The European stock market impulse to the US financial crisis:

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Abstract

This study examines how the European stock market reacts to the U.S. financial crisis and the Fed's policy, changing FFR. Johansen and Juselius cointegration analysis suggests that markets are integrated and there exists a long term relationship between these markets. The Granger causality test indicates that causality runs from US to European stock market. Implementing a Vector Error Correction Model (VECM), accounting for monetary and exchange rate policies, we measure the long-run elasticity of the European Stock Market not only to the Fed's policy, but to the US market indices and the parity of the Euro-dollar exchange rate. The impulse response function and variance decomposition technique suggest that the US stock market indices play prominent role in explaining the European stock market volatility, compared with EU monetary and real variables, highlighting contagion among financial markets. Using both DJ and NASDAQ, our results suggest that the European Stock Market is more sensitive to NASDAQ.

Keywords: Monetary transmission mechanism, stock market, financial turmoil, contagion, Federal Fund Rate (FFR), Vector Error Correction Model (VECM), global financial stability.

Introduction

As globalization spreads throughout the world, the financial markets become extremely integrated. In globally integrated financial markets, investors and policy makers become more concerned about monitoring and controlling contagion from other markets to avoid the undesirable destabilizing effects. Though the co-movements of the world's national stock market indices have already received particular attention in the finance literature, rarely these co-movements have been investigated in response to different shocks to fundamentals.

As the European Stock Market has adversely been affected by the global financial crisis, particularly by the US financial market turmoil, this paper tries to measure the long-run elasticity of the European stock market to the U.S. stock market shocks, to changes in FFR, and to the behaviour of Euro-dollar exchange rate, compared with EU monetary policy and real variables, through implementing a Vector Error Correction Model (VECM).

This paper is organized as follows. Section II provides a brief overview of literature on interlinks and interactions of equity markets. Section III describes data and methodology adopted in this study. Section IV discusses the empirical results. And finally Section V raps up and concludes.

2-Literature Review

Studying the co-movements of national stock markets has long been a popular research topic in finance (Makridakis & Wheelwright, 1974; Joy et al., 1976; Hilliard, 1979; Maldonaldo & Saunders, 1981; Phillipatos et al., 1983). Early studies by Ripley (1973), Lessard (1976), and Hilliard (1979) generally find low correlations among stock markets, which validate the benefits of diversifications in international portfolio management. However, after the U.S. stock market crash in October 1987, the trend was reversed. Lee and Kim (1994), among others, find that national stock markets became more interrelated after the crash. Applying a VAR and impulse response function analysis, Jeon and Von-Furstenberg (1990) show a stronger co-movement among international stock markets after the 1987 crash. Taylor and Tonks (1989) found long-run relationship between UK, Germany, Netherlands and Japan stock markets.

Kasa (1992) underpins the relationship between US, Japan, UK, Canada, and Germany based on monthly data. He applies Johansen estimation technique and concludes that there are four cointegration vectors indicating a common stochastic trend among the markets.

Roca (1999) investigates interlinks among U.S., U.K., Japan, Korea, Singapore, Taiwan, Australia, and Hong Kong by employing Joahansen cointegration technique. He uses weekly equity prices to determine the long-run relationship among equity markets. His results suggest that Australian market is significantly influenced by the U.S., and U.K. markets.

Aggarwal (2003) examines the integration of the three participating NAFTA countries based on daily, weekly, and monthly data for seven years before and after the passage of NAFTA. Their results indicate that the equity prices in three NAFTA countries are cointegrated only for the post-NAFTA period. And US stock prices are more integrated with both Canadian and Mexican stock prices.

Hashimoto and Ito (2004) analyze the co-movement of the exchange rates and the stock prices among eight South East Asian countries during the period of currency crisis, 1997–1999. Their results suggest contagion between the exchange rate and stock price of the same country or different countries during the crisis period; stock prices are found to be under the influence of exchange rates and stock prices of other countries.

Lamba (2005) implements a large sample to investigate the presence of long-run relationship between South Asian equity markets and the developed equity markets for the period of July 1997 to Dec 2003. His results indicate that Indian market is influenced by developed equity markets of US, UK, and Japan.

