The Effects of Index Futures on Market Volatility

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Stock index futures and options have been a topic of interest and controversy concerning whether they increase market efficiency or increase market volatility. Issues have been raised concerning whether futures and options markets operate efficiently and in the public interest (Section I). Since the October 1987 stock market crash, the controversy has widened. Some have argued that stock index futures and options accentuated or even triggered the market downfall. Criticisms of options and futures trading have been about the volatility of cash stock prices. A study by Edwards (1988) pointed out that there exists evidence of futures-induced short-run volatility but this volatility does not persist in the long-run. The cause of volatility on the expiration days resulted from terminating of positions by arbitragers. These trades are often imbalanced toward one side of the cash market which could lead to sharp price movements. On non-expiration days, portfolio insurance and computerized trading could also cause stock price volatility induced from extensive buying or selling of options and futures when the cash

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market is at a certain target price. Government regulators and legislators question their impact on the stability of the capital markets. Others argue that market instability occurs when computerized trading of stock index futures and options triggered similiar 'sell' orders at the same time, making greater impact on the market (Section I). Despite difference perspectives, stock index futures and options have economic benefits as useful hedging and investment-management instruments as mentioned in Ross (1976). Economic issues of futures and options will be discussed in Section I.

Classic models for pricing contingent claims such as Black and Scholes (1973) treat options as redundant assets that are derived from the underlying securities. However, Ross (1976) and Hakansson (1978) suggest that when the market is incomplete, the introduction of options may have an effect on equilibrium prices and allocations. John (1984) and Green and Jarrow (1987) also suggest that when options are introduced, demand for the underlying security increases, pushing the stock price upward. In addition, the volatility of the security returns decreases. Conrad (1989) finds that options introduction causes a permanent price increase in the underlying security and a decrease in excess returns volatility. Edwards (1988) shows that despite evidence of futures-induced short-run volatility, such as that occuring on futures contract expiration days, the increase in volatility does not persist for longer periods.

This paper examines the effect of index futures introduction on the distribution of market index returns. The focus is on the new equity derivative markets in Europe during the years 1985-1991. During this period stock index futures and/or stock index options have been introduced in eight European markets : Denmark, Finland, France, Germany, Ireland, Netherlands, Sweden and Switzerland.[1] Relationships between price changes and market activity, both in the stock and derivative markets are investigated. Cross-sectional studies between markets are performed. The results of the study have potential policy implications for emerging markets and their regulators.

The paper is organized as follows. The first section discusses the economic issues of the introduction of index futures and options. Section two describes the data and section three presents the methodology and results. Finally, the fourth section discusses the conclusions.

I. ECONOMIC ISSUES

"The benefits of derivatives, however, extends far beyond the market participants. Derivatives help financial markets become more efficient and

[1] Detailed discussions of new equity markets during 1985-1991 are presented in Barclay and Noll (1992)

provide better opportunities for managing risk. These benefits spill over into society as a whole".[2] Futures and options contracts can be used to shift risks such as market or price risks, interest rate risks, and exchange rate risks from firms and individuals less willing to bear them (hedgers) to those who are more willing to take such positions (speculators). Futures and options positions can be created such that the price at which an underlying asset can be bought or sold in the future is fixed. Institutional investors and commercial traders use index futures and options to manage risks associated with large positions in the cash markets. Mutual funds, pension plans and endowments and other investment funds hedge against adverse movement in the equity market by buying or selling index futures and options. Thus, index futures and options provide a means to manage market risks in an efficient and economic way. The transactions are generally quick and relatively inexpensive.[3]

Silber (1985) noted that when stock index futures were first introduced, most participants viewed them as satellites of the stock market. They were perceived as providing clues about the direction of price movements for stocks from large firms. A liquidity in the stock index futures market grew, hedgers participated in the futures market can offset risk quickly and efficiently such that these products become a more sensitive pricing indicator. It has been argued by Silber (1985) that futures markets contribute to the price discovery process because the cost of transaction in these markets is low and information materializes fastest in markets that are cost-efficient. Stein (1985) explains how dealers use index futures to diversify market risks resulting from changes in the market index. This diversification leads to a reduction in the risk premium dealers charged for commissions and spreads. Stein (1985) also suggested that index futures and options can reduce the cost of capital to firms and contribute to a higher rate of capital formation.

In 1985, the Board of Governors of the Federal Reserve System, the Commodity Futures Trading Commission and the Securities and Exchange Commission, with the assistance from the Secretary of the Treasury, examined the effects on the economy of trading in futures and options. Among other findings, the study concluded that financial futures and options markets serve a useful economic purpose, primarily by providing a means to transfer risks inherent in economic activities. These financial futures and options markets appear to have no measurable negative implications for capital formation. They,

[2] Chance, Don M., *An Introduction To Derivatives*. New York: The Dryden Press, Third Edition, (1995), p. 14.

