A Study on the Effects of Program Trading on KOSPI and KOSPI200 Futures Market in Korea

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Abstract

Vector Autoregressive models' estimation, Granger Causality Test, Impulse Response Function, and Forecast Error Variance Decomposition have been conducted to test the dynamic relation among program trading, KOSPI and KOSPI200 futures price. There were three results and implications. Firstly, program trading has increased relationship with the daily rate of return on KOSPI as well as Kospi200 futures market since 2001. Secondly, the daily rate of return on KOSPI as well as Kospi200 futures market affected program trading. Thirdly, the program trading was influenced by the daily rate of return on Kospi200 futures market much more than that on KOSPI market. The hypothesis that program trading increased the volatility of KOSPI market was not supported by these results. However Futures market has affected program trading significantly.

Key words: Rate of Return on KOSPI market, Vector Autoregressive models, Granger Causality Test, Impulse Response Function, Forecast Error Variance Decomposition

I. Introduction

The volume of program trade amount reached about 35.3% of trading volume by August 2006 in Korea.

Now program trading has emerged as an indicator of stock market trend and change. Generally speaking program trading can affect stock market in two ways. First, program trading can reduce temporary unbalance between spot market and future market, thus make the market more efficiently. Second, program trading may cause market turbulence and unbalance of liquidity, increase market volatility.

Overall there is close relationship between program trading and market movement and interaction between them exists as well. In this study, what effects program trading makes to stock market in Korea investigated. Especially we analyzed whether there is significant relation between program trading and daily return, daily volatility.

II. Extant Research and Trends of Program Trading

1. Extant Research

2. Trends of Program Trading

<Table1> Trend of the Volume of Program Trading (Billion Won, %)

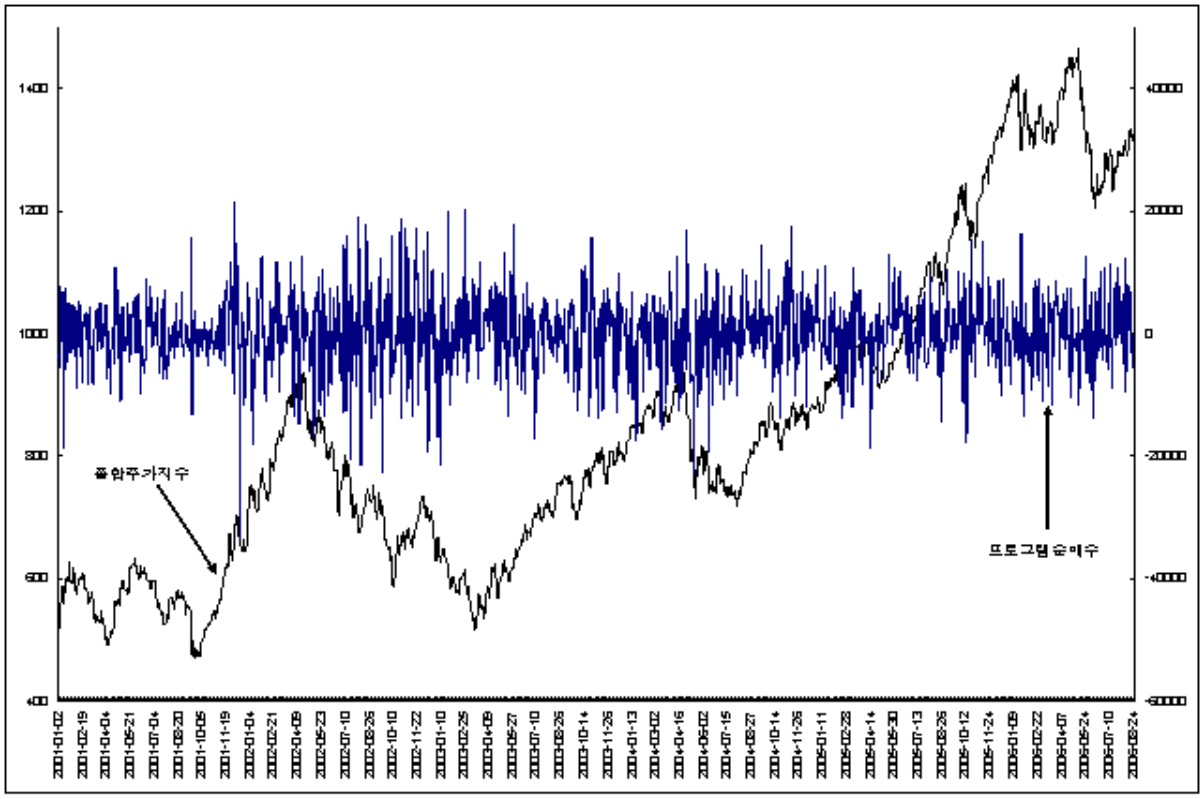
	Program trading		Stock trading Amount(C)	ratio [A+B/(C×2)]
	Arbitrage (A)	Non-Arbitrage(B)		
1997	931	252	162,281	0.4
1998	4,362	1,093	192,845	1.4
1999	20,270	17,993	866,923	2.2
2000	24,282	22,316	627,133	3.7
2001	19,154	26,818	491,365	4.7
2002	36,663	42,358	742,150	5.3
2003	49,183	33,907	547,509	7.6
2004	51,202	44,652	555,795	8.6
2005	44,982	67,274	786,258	7.1
2006.1-8	44,918	53,129	614,610	7.9