Suchismita (2005) examines the dynamic interaction among Asian equity market and the US stock market. His results indicate that the Indian equity market is integrated with the US stock market.

Glezakos, Merika, and Kaligosfiris (2007) examine the short and long-run relationship between Greek Stock Exchange and major world financial markets by using cointegration analysis and Granger-Causality test. Their results reveal the dominance of the US financial market and the strong influence of DAX and FTSE on the Greek market.

Several purported monetary policy transmission mechanisms have been emphasized in the literature to link changes in the monetary policies to the stock market, through affecting interest rate and industrial production. One monetary policy transmission mechanism suggests that a decrease in interest rate boosts stock prices and financial wealth, which in turn raises consumption through wealth effect (Modigliani 1971). Another transmission mechanism suggests that lower interest rate increases stock prices and therefore decreases the likelihood of financial distress (Mishkin 1977). Indeed, the transmission mechanism through interest rate has been extremely emphasized in the literature.

As it was sketched here, the influence of the US economy and its stock market on global markets is pervasive and well documented in the literature. The dominant role of the U.S. economy in the international monetary system has also strengthened the pivotal role of the US stock market indices on the global markets. To assess this role we use a VECM—including monetary, real and exchange rate variables—to see how the European Stock market reacts to the Fed's policy, to US stock market downturn, and to the parity of the Euro-dollar exchange rate, compared with domestic monetary and real variables in the EU. We also use Johansen Juselius test to see whether two markets are integrated and the test for the Granger causality among the two stock markets.

3-Data and Methodology

We use monthly data from January 1999 through April 2009. The data on the U.S. monetary and macroeconomic variables come from Federal Reserve Bank of St Louis. And the data for the European monetary and real variables come from the European Central Bank (ECB). The list of variables used in this study is as follows:

1. USM2: US Money Supply
2. FFR: Federal Fund Rate
3. USIP: US Industrial Production
4. NASDAQ: NASDAQ Industrial Index
5. DJ: US Dow Jones
6. EUM2: European Money Supply
7. EUIP: European Industrial Production
8. EUCPI: EU Consumer Price Index
9. EUDJ: European Dow Jones

10. EXCH: Euro-dollar parity

The descriptive statistics are presented in Table 1. Before we apply to the Johansen and Jusellius (1990) method to test the long-run relationship and to test Granger causality test, we must check whether series are stationary or not. The Augmented Dickey Fuller (ADF) unit root tests presented in Table 2 suggest that we can reject the null hypothesis of containing unit root in each variable. In other words, all the variables are stationary in their levels. Table 3 also suggests series are stationary in logarithm forms.

Now that the data are stationary, we can investigate (i) the long-term relationship between the variables through cointegration technique, (ii) the causality among the two stock markets (iii) long-run elasticity of EU stock market in response to changes FFR, DJ, NASDAQ, and the Euro-dollar exchange rate behavior, and finally (iv) we use variance decomposition technique to account for shares of different variables in explaining the European stock market performance.

3.1. Cointegration Test

Tables 4 and 5 present the Johansen cointegration result among logarithms of EUDJ and DJ with linear and quadratic deterministic trend respectively, assuming LFFR as an exogenous variable. We implement the Trace statistics as applied by Johansen and Juselius (1990) to test the cointegration among the variables. As it is indicated, the null hypothesis of no cointegration, r=0 is rejected at 5 percent level. However, the trace statistics supports the existence of two cointegration equations when a quadratic deterministic trend is included in the model.

We also test for the cointegration among EUDJ and NASDAQ with linear and quadratic deterministic trend, respectively presented in Tables 6 and 7, assuming FFR as an exogenous variable. In both cases the results support the existence of two cointegration equations among stock markets.

3.2. Granger-Causality Test

According to representation theorem, if two variables are cointegrated then the Granger-causality must exist in at least one direction. Results of Granger causality tests reported in Tables 8 and 9 indicate that there exists unidirectional Granger causality from the US to European stock market using both DJ and NASDAQ.

