}_{i,t} = \ln\left(\frac{\mathrm{VOLUME}_{i,t}}{(\mathrm{VOLUME}_{i,t-1} + \mathrm{VOLUME}_{i,t+1})/2}\right) \qquad (1)$$

where $\mathrm{VOLEF}_{i,t}$ is the measure[10] of the volume effect on expiration day t for share i. The $\mathrm{VOLUME}_{i,t}$, $\mathrm{VOLUME}_{i,t-1}$ and $\mathrm{VOLUME}_{i,t+1}$ operators are the tradingvolume in FIM for share i on the expiration day, the day before the expiration day and the day after the expiration day[11]. If the VOLEF-coefficient is above zero, as predicted by the Kumar and Seppi (1992) model, then trading volume is higher on expiration days than on an ordinary trading day.

The effect of the expiration day on the volatility is tested with a similar test as the test for trading volume

$$\mathrm{VAREF}_{i,t} = \ln\left(\frac{\mathrm{VARIANCE}_{i,t}}{(\mathrm{VARIANCE}_{i,t-1} + \mathrm{VARIANCE}_{i,t+1})/2}\right) \qquad (2)$$

---

market, such as the Helsinki exchange, since thin trading, according to Kumar and Seppi (1992) and Easley, Kiefer and O'Hara (1996), increases the possibility that the manipulator is confused with an informed trader.

[10] A relative measure is used instead of absolute numbers because the overall trading volume on HEX has risen substantially during the research period making, for example, any mean value comparisons inefficient.

[11] To account for the well known weekday effect we also use the same weekday one week before expiration and one week after expiration as control days.

where $\text{VAREF}_{i,t}$ is the measure of the variance effect on expiration day t for share i. The $\text{VARIANCE}_{i,t}$, $\text{VARIANCE}_{i,t-1}$ and $\text{VARIANCE}_{i,t+1}$ operators are the variance[12] for share i on the expiration day and the day before and after the expiration day. If the VAREF-coefficient is above zero, as predicted by the Kumar and Seppi (1992) model, then the volatility on expiration days are higher than on an ordinary trading day.

The price reversal effect is tested with a regression

$$\text{RETURN}_{i,t+1} = \alpha + \beta_1 * \text{RETURN}_{i,t} + \beta_2 * \text{D} + \beta_3 * \text{mult D} \qquad (3)$$

where $\text{RETURN}_{i,t+1}$ is the return[13] from day t to day t+1, based on volume weighted average prices. Volume weighted average prices are used, rather than the close price, since the expiration day price is based on these. The returns are calculated around the expiration day and for the corresponding days one week before and after. The returns one week before and after are used as a control sample to show the behaviour on non-expiration days. D is a dummy variable which takes the value of 1 around the expiration day and 0 for the control sample. Mult D is a multiplicative dummy which is defined as D * $\text{RETURN}_{i,t}$. If a price reversal effect exists then the correlation between $\text{RETURN}_{i,t+1}$ and $\text{RETURN}_{i,t}$ should be negative around the expiration day. Furthermore, if a price reversal occurs, then the β_3 regression coefficient should be negative since it measures the incremental behaviour around expiration days compared to normal days. Also, the sum of β_3 and β_1 has to be negative for a price reversal.

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[12] $\text{VARIANCE}_{i,t} = \frac{1}{n-1}\sum_{x=1}^{n}(\text{price}_{i,x,t} - \text{mean price}_{i,t})^2$ where n is the number of trades day t for share i, $\text{price}_{i,x,t}$ is the price of share i on day t and trade x and $\text{mean price}_{i,t}$ is the average price for share i on day t.

[13] logarithmic returns are used, i.e. $\text{RETURN}_{i,t+1} = \ln(\text{VWAP}_{i,t+1}) - \ln(\text{VWAP}_{i,t})$ where VWAP is the volume weighted average price for firm i on day t.

4. Results

The overall effects of the expiration days on the volatility and volume of the underlying shares can be seen in table 1 below. The Kumar and Seppi (1992) model predicts a positive effect on both trading volume and on the volatility. It is clear from table 1 that neither the volume or the volatility is significantly larger than on the control days, the volatility effect is even negative, although not significantly so.

