The European stock market impulse to the U.S. financial crisis

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Abstract

This study examines how the European stock market reacts to the US fundamentals including the Federal Fund Rate (FFR), the Euro-dollar exchange rate, and the US stock market indices. The results from Johansen and Juselius cointegration technique suggest that a long-term relationship exists between the European stock market, and the US fundamentals. The Granger causality test indicates that causality runs from the US to European stock market. Using a Vector Error Correction Model (VECM) we measure the long and short-term elasticity of the European Stock Market not only to European fundamentals, but to the US fundamentals, the parity of the Euro-dollar exchange rate, and the US stock market indices. Results from variance decomposition technique indicate that the US business cycles play a dominant role in explaining the European stock market volatility, compared with EU fundamentals.

Keywords: Monetary transmission mechanism, global financial stability, Vector Error Correction Model (VECM), macroeconomic fundamentals, business cycles.

Introduction

As globalization spreads throughout the world, the financial markets become more integrated. In a globally integrated market, 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 markets have already received particular attention in the finance literature, rarely these co-movements have been investigated in response to different shocks to fundamentals.

It is well documented in the finance literature that stock prices fluctuations are correlated with the movements of macroeconomic variables. For example, Fama (1981), French et al. (1983), Geske and Roll (1983), Kaul (1987), Barro (1990), Cochrane (1991) and Lee (1992) show that stock returns are related to various macroeconomic variables such as industrial production and monetary variables. Nasseh and Strauss (2000) find a significant long-run relationship between stock prices and domestic and international economic activity in six European economies. Hess (2004) finds that Switzerland stock price is strongly correlated with shocks to German macroeconomic fundamentals.

Since the European Stock Market has adversely been affected by the global financial crisis, particularly by the US financial turmoil, the aim of this paper is to measure the long and short-run elasticity of the European stock market to the U.S. shocks, to changes in the behaviour of Euro-dollar exchange rate, and to US compared with EU macroeconomic fundamentals.

The rest of the paper is organized as follows. Section 2 provides a brief overview of literature on interlinks and interactions of equity markets. Section 3 describes data and methodology adopted in this study. Section 4 discusses the empirical results. And finally Section 5 raps up and concludes.

2. Literature Review

The co-movement of national stock markets has long been a popular research topic in the finance literature (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. 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.

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 the U.S., the U.K., Japan, Korea, Singapore, Taiwan, Australia, and Hong Kong stock markets 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 three participating NAFTA countries based on daily, weekly, and monthly data for seven years pre and post NAFTA implementation. 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.

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.

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 dominant role of the US financial market and the strong influence of DAX and FTSE on the Greek market.

Lahrech (2009) uses a VECM and Johansen's multivariate cointegration technique to examine the long and short-run association between Canadian stock price and macroeconomic fundamentals in both Canada and the US. His results suggest evidence of long-run association between Canadian stock price, US stock price, and Canadian as well as US fundamentals, measured by industrial production, real money supply, and consumer prices. The impulse response function suggests that the impact of fundamentals on Canadian stock prices depends on the stage of the US business cycle. In addition, results from variance decomposition technique show great explanatory power of US stock price during the expansionary periods.

3. Data and Methodology

We use monthly data from January 1999 to April 2009. Data on the U.S. monetary and macroeconomic variables come from Federal Reserve Bank of St Louis and data for the European monetary and real variables come from European Central Bank (ECB). We use Johansen and Jusellius (1990) technique to test for the long-run relationship between EU stock market and US fundamentals, and we implement the Granger causality test to see the causality runs from the US to EU stock market or vice versa. Finally we use a Vector Error Correction Model to estimate the long-run elasticity of the EU stock market to the US fundamentals.

The list of variables used in this study is as follows:

1. USM2: US Money Supply (M2)
2. FFR: Federal Fund Rate
3. USIP: US Industrial Production
4. USINF: US Inflation
5. NASDAQ: NASDAQ Industrial Index
6. DJ: US Dow Jones
7. EUM2: European Money Supply (M2)
8. EUIP: European Industrial Production
9. EUCPI: EU Consumer Price Index
10. EUINF: European Inflation
11. EUDJ: European Dow Jones
12. EXCH: Euro-dollar parity

The Industrial production is included in the model as a measure of real economic activity as emphasized by Geske and Roll (1983), Kaul (1987), Shah (1989), and Barro (1990). The money supply is also included in the model. Indeed, based on monetary view, Mishkin (2001), an increase in the money supply leads to lower interest rate, which in turn, increases the return on bonds and stocks. The relationship between inflation and stock prices has also been the focus of a substantial body of research (e.g., Fama 1981, Geske and Roll 1983, lee 1992). Exchange rate has also been included in the model since with the changes in the exchange rate, capital flows are induced, which in turn, affects the demand for stock markets (e.g., Griffin and Stulz 2001, Hashimoto and Ito 2004, Bartram 2004).