Note) KRX Review.

<Table2> Monthly Volume of Program Trading in FY 2006 (, %)

2006	Program trade		Arbitrage		Amount of Stock Trading		Ratio of Program Trading
	sell	buy	sell	Buy	Total	Daily Average	
August	5,053,131	7,108,818	2,179,301	3,598,454	58,971,802	2,680,536	10.31
July	4,433,707	5,105,730	2,378,618	2,390,557	51,207,519	2,560,375	9.31
June	5,884,892	6,388,434	2,397,676	2,575,861	63,814,999	3,038,809	9.62
May	7,446,69 6	6,526,839	3,867,299	2,094,186	76,289,548	3,814,477	9.16
April	5,353,363	6,253,959	2,018,807	2,728,452	82,237,201	4,111,860	7.06
March	5,904,226	6,484,075	2,936,307	3,398,888	74,732,141	3,396,915	8.29
February	6,296,996	6,068,522	3,076,100	3,202,155	86,292,861	4,314,643	7.16
January	7,282,111	6,456,231	3,617,781	2,458,023	121,064,472	5,764,974	5.67

Note) KRX Review Monthly.



<Figure 1> Trends of Composite Stock Exchange Index and Program Trading Net buy

<Table 3> Results of Time Series Stability Test

(Unit root Test Results)

	ADF test result	1%	5%
Program Net Sell(PM)	-37.18083**	-3.4348	-2.8634
Arbitrage Net Sell(ARB)	-38.14967**	-3.4348	-2.8634
Daily Range of Fluctuation(INTRA)	-6.48336**	-3.4348	-2.8634
Daily Rate of Return of Stock(LNKOSPI)	-36.55278**	-3.4348	-2.8634
Daily Rate of Return of KOSPI200Futures (LNFUT)	-13.79176**	-3.4712	-2.8793

Note) n=1,397 (for Futures of KOSPI200 n=162 in FY 2006), ** significant at 1% level.

Daily Rate of Return = (today's closing price - yesterday's closing price)/yesterday's closing price,

Daily Range of Fluctuation = Daily Highest Price – Daily Lowest Price.

III. Research Methodology

IV. Results of Analysis

<Table 4> Correlation between each Time series (2001.1.4~ 2006.8.25)

	Program trading net buy	Arbitrage	LNKOSPI	LNFUT
Program trading net buy	1.00000	**0.93179****	-0.01423	**0.35250****
Arbitrage net buy	**0.93179****	1.00000	-0.01864	**0.32399****
Daily Rate of Return of Stock(LNKOSPI)	-0.01423	-0.01864	1.00000	-0.16851
Daily Rate of Return of KOSPI200Futures (LNFUT)	**0.35250****	**0.32399****	-0.16851	1.00000

?) n=1,397, ** : significant at 1% level.