Table 1. The overall volume and volatility effect of expiration days

	VOLEF (1)	VOLEF (7)	VAREF (1)	VAREF (7)
Mean	0,323	0,255	-0,195	-0,291
St.dev.	0,897	0,917	1,24	1,47
Min	-4,234	-3,473	-5,99	-6,149
Max	3,878	4,168	3,454	3,409
t-value	0,360	0,278	-0,157	-0,198
p-value	[0,359]	[0,391]	[0,562]	[0,578]

The number in the parentheses after the Volef and Varef variabelnames denotes that the control days are the day before and after or the day one week before and one week after the expiration day. The p-value is for a one sided test of significa-nce.

No price reversal effects could be found around the expiration day. The correlation between t and t+1 returns was 0,164 and the corresponding correlation for the control sample was 0,139. This is confirmed by the regression results in table 2. The coefficient for the multiplicative dummy is negative as expected, but insignificant.

Table 2. Price reversal effect

Constant	Return	D	Mult D	R-sq	F-value
0,123	0,438	-0,128	-0,058	0,008	5,00*
(3,70)*	(1,37)	(-3,83)*	(-0,18)		

Note: The dependent variable is the return from the expiration day to the next day and the corresponding return one week before/after for the controll sample. Return is the lagged return to the dependent va-riable. D is a dummy variable which takes the value of 1 for the expi-ration days and 0 for the control sample. Mult D is D*Return. R-sq is the adjusted R-Square. The values in the brackets are the t-statistics, a star (*) denotes significance at the 5 % level.

There are three factors affecting the overall results. First, the weight of individual shares in the index varies. Consequently, to move the index one should trade in the shares with large weights in the index. Second, the number of open option and futures contracts is a key factor, if there are no or few contracts open then no one has the incentive to move the index. Moreover, the open option contracts should be in or at the money. If the contracts are out of the money options then there is no reason to move the index since it would be too costly to move the index enough to actually benefit anything. Third, the trading volume of the underying shares is important. Since the expiration day price depends on the volume weighted average price, the costs of moving the expiration day price rises with the trading volume of the underlying shares. To summarize, manipulation is more likely to be found when there is a large amount of open futures and in the money options and there are shares in the Fox-index that have high index weights but fairly low trading volume.

To examine the effect of the above mentioned factors on trading volume, volatility and price reversal a series of regressions[14] was run. For the regressions a measure for price reversal had to calculated. Price reversal is defined[15] as

$$
\begin{aligned}
\mathrm{REV}_{i,t} &= \left|\mathrm{RETURN}_{i,t+1}\right| \text{ if sign } (\mathrm{RETURN}_{i,t}) \\
&\quad \text{not equal sign } (\mathrm{RETURN}_{i,t+1}) \\
\mathrm{REV}_{i,t} &= -\left|\mathrm{RETURN}_{i,t+1}\right| \text{ otherwise.}
\end{aligned}
\tag{4}
$$

First, the effect on volume, volatility and price reversal was explained by the number of open futures and in the money option contracts[16] that expired on the expiration day, the weight of the underlying share in the Fox-index and the average daily volume[17] of

[14] Ordinary least square (OLS) regressions using White's heteroskedastic-consistent covariance matrix and Newey-West variance estimator for models with possible autocorrelation with lag length 1.

[15] The price reversal definition of Stoll and Whaley (1987) where Rev = 0 if the signs are equal was also used. The results were very close to those reported for this measure.

[16] Option contracts that actually expired in the money.

[17] The volume was calculated as the average of the trading days highest and lowest price for the share multiplied by the amount of shares traded.

a 10-day[18] period before the expiration day of the contracts. The results are shown in table 3, regressions 1.1-1.5. The overall explanatory power of the regressions is very low. There is some indication that the expiration day trading volume effect could be explained by the number of open contracts (positive effect expected) and average earlier trading volume in the share (negative effect expected). However, no explanatory power concerning the volatility and price reversal effects was found.

Second, the regression was modified to account for the joint effect of earlier trading volume and the index weight by dividing the index weight with the prior trading volume. The reason is fairly obvious since the ideal target for manipulation is a share with high index weight and low trading volume. The results are shown in table 3, regressions 2.1-2.5. The explanatory power concerning the volume effect rose, but is still fairly low. No explanatory power concerning volatility and price reversal was found.