[3] See Stoll and Whaley (1988), Dubofsky (1992), and Chance (1995).

however, seem to enhance liquidity in some of the underlying markets. Despite differences between futures and options, they have similar economic functions. Markets for both are interrelated with the underlying markets and participants have similar characteristics. The study also noted that futures and options markets have similar potential for causing harm if they function improperly. The study recommended close harmonization of federal regulation of these markets.

Stoll and Whaley (1988) discuss the economic purpose, arbitrage activity between index futures and options markets and the stock markets, and market structure of stock index futures and options. Their study concluded that index futures and options are useful portfolio-management and hedging tools. Using these markets, inventories and cash flows can be hedged and analysts can concentrate on stock selection while avoiding market risks. Separation of market timing and stock selection functions and dynamic hedging are some of the benefits of having index futures and options. Even though index arbitrage is limited by transaction costs, regulatory restrictions and other factors, it stabilizes prices by linking the prices of derivative products and the underlying cash index.

The economic values of index futures and options are undeniable. However, they are often criticized in the press after a case of severe loss from derivatives. Options and futures were blamed as catalysts for the Black Monday of 1987. Much of the criticism stems from the lack of sufficient understanding and the purpose they serve. It would be interesting to investigate their actual impact on various underlying cash markets in different countries. Implications of the study should be benificial to practitoners as well as regulators.

II. DATA

For each of the new equity derivative markets identified earlier, a broad general return index is used as a proxy for market return. Data consist of daily index return and daily turnover value[4] for approximately one year before and one year after the index futures and/or index options introductory dates. The study is conducted on four equity derivative markets and four index futures contracts as presented in Table 1. The motivation for selecting these markets stem from the fact that index options and/or futures commenced trading after 1985 and all in European markets. (Appendix I lists equity index derivative markets established during 1985-1991. Data were not available for all countries.)

[4] Turnover by volume is used for Ireland.

Data are from the Datastream Financial Futures Service of Datastream International, New York.

Table 1 : Market and Index Futures Descriptions

Country	Return Index	Index Futures Contract
France	CAC	CAC40
Germany	FAZ	DAX
Ireland	Irish Equity	ISEQ
Netherlands	CBS	Dutch Stock Index

The above markets and index futures were chosen due to the availability of data at Datastream International. Descriptions of index futures contracts in the study are as follows:[5]

CAC 40 Stock Index Futures Contract

This contract is based on the CAC 40 Stock Index, calculated from a sample of 40 main stocks listed on the MATIF, with a basis value of 1,000 on December 31, 1987. The stocks represent 60-65 percent of the market capitalization and approximately 70 percent of the traded volume. Volume traded is generally steady with peaks occuring at the end of the month. As there are contracts for every three consecutive months, turnover volatility widens around the expiry dates.

DAX Index Futures Contract

Launched in the early nineties, this index futures contract is based on the German Stock Index - DAX, calculated from the stocks listed on the DTB. Contracts are March, June, September and December cycle.

ISEQ Stock Index Futures Contract

The contract is based on the Irish Stock Index, dominated by Ireland's two quoted domestic banks, accounting for 25 percent of the Index. Another 25 percent, however, is also contributed by two stocks, CRH, a building materials group and SMURFIT, a U.S. paper and packaging group.

Dutch Stock Index Futures Contract

The contract is based on the EOE Stock Index calculated from prices

[5] For detailed discussions see *The European Options and Futures Markets (1991)* and Appendix II for detailed contract specifications.

quoted on the Amsterdam Stock Exchange for 25 leading Dutch stocks (shares or certificates of shares)

III. METHODOLOGY AND RESULTS

To determine whether the introduction of index futures and options lead systematic changes in price and volatility of the market, simple descriptive statistics are calulated for 250 days before and 250 days after the introduction date. To pick out any changes which are more closely associated with the introduction date, we also examine average standard return and volume measures around the contract introduction. Initially, a generalized Autoregressive Conditional Heteroskedasticity (GARCH) model is used to parsimoniously and effectively model time variation and to test whether in return characteristics are affected by futures and options introduction. The GARCH model includes a dummy *(FUTDUM)* which is equal to 1 in periods when index futures and options contracts are available.

$$r_t = \alpha + \beta_1 h_t + \beta_2 r_{t-1} + \beta_3 FUTDUM + \beta_4 \varepsilon_{t-1} + \varepsilon_\tau \quad (1)$$

$$h_t = c + \gamma_1 h_{t-1} + \gamma_2 \varepsilon^2_{t-1} + \gamma_3 VOLUME \quad (2)$$

where r_t is the market return, h_t is the conditional variance, and α, β, ε, c and r are parameters to be estimated via the maximum likelihood method and

$$XSRET_{it} = \frac{R_{it} - \mu_t}{\sigma_1} \quad (3)$$

where *XSRET* is the excess returns, R, μ and σ are estimates of returns, means and standard deviations, respectively.