<Table 5> Causal Relation between Program Trading and Daily Rate of Return and Daily Rate of Fluctuation (2001~ 2005)

Year	**Hypotheses(Ho)**	**F value**	**P value**
2001	Daily Rate of Return of Stock does not effect Arbitrage Net Buy	3.18944	0.07537
	Arbitrage Net Buy does not effect Daily Rate of Return of Stock	0.35526	0.55171
	Daily Rate of Return of Stock does not effect Program Trading Net buy	4.56021	0.03373*
	Program Trading Net buy Does not effect Daily Rate of Return of Stock	0.00227	0.96203
	Daily Range of Fluctuation does not effect Arbitrage Net Buy	0.12847	0.72034
	Arbitrage Net Buy does not effect Daily Range of Fluctuation	2.59779	0.10832
	Daily Range of Fluctuation does not effect Program Trading Net Buy	0.00132	0.97104
	Program Trading does not effect Daily Range of Fluctuation	1.28790	0.25756

2002 ?	**Daily Rate of Return of Stock does not effect Program Trading Net buy**	**7.01467**	**0.00862****
	Arbitrage Net Buy does not effect Daily Rate of Return of Stock	3.21550	0.07420
	Daily Rate of Return of Stock does not effect Program Trading Net buy	**8.03421**	**0.00498****
	Program Trading Net buy Does not effect Daily Rate of Return of Stock	2.15748	0.14319
	Program Trading Net buy Does not effect Daily Rate of Return of Stock	0.34728	0.55621
	Arbitrage Net Buy does not effect Daily Range of Fluctuation	1.07669	0.30048
	Daily Range of Fluctuation does not effect Program Trading Net Buy	0.12345	0.72563
	Program Trading does not effect Daily Range of Fluctuation	1.81188	0.17955
2003 ?	Daily Rate of Return of Stock does not effect Arbitrage Net Buy	3.02545	0.08324
	Arbitrage Net Buy does not effect Daily Rate of Return of Stock	2.33095	0.12813
	Daily Rate of Return of Stock does not effect Program Trading Net buy	3.82433	0.05166
	Program Trading Net buy Does not effect Daily Rate of Return of Stock	3.49452	0.06278
	Daily Range of Fluctuation does not effect Arbitrage Net Buy	2.03630	0.15487
	? Arbitrage Net Buy does not effect Daily Range of Fluctuation	4.48457	0.03522*
	Arbitrage Net Buy does not effect Daily Range of Fluctuation	3.61494	0.05845
	Program Trading does not effect Daily Range of Fluctuation	3.81818	0.05185
2004 ?	**Daily Rate of Return of Stock does not effect Arbitrage Net Buy**	**7.51017**	**0.00659****
	Arbitrage Net Buy does not effect Daily Rate of Return of Stock	0.00080	0.97750
	Daily Rate of Return of Stock does not effect Program Trading Net buy	**12.9410**	**0.00039****
	Program Trading Net buy Does not effect Daily Rate of Return of Stock	0.17195	0.67875
	Daily Range of Fluctuation does not effect Arbitrage Net Buy	1.39332	0.23899
	Arbitrage Net Buy does not effect Daily Range of Fluctuation	6.38033	0.01217*
	Arbitrage Net Buy does not effect Daily Range of Fluctuation	1.93338	0.16566
	Program Trading does not effect Daily Range of Fluctuation	4.72244	0.03073*
2005 ?	**Daily Rate of Return of Stock does not effect Arbitrage Net Buy**	**7.70016**	**0.00595****

	Arbitrage Net Buy does not effect Daily Rate of Return of Stock	0.22586	0.63504
	Daily Rate of Return of Stock does not effect Program Trading Net buy	**16.8899**	**0.00005****
	Program Trading Net buy Does not effect Daily Rate of Return of Stock	0.30481	0.58139
	? Daily Range of Fluctuation does not effect Arbitrage Net Buy	0.26697	0.60584
	Arbitrage Net Buy does not effect Daily Range of Fluctuation	4.64875	0.03205*
	Arbitrage Net Buy does not effect Daily Range of Fluctuation	0.15966	0.68982
	Program Trading does not effect Daily Range of Fluctuation	4.38097	0.03748*

?) n= 246(2001), 244(2002), 246(2003), 248(2004), 248(2005).

At levels of 5%, 1% reject hypotheses, causal relation between variables exists then expressed by *, **.