Third, two time dummies were added to the regressions 1.1-1.5 and 2.1-2.5 to account for fundamental changes in the trading on the Helsinki exchange. These changes include the rapid rise of trading volume (see appendix B), the rising interest among foregin investors towards Finnish stocks and the fact that the Helsinki exchange is fastly becoming a technology firm centered exchange (the “Nokia-effect”). The first dummy (D1) has the value of 1 for expiration days 28.11.1995 through 23.12.1996, zero otherwise. The second dummy (D2) has the value of 1 for expiration days 27.2.1997 through 26.2.1998, zero otherwise. No prior expections was made for the effect of time on the volume and volatility expiration day effects. The result, shown in table 3 regressions 3.1-3.5 and 4.1-4.5, was quite suprising. It seems that manipulation is likelier to occur during the third period (23.4.1998 through 22.4.1999).

[18] On expiration day 22.4.1999 the nokia shares volume is the average of 8 days tradingvolume since the nokia A and K series were joined on the 12.4.1999.

Table 3. Explanatory power of indexweight, prior trading volume, open contracts and time on the volume, variance and price reversal on the expiration day

	Depen. variable	Independent variables Const	W [+]	V [-]	W/V[+]	C [+]	D1	D2	R-sq	F-value
Regr. 1.1	Volef(1)	0,061	0,415	-0,148		0,423			0,02	5,09*
		(0,52)	(0,45)	(-3,22)*		(2,67)*				
Regr. 1.2	Volef(7)	0,049	0,972	-0,088		0,278			0,00	1,71
		(0,39)	(0,83)	(-2,05)*		(1,81)				
Regr. 1.3	Varef(1)	-0,443	2,633	-0,034		0,225			0,00	1,25
		(-2,49)*	(1,56)	(-0,54)		(1,06)				
Regr. 1.4	Varef(7)	-0,372	1,435	0,037		0,023			-0,00	0,44
		(-1,69)	(0,72)	(0,55)		(0,09)				
Regr. 1.5	Rev	0,024	-0,047	0,032		0,027			0,01	2,33
		(-2,09)*	(-0,14)	(0,14)		(1,92)				
Regr. 2.1	Volef(1)	-0,098			3,091	0,390			0,06	16,75*
		(-0,86)			(4,55)*	(2,55)*				
Regr. 2.2	Volef(7)	-0,355			2,331	0,251			0,03	8,28*
		(-0,30)			(3,73)*	(1,67)				
Regr. 2.3	Varef(1)	-0,387			0,949	0,218			0,00	1,15
		(-2.32)*			(1,09)	(1,03)				
Regr. 2.4	Varef(7)	-0,261			-0,995	0,038			-0,00	0,46
		(-1,27)			(-1,03)	(0,14)				
Regr. 2.5	Rev	-0,025			0,015	0,027			0,01	3,51*
		(-2,01)*			(0,09)	(1,95)				
Regr. 3.1	Volef(1)	0,151	0,810	-0,176		0,828	-0,476	-0,672	0,11	13,16*
		(1,28)	(0,91)	(-3,46)*		(5,14)*	(-4,51)*	(-6,39)*		
Regr. 3.2	Volef(7)	0,105	1,238	-0,107		0,511	-0,304	-0,373	0,03	3,85*
		(0,85)	(1,05)	(-2,44)*		(3,05)*	(-2,34)*	(-3,63)*		
Regr. 3.3	Varef(1)	-0,401	2,819	-0,047		0,411	-0,222	-0,306	0,01	1,71
		(-2,24)*	(1,66)	(-0,74)		(1,83)	(-1,50)	(-2,06)*		
Regr. 3.4	Varef(7)	-0,313	1,731	0,015		0,247	-0,326	-0,345	0,00	1,28
		(-1,43)	(0,86)	(0,22)		(0,85)	(-1,65)	(-1,92)		
Regr. 3.5	Rev	-0,027	-0,014	0,091		0,019	0,011	0,013	0,01	2,34*
		(-2,13)*	(-0,39)	(0,40)		(1,66)	(1,88)	(2,46)*		
Regr. 4.1	Volef(1)	0,005			2,816	0,771	-0,473	-0,601	0,13	19,54*
		(0,05)			(4,45)*	(4,89)*	(-4,54)*	(-5,54)*		
Regr. 4.2	Volef(7)	0,026			2,254	0,463	-0,308	-0,318	0,05	7,19*
		(0,22)			(3,56)*	(2,82)*	(-2,43)*	(-3,09)		
Regr. 4.3	Varef(1)	-0,339			0,813	0,397	-0,218	-0,283	0,01	1,63
		(-2,01)*			(0,92)	(1,78)	(-1,48)	(-1,86)		
Regr. 4.4	Varef(7)	-0,195			-1,136	0,276	-0,312	-0,368	0,00	1,57
		(-0,96)			(-1,11)	(0,95)	(-1,60)	(-2,04)*		
Regr. 4.5	Rev	-0,027			0,070	0,019	0,011	0,013	0,02	2,92*
		(-2,07)*			(0,38)	(1.69)	(1,93)	(2,39)*		