Before we apply to the Johansen and Jusellius (1990) method to test the long-run relationship and to test for Granger causality between two stock markets, we must check whether series are stationary or not.

3.1. Stationary tests

The descriptive statistics are presented in Table 1. The first step in our analysis is to determine the order of integration of the variables. Both Augmented Dickey Fuller and Kwiatkowski et al. (1992) (KPSS) tests are conducted to test for unit roots in the level as well as in the first and second differences of the variables. Tables 2 suggests that according to ADF test USM2, USIP, FFR, EUIP, EUCPI, and EUINF are I(2). However, based on the results of KPSS test presented in Table 3 all variables are (I).

Now we can investigate (i) the long-term relationship between the variables through cointegration technique, (ii) the causality among the two stock markets (iii) and long-run elasticity of EU stock market in response to US fundamentals, as well as the Euro-dollar exchange rate behavior.

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 with ADF in logarithm form (with trend and intercept)*

Variables	No. of Lagged Differences	Test Statistic	5% Critical Value	1% Critical Value
USM2	2	-9.70	-3.44	-4.02
USIP	2	-11.74	-3.43	-4.01
FFR	2	-12.36	-3.43	-4.01
USCPI	1	4.33	-3.43	-4.01
DJ	1	-12.12	-3.43	-4.01
NASDAQ	1	-11.30	-3.43	-4.01
EXCH	1	-8.03	-3.44	-4.03
EUM2	1	-14.13	-3.43	-4.01
EUCPI	2	-6.07	-3.44	-4.02
EUINF	2	-6.10	-3.44	-4.02
EUIP	2	-6.75	-3.44	-4.02
EUDJ	1	-8.78	-3.43	-4.01

Table 3 *Unit Root Tests with KPSS in logarithm form (with trend and intercept)*

Variables	No. of Lagged Differences	Test Statistic	5% Critical Value	1% Critical Value
USM2	1	0.083	0.146	0.216
USIP	1	0.061	0.146	0.216
FFR	1	0.146	0.146	0.216
USINF	1	0.154	0.146	0.216
DJ	1	0.081	0.146	0.216
NASDAQ	1	0.087	0.146	0.216
EXCH	1	0.176	0.146	0.216
EUM2	1	0.047	0.146	0.216
EUCPI	1	0.046	0.146	0.216
EUINF	1	0.050	0.146	0.216
EUIP	1	0.043	0.146	0.216
EUDJ	1	0.128	0.146	0.216

3.2. Cointegration Test

Table 4 presents the Johansen cointegration test results among the variables with linear deterministic trend and four lags. The Trace test as applied by Johansen and Juselius (1990) indicates the null hypothesis of no cointegration, r=0 is rejected at 5 percent level and at least three cointegration equations exist. Using Max-eigenvalue test indicates two cointegration equations at 0.05 level.

We also test for the cointegration using NASDAQ rather than DJ, with linear and deterministic trend, presented in Tables 5. The results suggest that the null hypothesis of no cointegration, r=0 is rejected at 5 percent level and at least four and two cointegration equations exist based on Trace and Max-eigenvalue test, respectively.

Table 4 Johansen Cointegration Test results (4 lags) with linear deterministic trend with DJ

Hypothesized No. of CE	Max-Eigenvalue	Critical value 0.05	Trace Statistics (λ)	Critical Value 0.05
None (r=0)*	109.40	58.43	292.77	197.37
At most 1 (r≤1)*	53.55	52.36	183.36	159.52
At most 1 (r≤2)	40.35	46.23	129.81	125.61
At most 1 (r≤3)	36.00	40.07	89.45	95.75
At most 1 (r≤4)	20.27	33.87	53.44	69.81
At most 1 (r≤5)	15.13	27.58	33.17	47.85
At most 1 (r≤6)	11.36	21.13	18.04	29.79
At most 1 (r≤7)	6.34	14.26	6.67	15.49
At most 1 (r≤8)	0.32	3.84	0.32	3.84