<Table 6> Results of VAR(2) Model Estimation

	LNFUT			LNKOSPI			PRO			ARB		
	ß	SE	t-	ß	SE	t-	ß	SE	t-	ß	SE	t-
LNFUT(-1)	-0.6235	0.4455	-1.3995	-0.1599	0.3968	-0.4030	56652	16044	0.3531	83468	14063	0.5935
LNFUT(-2)	0.1872	0.4132	0.4397	0.2644	0.3680	0.7185	**19116°**	**14883**	**1.2845**	**19119°**	**13045**	**1.4655**
LNKOSPI(-1)	0.6173	1.4890	1.2626	0.1933	0.4356	0.4438	-13328	17613	-0.7567	-16776	15439	-1.0866
LNKOSPI(-2)	-0.2979	0.4410	-0.6755	-0.3295	0.3928	-0.8390	-14340	15882	-0.9029	-12000	13922	-0.8619
PRO(-1)	0.0000	0.000	0.7318	0.0000	0.0000	0.9351	0.0720	0.3285	0.2193	0.3550	0.2879	-1.2328
PRO(-2)	0.0000	0.000	0.4477	0.0000	0.000	0.3290	0.2690	0.3170	0.8485	0.2033	0.2779	0.7318
ARB(-1)	0.0000	0.000	0.8060	0.0000	0.000	1.0389	0.0026	0.3657	0.0073	0.3940	0.3206	1.2291
ARB(-2)	0.0000	0.000	-0.6062	0.0000	0.000	-0.5210	-0.4675	0.3558	-1.3137	-0.4140	0.3119	-1.3272
c	0.0000	0.0012	-0.0045	-0.0001	0.0010	-0.1344	140.36	435.06	0.3226	7.6343	381.35	0.0200

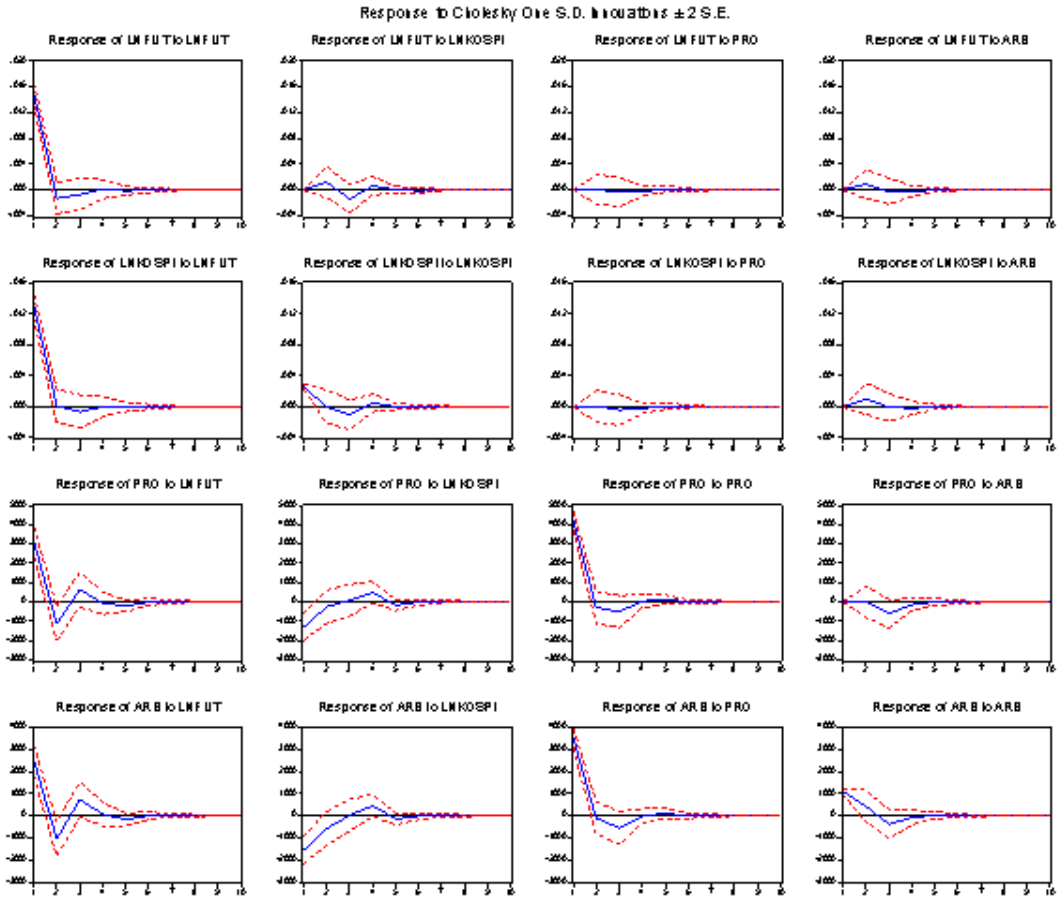
Note) n= 162, 10% level significant °.