3.3. Vector Error Correction Model (VECM)

Finally we conduct a Vector Error Correction Model to examine the long-run response of European stock market to variables such as DJ, NASDAQ, FFR, and the Euro-dollar exchange rate, compared with European monetary and real variables. The ordering of the variables used in our VECM model is as follows:

$$\begin{bmatrix} USM2 \\ FFR \\ USIP \\ NASDAQ \\ EXCH \\ EUM2 \\ EUCPI \\ EUIP \\ EUDJ \end{bmatrix}$$

4-Empirical Results and Interpretations

Using a VECM for the period January 1999 through April 2009, the estimated results shown in Table 10, suggest that the long-run elasticity of the European stock market to the FFR is almost +0.001%. In other words, one deviation in the FFR increases the EUDJ by 0.001%, whereas the long-term elasticity of EUDJ to DJ is +0.25 highlighting the contagion among two markets. Ironically, when we implement NASDAQ rather than DJ, the results, presented in Table 11, indicates that the correlation among the two stock market indices increases to 0.47. And the elasticity of the EUDJ to FFR increases to 0.12. A one percent increase in FFR increases the EUDJ by 0.12%. In this scenario the role of exchange rate is equal to 0.15, compared with 0.17 in the former scenario using DJ.

The variance decomposition technique for a period of 12 months, presented in Table 12 indicates that the European stock market is mainly affected by Dow Jones and industrial production; almost 17% of the variance of the EUDJ is attributable to the FFR after 12 months and 32% of its changes can be attributed to DJ. The role of exchange rate decreases from 4.7% in the beginning of the period to 2.00% at the end of the period. In sum, the results support the dominant role of the US stock market on the European market, compared with other EU monetary and real variables.

Implementing NASDAQ, the variance decomposition technique presented in Table 13, indicates that NASDAQ explains more than 40% of the EUDJ by the end of the period, whereas the role of EUMS and EUIP does not exceed 2.8 and 5.6 respectively, highlighting the contagion of US stock market to EU market, particularly when using NASDAQ rather than DJ.

5-Conclusions

This paper employs the data from January 1999 through April 2009 to investigate (i) the long-run relationship between the European and US stock market indices through cointegration technique, (ii) test for the causality among the two stock markets and finally (iii) estimate the long-run elasticity of the EU stock market in response to changes in FFR, DJ, NASDAQ, and the Euro-dollar exchange rate.

The Johansen Jusellius test results suggest that the two markets are cointegrated and at least one cointegration vector exists among the two markets. The Granger Causality Test indicates that the causality runs from the US to European stock market. The long-run elasticity of EUDJ to DJ and NSDAQ measured by a VECM equals 0.25 and 0.47 respectively, highlighting the fact the European stock market is extremely affected by NASDAQ. A one percent deviation in NASDAQ increases the EU stock market by 0.47%.

The results of variance decomposition technique also suggest that DJ has had the largest impact on European stock market explaining more than 32% of changes in the EUDJ at the end of the period. Interestingly enough when we use NASDAQ rather than DJ, this role increases to 41% undermining the importance of domestic monetary and real variables in the EU. The contribution of EU monetary policy is trivial, and decreases from 3.4% in the beginning of the period to 2.8% at the end of the 12 months. And the EUIP contribution to EUDJ does not exceed 5.6% at the end of the period.

In sum, the results suggest that contagion from US to EU stock market has neutralized the European domestic monetary and exchange rate policies to a great extent, making the global financial stability highly dependent to the recovery of the US stock market.

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Table 1 *Descriptive Statistics*

Statistics	Mean	Median	No	Std Dev.	Skewness	Kurtosis
USM2	6110.445	6098.650	122	1045.245	0.070	1.993
USIP	104.464	103.726	122	4.437	0.306	1.764
FFR	3.382	3.560	122	1.883	0.018	1.575
DJ	10574.04	10512.87	122	1378.212	0.210	3.201
EXCH	1.157	1.190	122	0.193	0.137	2.148
EUM2	5529038	5269834	122	1225170	0.541	2.142
EUCPI	97.282	96.620	122	6.332	0.140	1.895
EUIP	99.344	100.525	122	8.657	- 0.595	3.261
EUDJ	3560.061	3602.333	122	819.646	0.230	2.274