Note: R-sq is the adjusted R-square. The independent variables are the constant (Const), the shares weight in the Fox-index (W), prior trading volume of the stock (V), the indexweight divided by prior volume (W/V), the number of open contracts in the money on the expiration day (C), and two dummy-variables where D1 takes the value of 1 for the first third of the data and D2 takes the value of 1 for the second third of the data, zero otherwise. The +/- in the brackets after the independent variables indicate the expected effect is positive or negative. The value in the brackets below the coefficients are the t-values of the coefficients, the * denotes significanse on a 5% level (two-sided).

The results in table 3 indicate that manipulation might be found on those expiration days when there are a large amount of open futures and in the money option contracts. Manipulation is more likely to be conducted for shares which have a high weight in the Fox-index and fairly low trading volume. Moreover, manipulation is likelier to be found in the period 23.4.1998 through 22.4.1999. However, one should be very cautious in drawing conclusions since the explanatory power of the regressions is very low. However, the results in table 3 justifies an further examination of the possible effects of the number of open contracts, index weight, trading volume and period of time on the expiration day.

In table 4 and 5 below are the results when the effect of open contracts, index weight, trading volume and time is taken into account. First, he sample was ordered on basis of the number of open futures and in the money option contracts (C), the half of the observations with the lowest number of contracts was deleted. Then the remaining observations was ordered by the index weight/prior trading volume (W/V), again the half with the lowest quotients was deleted. This left a sample of 121 observations of the initial 486 (subsample 1), results for volume and volatility effects are shown in panel A of table 4. The results for price reversal is shown in panel A of table 5. Last, the days not belonging to the third period of time (23.4.1998 through 22.4.1999) were deleted. This left a sample of 43 observations of the initial 486 (subsample 2), results for volume and volatility are shown in panel B of table 4. The price reversal effects are shown in panel B of table 5.

The results clearly suggests that price manipulation is not undertaken regularly on the Helsinki stock exchange. The results for volume, volatility and price reversal are all insignificant. This, of course, does not mean that manipulation never occures, it just is not done on a regular basis.

Table 4. Expiration day effects, sample selected on basis of number of open contracts, the prior volume/index weight quotient and time

	VOLEF (1)	VOLEF (7)	VAREF(1)	VAREF (7)
Panel A				
Mean	0,755	0,563	-0,042	-0,306
St.dev.	0,937	1,013	1,354	1,523
Min	-1,466	-1,869	-5,990	-6,149
Max	3,878	4,168	3,366	3,409
t-value	0,806	0,556	-0,031	-0,201
p-value	[0,211]	[0,29]	[0,512]	[0,579]
Panel B				
Mean	1,196	0,801	-0,008	-0,443
St.dev.	0,801	1,034	1,370	1,502
Min	-0,690	-1,455	-4,238	-4,228
Max	3,878	4,168	3,366	3,000
t-value	1,492	0,775	-0,006	-0,295
p-value	[0,072]	[0,221]	[0,502]	[0,615]

The number in the parentheses after the Volef and Varef variabelnames denotes that the control days are the day before and after or the day one week before and one week after the expiration day. The p-value is for a one sided test of significance. The data for panel A is selected in the following manner: first the original data(486 observations) is sorted by the number of open contracts, then the lower half is deleted. Then the remaining data was sorted by the wight/volume (W/V) quotient and again the lower half was eliminated, this left 121 observations (subsample 1). The data in panel B is a subsample of the Panel A data, all observations not belonging to the third time period (23.4.98-22.4.99) was deleted, this left 43 observations (subsample 2).