<Table 7> Results of Granger Causality Test

Hypothesis (H_0)	F-	P	Reject H_0
Daily Rate of Return of Stock does not effect Daily Futures' Rate of Return	0.9567	0.3295	No
Daily Futures' Rate of Return does not effect Daily Rate of Return of Stock	0.0181	0.8930	Yes
Program Trading Net Buy does not effect Daily Futures' Rate of Return	0.0017	0.9667	No
Daily Futures' Rate of Return does not effect Program Trading Net Buy	**4.6330**	**0.0328**	**Yes***
Arbitrage Net Buy does not effect Daily Futures' Rate of Return	0.0309	0.8606	No
Daily Futures' Rate of Return does not effect Arbitrage Net Buy	**8.0229**	**0.0052**	**Yes****
Program Trading NetBuy does not effect Daily Stock' Rate of Return	0.0869	0.7685	No
Daily Stock' Rate of Return **does not effect Program Trading Net Buy**	**4.8125**	**0.0297**	**Yes***
Arbitrage Net Buy does not effect Daily Stock's Rate of Return	0.3050	0.5815	No
Daily Stock's Rate of Return **does not effect Arbitrage Net Buy**	**8.5974**	**0.0038**	**Yes****

Note) n= 162, lag is 1day, 1%(**), 5%(*) .

<Figure 2> Results of Var(2) Model Impulse Response Function



<Table 8> Results of Impulse Response Function

Response of LNFUT					Response of LNKOSPI			
Day	LNFUT	LNKOSPI	PRO	ARB	LNFUT	LNKOSPI	PRO	ARB
1	0.0149	0.0000	0.0000	0.0000	0.0130	0.0026	0.0000	0.0000
2	-0.0012	0.0012	0.0000	0.0009	0.0001	0.0000	0.0001	0.0010
3	-0.0006	-0.0014	-0.0003	-0.0002	-0.0006	-0.0010	0.0003	0.0000
4	0.0001	0.0006	-0.0002	-0.0002	0.0000	0.0004	-0.0002	-0.0001
5	-0.0001	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000
Response of PRO					Response of ARB			
?	LNFUT	LNKOSPI	PRO	ARB	LNFUT	LNKOSPI	PRO	ARB
1	3101.4**	-1298.5**	4212.9**	0.0000	2514.9**	-1553.6**	3515.7**	1106.4**
2	-1111.1**	-258.85**	-294.07**	2.9812**	-1053.8**	-589.50**	-110.33**	436.01**
3	631.37**	83.662**	-499.45**	-603.63**	731.68**	20.769**	-549.67**	-386.21**
4	-70.508**	483.93**	39.584**	-143.80**	59.571**	452.44**	-13.227**	-81.323**
5	-205.13**	-169.95**	130.14**	2.8216**	-175.07**	-157.57**	108.70**	30.358**

Note) 1% level of significant : **.

<Table 9> Results of Forecast Error Variance Decomposition(%)

	LNFUT	LNKOSPI	PRO	ARB
Decomposition of LNFUT	97.843	1.6785	0.0819	0.3959
Decomposition of LNKOSPI	94.756	4.5006	0.1249	0.6173
Decomposition of PRO	35.518	6.3643	56.905	1.2116
Decomposition of ARB	31.696	11.850	50.232	6.2207

<Table 10> Yearly Trend of Volatility of Korean Stock Market (%)

	2001	2002	2003	2004	2005	2006
Volatility of Stock Market	2.15	2.03	1.63	1.48	1.05	1.27

Note) Volatility of Stock Market indicates standard deviation of daily rate of return.

V. Conclusion

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