Table 2 *Unit Root Tests (Augmented Dickey Fuller ADF test)*

Variables	No. of Lagged Differences	Test Statistic	5% Critical Value	1% Critical Value
USM2	0	1.426	-2.881	-3.475
USIP	0	-1.669	-2.880	-3.473
FFR	0	-0.901	-2.880	-3.473
DJ	0	-2.234	-2.879	-3.471
NASDAQ	0	-0.418	-1.942	-2.579
EXCH	0	-1.020	-2.885	-3.485
EUM2	0	8.451	-2.881	-3.476
EUCPI	0	2.063	-2.881	-3.475
EUIP	0	-2.207	-2.881	-3.476
EUDJ	0	-1.795	-2.879	-3.472

Table 3 *Unit Root Tests (Augmented Dickey Fuller ADF test) for variables in logarithm form*

Variables	**No. of Lagged Differences**	**Test Statistic**	**5% Critical Value**	**1% Critical Value**
USM2	0	-2.562	-3.441	-4.022
USIP	0	-0.267	-3.439	-4.019
FFR	0	-0.969	-3.439	-4.019
DJ	0	-1.510	-3.438	-4.016
NASDAQ	0	-1.905	-3.438	-4.016
EXCH	0	-2.743	-3.447	-4.035
EUM2	0	-0.669	-3.438	-4.017
EUCPI	0	-2.489	-3.441	-4.023
EUIP	0	-1.289	-3.441	-4.023
EUDJ	0	-1.235	-3.438	-4.017

Table 4 Johansen Cointegration Test results among log (EUDJ) and log (DJ) with linear trend

Hypothesized No. of CE	Eigenvalue	Trace Statistics (λ)	Critical Value 0.05	Prob
None (r=0)*	0.110	29.11	25.87	0.01
At most 1 ($r \leq 1$)	0.074	11.54	12.51	0.07

*denotes rejection of Hypothesis at the0.05 level (at least one cointegration equation exists at the 0.05 level)

Table 5 Johansen Cointegration Test results among log (EUDJ) and log (DJ) with Quadratic deterministic trend

Hypothesized No. of CE	Eigenvalue	Trace Statistics (λ)	Critical Value 0.05	Prob
None (r=0)*	0.105	26.50	18.39	0.003
At most 1 ($r \leq 1$)*	0.062	9.70	3.84	0.001

*Trace test indicates two cointegration equations at the 0.05 level

Table 6 Johansen Cointegration Test results among log (EUDJ) and log (NASDAQ) with linear trend

Hypothesized No. of CE	Eigenvalue	Trace Statistics (λ)	Critical Value 0.05	Prob
None (r=0)*	0.111	26.17	15.49	0.000
At most 1 ($r \leq 1$)*	0.054	8.38	3.84	0.003

*Trace test indicates two cointegration equations at the 0.05 level)

Table 7 Johansen Cointegration Test results among log (EUDJ) and log (NASDAQ) with Quadratic deterministic trend

Hypothesized No. of CE	Eigenvalue	Trace Statistics (λ)	Critical Value 0.05	Prob
None (r=0)*	0.100	23.80	18.39	0.007
At most 1 ($r \leq 1$)*	0.051	7.98	3.84	0.004

*Trace test indicates two cointegration equations at the 0.05 level)

Table 8 Granger Causality Test among log (EUDJ) and log (DJ)

Null Hypothesis	F-Statistics	Probability
LDJ does not Granger cause LEUDJ	14.77	1.4E-06
LEUDJ does not Granger cause LDJ	0.13	0.87

Table 9 Granger Causality Test among log (EUDJ) and log (NASDAQ) with 2 lags

Null Hypothesis	F-Statistics	Probability
LNASDAQ does not Granger cause LEUDJ	10.88	3.8E-05
LEUDJ does not Granger cause LNASDAQ	0.43	0.64

Table 10 *Vector Error Correction Estimates (with DJ)*

List of Variables	CointEq1
LUSM2(-1)	1
LFFR(-1)	-0.009
	(-0.62)
LUSIP(-1)	0.374
	(0.886)
LDJ(-1)	-0.257
	(-2.125)
LEXCH(-1)	0.171
	(1.801)
LEUM2(-1)	-0.173
	(-0.464)
LEUCPI(-1)	-1.381
	(-1.120)
LEUIP(-1)	-1.518
	(-12.238)
LEUDJ(-1)	0.299
	(3.531)
C	5.477
Determinant Residual Covariance (adj)	1.66E-33
Log Likelihood	3069.675
Akaike information Criteria	-48.414
Schwarz Criteria	-44.000