It is, however, interesting to compare the the results for the volume in table 1 and table 4. When we select days with more open futures and in the money option contracts and look at shares with high index weight / trading volume the effect becomes stronger (subsample 1, Panel A), although it is still insignificant. If we consentrate on the period 23.4.1998 to 22.4.1999 (subsample 2, Panel B) the effect is even clearer, the volume effect actually is significant at the 10 % level for the volume quotient when the preceding day and the day after is used as a benchmark. This suggests that manipulation is likelier to occur for shares with high index weight / volume quotient when there are many outstanding contracts. The possibility of manipulation also seems to be likelier towards the end of the research period. There is some indication that volatility would behave in the same manner as volume, although the effect is not equally clear.

Table 5. Price reversal effect, sample selected on basis of the number of open contracts, prior volume/index weight quotient and time

	Constant	Return	D	Mult D	R-sq	F-value
Panel A						
Coefficient	0,005	0,130	-0,000	-0,304	0,02	2,88*
t-stat	(3,12)*	(1,34)	(-0,23)	(-2,00)*		
total effect			(1,77)	(-1,49)		
Panel B						
Coefficient	0,013	0,162	-0,020	-0,284	0,22	13,15*
t-stat	(5,72)*	(1,14)	(-5,08)*	(-1,48)		
total effect			(-2,15)*	(-0,95)		

Note: The dependent variable is the return from the expiration day to the next day and the corresponding return one week before/after for the control sample. Return is the lagged return for the dependent variable. D is a dummy variable which takes the value of 1 for the expiration days, and 0 for the control sample. Mult D is D*Return. R-sq is the adjusted R-square. "Total effect" tests if the expiration day effect is significant, i.e are (constant+D) and (return+mult D) significantly different from zero. The data for panel A is selected in the following manner: first the original data (486 observations) is sorted by the number of open contracts, then the lower half is deleted. Then the remaining data was sorted by the wight/volume (W/V) quotient and again the lower half was eliminated, this left 121 observations (subsample 1). The data in panel B is a subsample of the Panel A data, all observations not belonging to the third time period (23.4.98-22.4.99) was deleted, this left 43 observations (subsample 2).

An examination of the price reversal effect of subsample 1 (Panel A) confirms the results found for volume. A significant negative change, as indicated by the t-stat of Mult D, in the price behaviour on expiration days can be found. The correlation of returns around the exchange days is negative –0,1796 (+0,1298 for the control group). The sum of the return and Mult D coefficients is –0,174. However, the effect is not significantly negative (the "from zero" t-stat). The result for subsample 2 (Panel B) is similar although the difference between actual expiration days and the control group is not significant.

5. Summary and conclusions

This paper examines the effect of the expiration day of index options and index futures on the trading of the underlying shares, specifically the trading volume, volatility and price reversal of the shares on the expiration day.

The idea is simple, investors earn positive expected profits by establishing a futures position and then trading in the spot market to manipulate the spot price used to calculate the cash settlement at delivery. Cash settlement is crucial because it allows “paper” capital gains to be converted into cash without taking delivery of the mispriced underlying asset. Although the investor makes a loss in the spot market it is more than made up for in the futures market. The theory, developed by Kumar and Seppi (1992), predicts that if this kind of manipulation occur a rise in the trading volume and the volatility of the underlying shares on the expiration day would be observed. Also, if the manipulation is even partially succesful a price reversal effect should be observed.

The timeperiod for this study is 21 expiration days for options and futures on the Fox-index between 28.12.1995 and 22.4.1999. The expiration day price for the Fox-index is calculated as the value weighted average price on the expiration day, rather than the price at any fixed point of time.

Overall, the results show virtually no indication of manipulation on a larger scale. On the other hand, there is clear indication that manipulation is likelier to occur on expiration days when there are many open futures and in the money options contracts for shares with a high weight in the index but low trading volume.

The results support Kans (Kan 2001) conclusions that the results, concerning expiration day effects, found in studies on the US market are not applicable on other markets. Kan argue that the possible reasons for the difference in results are the difference in expiration day, the difference in the way the settlement price is calculated, the difference in the trading mechanism of the contracts, the difference in the trading mechanism of the underlying spot markets, short selling restrictions, programme trading and macroeconomic factors.

The author of this paper believes that key factors in reducing manipulation around expiration days are: calculation of the settlement price, market transparency and restrictions on short selling. If the settlement price is an average of prices for some length of time instead of the price at a fixed point of time, then manipulation will be more costly and therefore the profitability of manipulation is diminished. We also argue that the specialist trading system in the US can, at least to some extent, explain the differences. A system with better transparency probably diminishes the unwanted expiration day effects. Lastly, it is clear that if short selling is regulated around expiration days then price manipulation is more difficult.