*denotes rejection of the Null Hypothesis at the 0.05 level

Table 5 Johansen Cointegration Test results (4 lags) with linear deterministic trend with NASDAQ

Hypothesized No. of CE	Max-Eigenvalue	Critical value 0.05	Trace Statistics (λ)	Critical Value 0.05
None (r=0)*	106.28	58.43	306.86	197.37
At most 1 (r≤1)*	61.63	52.36	200.58	159.52
At most 1 (r≤2)*	38.70	46.23	138.94	125.61
At most 1 (r≤3)	33.45	40.07	100.24	95.75
At most 1 (r≤4)	26.28	33.87	66.78	69.81
At most 1 (r≤5)	20.89	27.58	40.49	47.85
At most 1 (r≤6)	13.29	21.13	19.60	29.79
At most 1 (r≤7)	5.87	14.26	6.31	15.49
At most 1 (r≤8)	0.44	3.84	0.44	3.84

* denotes rejection of the Null Hypothesis at the 0.05 level

3.3. 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 6 and 7 indicate that there exists unidirectional Granger causality from the US to European stock market using both DJ and NASDAQ.

Table 6 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 7 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

3.4. Vector Error Correction Model (VECM)

As it was sketched earlier in this paper, 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 US fundamentals, to US stock market downturn, and to the parity of the Euro-dollar exchange rate, compared with European fundamentals.

4. Empirical results:

Using a VECM for the period January 1999 through April 2009, the estimated results shown in Table 8, suggest that the long-run elasticity of the European stock market to the FFR is almost 0.09. In other words, a one percent deviation in the FFR increases the EUDJ by 0.09, whereas the long-term elasticity of EUDJ to the USDJ amounts to 0.64, highlighting the contagion among two stock markets. The elasticity of EUDJ to Euro-dollar exchange rate is equal to 0.43, underlining the importance of conversion rate in explaining stock market behaviour as emphasized in the literature. Interestingly enough, the EUDJ is completely elastic with respect to US fundamentals.

Ironically, when we implement NASDAQ rather than USDJ, the results presented in Table 9 indicate that the correlation among the two stock markets increases slightly to 0.66, emphasizing higher correlation of NASDAQ with European stock market. In this scenario the elasticity of the EUDJ to FFR increases to 0.19. Put differently, a one percent increase in the FFR increases the EUDJ by 0.19%.

Table 8 *Vector Error Correction Estimates 2 lags (with DJ)*

List of Variables	**CointEq1**
LEUDJ(-1)	1
LUSM2(-1)	2.43
	(2.03)
LUSIP(-1)	2.77
	(1.72)
LFFR(-1)	-0.09
	(-1.18)
LDJ(-1)	-0.64
	(-2.30)
LEXCH(-1)	0.43
	(1.41)
LEUM2(-1)	-1.40
	(-1.30)

LEUIP(-1)	-5.80
	(-12.13)
C	12.26
Determinant Residual Covariance (adj)	3.36E-28
Log Likelihood	2491.22
Akaike information Criteria	-39.31
Schwarz Criteria	-35.76

Table 9 *Vector Error Correction Estimates 2 lags (with NASDAQ)*

List of Variables	**CointEq1**
LEUDJ(-1)	1
LUSM2(-1)	-0.27
	(-0.23)
LUSIP(-1)	6.55
	(3.98)
LFFR(-1)	-0.19
	(-3.31)
LNASDAQ(-1)	-0.66
	(-5.63)
LEXCH(-1)	0.27
	(1.13)
LEUM2(-1)	-0.25
	(-0.28)
LEUIP(-1)	-4.38
	(-12.78)
C	-6.83
Determinant Residual Covariance (adj)	1.10E-27
Log Likelihood	2420.49
Akaike information Criteria	-38.12
Schwarz Criteria	-34.57

The variance decomposition technique for a period of 12 months ahead, presented in Table 10 indicates that the European stock market is mainly affected by US industrial production; almost 29% of its changes can be attributed to US industrial production by the end of the period. The role of DJ decreases from 2.4% in the beginning of the period to 0.5% at the end of the period. However, the contribution of FFR increases from 0.17% in the first month to 0.6% at the end of the period. In sum, the results support the dominant role of the US business cycles on the European stock market, compared with EU monetary and real variables.