Table 11 *Vector Error Correction Estimates(with NASDAQ)*

List of Variables	CointEq1
LUSM2(-1)	1
LFFR(-1)	-0.125
	(-2.562)
LUSIP(-1)	4.706
	(3.807)
LNASDAQ(-1)	-0.473
	(-3.498)
LEXCH(-1)	0.153
	(0.708)
LEUM2(-1)	1.168
	(1.240)
LEUCPI(-1)	-7.235
	(-2.274)
LEUIP(-1)	-3.544
	(-11.200)
LEUDJ(-1)	0.690
	(3.530)
C	-1.167
Determinant Residual Covariance (adj)	6.03E-33
Log Likelihood	2993.050
Akaike information Criteria	-47.126
Schwarz Criteria	-42.712

Table 12 *Variance Decomposition of EUDJ (with DJ)*

LUSM2	LFFR	LUSIP	LDJ	LEXCH	LEUM2	LEUCPI	LEUIP	LEUDJ
1.240723	1.456842	1.617707	32.44442	4.738627	0.402133	0.054038	4.519414	53.52609
0.494031	0.641950	1.094301	44.47196	4.606083	0.167299	0.027919	6.649599	41.84686
0.280475	0.352199	5.526809	41.80179	3.867726	0.093385	0.038842	7.778605	40.26017
0.216107	0.323004	7.483584	40.78677	3.482481	0.062700	0.090330	6.533260	41.02177
0.268320	0.751383	9.164596	38.84343	3.221001	0.049804	0.396392	5.570436	41.73464
0.256779	1.150315	10.74915	37.08688	2.920741	0.048764	0.832740	5.226343	41.72828
0.278188	1.198897	12.29328	35.45313	2.613346	0.083302	1.209661	5.393066	41.47714
0.324497	1.093338	13.69895	34.52870	2.384884	0.101509	1.436756	5.379190	41.05218
0.343739	1.019974	14.85312	33.96337	2.237839	0.100983	1.562671	5.178886	40.73941
0.343481	1.039290	15.70580	33.38451	2.151837	0.099588	1.684998	4.988854	40.60165
0.350148	1.105277	16.36256	32.76013	2.081851	0.103533	1.840976	4.900839	40.49468
0.367629	1.145448	16.92690	32.24237	2.005363	0.114123	1.988544	4.860649	40.34898

Table 13 *Variance Decomposition of EUDJ (with NASDAQ)*

LUSM2	LFFR	LUSIP	LNASDAQ	LEXCH	LEUM2	LEUCPI	LEUIP	LEUDJ
1.233369	1.890288	1.856711	37.07528	4.115622	3.469540	0.004816	3.590643	46.76373
0.458780	0.873118	0.980392	51.45964	4.404844	2.657980	0.058410	6.625752	32.48108
0.278671	0.470293	4.968095	49.23156	4.281828	2.787090	0.414739	8.357461	29.21026
0.183020	0.404680	6.632285	49.37189	3.973348	2.800863	0.891872	7.051323	28.69071
0.166670	0.709406	8.351384	48.35987	3.532334	2.526760	1.612596	6.170702	28.57028
0.136927	0.962857	10.22748	46.98795	3.050198	2.502619	2.433699	5.862268	27.83600
0.137013	1.007216	11.86106	45.41394	2.638873	2.681227	3.011726	6.103360	27.14558
0.163953	0.970850	13.18954	44.41474	2.377563	2.796937	3.348207	6.126129	26.61207
0.174777	0.974614	14.33858	43.70728	2.203482	2.811918	3.552459	5.965361	26.27153
0.170659	1.036076	15.28589	43.07358	2.060363	2.806353	3.750977	5.786536	26.02957
0.172381	1.099231	16.06896	42.44270	1.926275	2.814445	3.969521	5.714157	25.79232
0.181933	1.129114	16.74984	41.88929	1.808849	2.839279	4.160637	5.688445	25.55261