However, we suggest that even if manipulation is made harder by the above mentioned measures manipulation can still be feasible if certain attributes are favorable. Such attributes include: the manipulator has a large quantity of futures and/or in the money options and there exists shares in the spot market with a high weight in the index but have a fairly low trading volume.

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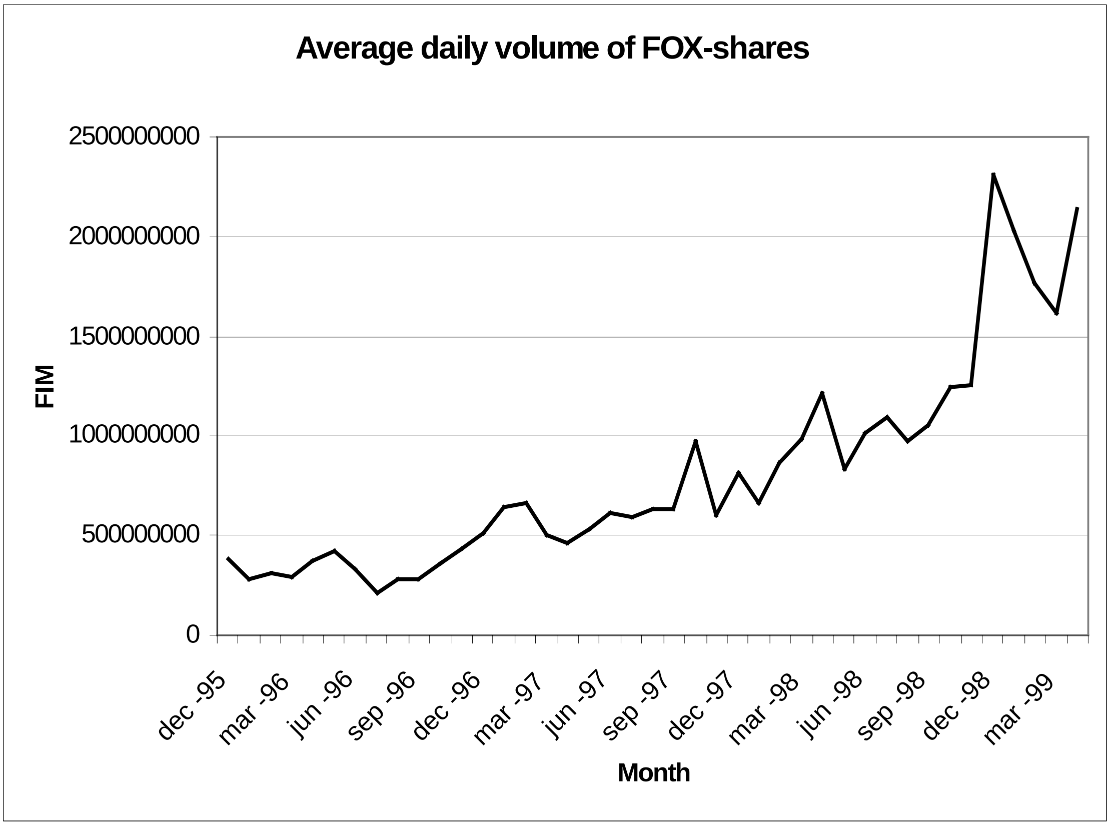
Appendix A. Expiration days

Date	Weekday
28.12.1995	Thursday
22.02.1996	Thursday
25.04.1996	Thursday
27.06.1996	Thursday
22.08.1996	Thursday
24.10.1996	Thursday
23.12.1996	Monday
27.02.1997	Thursday
24.04.1997	Thursday
26.06.1997	Thursday
28.08.1997	Thursday
23.10.1997	Thursday
23.12.1997	Tuesday
26.02.1998	Thursday
23.04.1998	Thursday
25.06.1998	Thursday
27.08.1998	Thursday
22.10.1998	Thursday
23.12.1998	Wednesday
25.02.1999	Thursday
22.04.1999	Thursday

Appendix B. Average daily trading volume for FOX-shares for the months December 1995 to April 1999.



The average daily trading volume for each month was calculated by taking the average of the highest and lowest price during the day multiplied by the number of traded shares for each share in the FOX-index. Then individual volumes for different shares was summed to get the daily volume. From daily volumes the average for the different months was calculated.