Table 10 *Variance Decomposition of EUDJ*

LUSM2	LUSIP	LFFR	LDJ	LEXCH	LEUM2	LEUIP
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.330333	3.238778	0.172787	2.424231	0.081299	0.343008	0.488313
0.855931	11.42416	0.434525	1.876243	0.052696	0.396218	0.853445
0.904993	14.91488	0.300116	1.541544	0.049781	0.373251	0.567382
0.809085	17.41074	0.354858	1.226077	0.052489	0.420035	0.463149

0.824509	19.67457	0.552626	0.995769	0.076785	0.357143	0.355206
0.793749	22.01026	0.593996	0.831616	0.133520	0.292925	0.275652
0.732896	24.16305	0.536398	0.762083	0.194366	0.256922	0.220054
0.703116	25.91802	0.492698	0.723912	0.237556	0.245041	0.184746
0.700708	27.22329	0.506763	0.670588	0.262243	0.237027	0.163781
0.690970	28.23259	0.561917	0.613192	0.282733	0.225563	0.143435
0.670715	29.09077	0.609737	0.572987	0.308370	0.212180	0.126125

Implementing NASDAQ rather than DJ in the VECM, the elasticity of EUDJ to EU and US fundamentals are presented in Table 11. The results suggest that the contribution of NASDAQ to EUDJ decreases from 2.9% in the first month to 1.4% at the end of the period. Consistent with previous scenario, more than 29% of the EUDJ is explained by USIP by the end of the period, highlighting the importance of US business cycles in explaining the EUDJ.

Table 11 *Variance Decomposition of EUDJ (with NASDAQ)*

LUSM2	LUSIP	LFFR	LNASDAQ	LEXCH	LEUM2	LEUIP
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.501075	3.097575	0.214024	2.946774	0.212021	0.001172	0.988670
1.178321	11.25202	0.435750	2.468442	0.172028	0.028593	1.755749
1.419433	14.61330	0.332259	2.361719	0.128811	0.021103	1.244917
1.359506	17.26328	0.285348	2.191917	0.091167	0.036716	0.892980
1.392952	19.87897	0.374927	2.049571	0.083512	0.033827	0.710416
1.349788	22.30839	0.424679	1.856989	0.112748	0.026226	0.680350
1.257046	24.37078	0.426788	1.745052	0.141374	0.021099	0.629846
1.200468	26.14508	0.441975	1.662403	0.164662	0.020378	0.558527
1.185565	27.59697	0.489586	1.585688	0.188974	0.021458	0.498968
1.162048	28.78641	0.547793	1.510647	0.217651	0.021880	0.467841
1.126875	29.79658	0.596915	1.451883	0.246315	0.021425	0.447265

5. Conclusions

This paper employs data from January 1999 through April 2009 to examine (i) the long-run association between EU and US stock markets and their fundamentals through cointegration technique, (ii) test for the causality among the two stock markets and finally (iii) estimate the long and short-run elasticity of the EU stock market in response to deviation in FFR, DJ, NASDAQ, Euro-dollar exchange rate, and the US business cycles. To compare the degree of explanatory power of the EU and US fundamentals in contributing to EUDJ, we used a variance decomposition technique.

The Johansen Juselius test results suggest that the two markets are cointegrated and at least two cointegration vectors exist among the EU and US stock markets. The Granger Causality test indicates that the causality runs from the US to European stock market.

The VECM results suggest that the EUDJ is highly elastic to USDJ and NASDAQ. A one percent deviation in the FFR increases the EUDJ by 0.09, whereas the long-term elasticity of EUDJ to USDJ and NASDAQ amounts to 0.64 and 0.66, respectively, highlighting the contagion among the two stock markets. Interestingly enough, the elasticity of the EUDJ to US industrial production exceeds other variables, emphasizing the importance of US business cycles for the EUDJ.

The results from variance decomposition technique for a period of 12 months ahead suggest that USIP has had the largest impact on European stock market explaining more than 29% of changes in the EUDJ at the end of the period. This contribution exceeds that of EU fundamentals, undermining the importance of US business cycles in explaining EUDJ. Indeed, the contribution of EU monetary policy is trivial and does not exceed 0.21% at the end of the period. In addition, the EUIP contribution to EUDJ does not exceed 0.44% at the end of 12 month.

In sum, the results suggest that contagion from the US to EU stock market has neutralized the European domestic monetary policy to a great extent, making their financial stability highly dependent on the US business cycles. Put differently, the EU policy makers need to focus more on US rather than EU fundamentals, and this might be a result of trade and economic integration between the two markets. Our results also reinforce some of previous studies that emphasize the role of business cycles on the interaction between stock prices and macroeconomic fundamentals, including those of Hess (2004) and Lahrech (2009).

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