Table 2 presents some general data description for the four markets in the preliminary analysis, for the year before and after index futures introduction. There is no consistent pattern in changes in return or changes in volume across the introduction data. For France and the Netherlands, volume increases after index futures introduction. The mean return appears to increase slightly and standard deviation declines after the introduction.

Table 2 : Data Descriptions

	Before Introduction		After Introduction	
	μ	σ	μ	σ
FRANCE				
N	254		236	
Return	0.1256	1.3505	0.0969	0.9068
Volume	385,319.3	3,713,410.7	684,165.6	3,487,968.5
GERMANY				
N	247		247	
Return	0.0174	1.4375	0.0127	1.2172
Volume	210.736	1,271.0	120.294	1,173.8
IRELAND				
N	236		241	
Return	-0.1246	1.0624	0.0651	0.8529
Volume	0.9614	8.1419	0.6833	9.0868
NETHERLANDS				
N	249		253	
Return	0.0422	1.6145	0.1094	0.6733
Volume	17,867.4	181,779.8	21,797.0	224,376.4

The results from the GARCH model is presented in Table 3. While volume seems to have some relationship with volatility for Germany and Ireland, these two countries do not experience a systematic increase in volume after the introduction. Overall, the estimated parameters suggest that there are no significant listing effects of futures introduction.

Analysis from a tighter window around the contract introduction date is also conducted. For each country, returns from day -30 to +30 are standardized by the mean and standard deviation of returns outside this window (formula 3). These standardized returns are then averaged across the four countries to present a composite of returns and volume behavior immediately around the introduction date. These returns are also cumulated to investigate the effects. The excess returns and cumulative excess returns do not suggest any significant pattern. Thus, introduction of index futures seemed to have no significant effect in the four markets.

Table 3 : GARCH Model Estimates

	France	Germany	Ireland	Netherlands
α	0.001995	-0.00085	-0.00079	0.00150
	(0.69)	(-0.35)	(-1.30)	(2.36)
β_1	-4.8719	12.963	6.2448	-3.6816
	(-0.45)	(1.01)	(1.13)	(-0.81)
β_2	0.01284	-0.21955	0.5335	0.0400
	(0.01)	(-0.46)	(2.61)	(0.87)
β_3	-0.00014	-0.00085	0.00036	-0.00031
	(-0.14)	(-0.51)	(0.65)	(-0.47)
β_4	0.02106	0.31060	-0.3408	-0.0692
	(0.02)	(0.66)	(-1.53)	(-1.12)
c	0.0000015	0.0000	0.0000	0.000004
	(0.38)	(0.0000)	(0.000)	(1.32)
r_1	0.8714	0.4621	0.7865	0.7944
	(36.21)	(4.75)	(13.32)	(22.45)
r_2	0.10585	0.2406	0.1586	0.1624
	(5.41)	(2.65)	(3.09)	(5.04)
r_3	0.00118	0.00011	0.00006	0.0000
	(0.40)	(2.68)	(2.46)	(0.00)
skewness	-0.3766	-1.3961	-0.4289	-0.4644
kurtosis	4.76	15.94	6.12	4.07
LB(12), ε_t	9.26	8.25	11.64	13.23
LB(12), ε^2_t	20.45	0.68	12.51	21.62

(T - STAT.)

IV. CONCLUSION

This paper examines the effect of index futures on the distribution index returns. The analysis of index futures introduction in four European markets indicated the mean market return increases slightly and the volatility declines after the introduction date. There is no clear pattern across countries with regard to volume changes. With only four countries and four index futures contracts used in the analysis, the results are not good indication. However, economic benefits cited by previous studies are evident. Policy makers doubting the impact of such innovative instruments have to weigh out the criticisms and the potential value that futures and options may have for the economy. Based on the literature review, there is no clear evidence that introduction of index futures and options causes undue price volatility. The results from the study, at the very least, do not support the criticisms of index futures and options. Further analysis should include index options and index futures contract introduction to more markets as data become available.

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APPENDIX I

EQUITY INDEX DERIVATIVE MARKETS ESTABLISHED 1985 - 1991

COUNTRY	FIRST FULL TRADING YEAR
Brazil	1986
Denmark	1990
Finland	1988
France	1988
Germany	1991
Hong Kong	1987
Ireland	1990
Japan	1989
Netherlands	1988
New Zealand	1987
Sweden	1988
Switzerland	1990

APPENDIX II

DETAILED CONTRACT SPECIFICATION

CAC40 Index Futures Contract

Contract Size:	TRF 200 times the futures quoted index.
Delivery Months:	3 consecutive months and one of the quarterly cycle March June September December.
Delivery Day:	16.00 p.m. last trading day.
Last Trading Day:	Last business day of the month
Quotaion:	Index points to one decimal place i.e. 2123.4
Minimum Price Movement (Tick Size and Value):	0.1 of an Index point = FRF 20.
Trading Hours:	10.00 a.m. - 17.00 p.m.
Initial Margin:	Standard contract = FRF 30,000 per contract and for a Straddle FRF 12,000.
Price Limit:	120 Index points from the previous clearing price.
Contract Standard:	Cash settlement.
Exchange Delivery Settlement Price:	The first CAC40 index quotation after 16.00 p.m. on the last trading day.
Reuters Pages:	CACF CSIE CACE.
Telerate Pages:	3215 - 3216
Exchange Fees:	FRF 8 per conract

(DAX) Index Futures Contract

Contract Size:	DM 100 per index point.
Expiry Months:	3 6 and 9 months from the March June September and December cycle.
Expiry Day:	Third Saturday of the expiry month.
Last Trading Day:	12.30 p.m. Frankfurt time on the last business day before the third Saturday of the expiry month.
Quotation:	DM to one decimal place.
Minimum Price Movement	DM 0.5 per index point = DM 50.
(Tick Size and Value):	
Trading Hours:	Not determined as yet but will depend on the time frame for the calculation of the DAX.
Initial Margin:	Risk based margins charged by the DTB for long and short positions are calculated with reference to the projected underlying prices based on daily calculated risk factors. These position values are summed to arrive at a projected liquidation value for the margin class. Reduced margin will be applied for spread positions.
Price Limit:	No price limit. However the DTB has the right to set limits for the maximum price fluctuations if this should appear necessary due to extreme market conditions.
Position Limits:	These will be implemented.
Contract Standard:	Cash settlement the business day following the last trade day.
Exchange Delivery Settlement Price:	The Daily settlement price is the average of the trades in the ten minutes of trading.
	The EDSP is determined using the same method as the daily settlement price except that it is based on 12.30 p.m. Frankfurt time on the last trading day.
Reuters Pages:	N.A.
Telerate Pages:	N.A.

ISEQ Stock Index Futures Contract

Unit of Trading:	Valued at IR£10 per full index point (e.g. value IR£15,000 at 1,500.00).
Settlement Months:	March June September December.
Settlement Day:	Third Thursday of Settlement Month.
Last Trading Day:	16.15 p.m. one business day prior to Settlement Day.
Quotation:	ISEQ index divided by 10.
Minimum Price Movement (Tick size and value):	IR£0.01 & IR£1.00.
Trading Hours:	8.30 a.m. - 16.15 p.m.
Initial Margin:	IR£1,300.
Price Limits:	A 50 point movement in the Index.
Settlement Price:	The ISEQ Index is calculated by the Stock Exchange 4 times a day based on the last dealt prices at 11.00 a.m. 13.00 p.m. 15.30 p.m. and 17.30 p.m. The Exchange Delivery Settlement Price is calculated using a simple average of these quotations on the last trading day (excluding the 17.30 p.m. quotation) and the previous business day.

Dutch Stock Index Futures Contract

Contract Size:	200 x the EOE Dutch Stock Index.
Expiry Months:	The first 3 consecutive months and also every 3 months a 6-month future will be introduced.
Expiry Day:	Three days after last trading day.
Last Trading Day:	The third Friday of the settlement month
Quotation:	Dfl.per Index Point
Minimum Price Movement (Tick Size and Value):	Dfl.0.05 = Dfl. 10.
Trading Hours:	10:15 a.m. to 16:30 p.m. Amsterdam time.
Initial Margin:	Dfl. 400 per contract.
Price Limit:	If the price of a contract changes more than 10 points relative to the closing quote on the previous business day, trading in all contracts except for contracts due to be settled in the current month shall cease for 30 minutes. When trading has resumed there shall be no further break in that day.
Contract Standard:	Cash settlement.
Exchange Delivery Settlement Price:	Equal to the settlement price of options on the EOE Dutch Stock Index
Reuters Pages:	FTAA
Talekurs Pages:	AF2