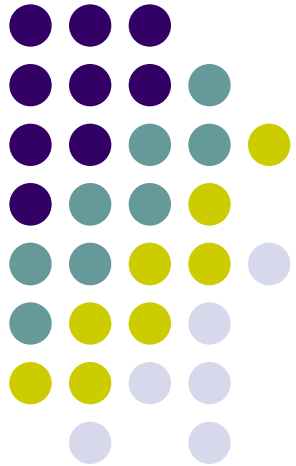
Dynamic Relationship and Volatility Spillover Between the Stock Market and the Foreign Exchange market in Pakistan: Evidence from VAR-EGARCH Modelling

Dr. Abdul Qayyum

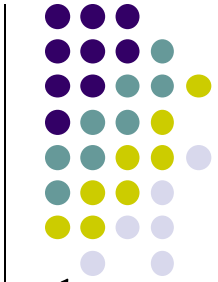
Dr. Muhammad Arshad Khan



Introduction

- A volatile stock and exchange markets of a country adversely affect investment and hence economic growth.
  - **Reasons:**
    - Volatility increases risk to investors and they reduce their positions.
    - Increases uncertainty and reduce profitability.
    - Countries that are linked through trade and investment, may disrupted through spillover effects.
    - Investors withdrew capital.
    - exchange rate volatility affects:
      - firm's competitiveness,
      - earnings,
      - cost of funds,
      - stock prices.

Theoretical Link between the Stock and Forex Markets



- Connections between stock and forex market can be traced through standard trade theory:
- Flow-oriented Exchange Rate Models:
  - Exchange rate movements influences international competitiveness and trade balance, which in turn influences real income.
  - Stock prices react to exchange rate changes and effects consumption and investment decisions.
  - shocks in the stock market impacts aggregate demand through:
    - Wealth and liquidity effects
      - Money demand and
      - Exchange rates

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- **Stock-oriented Exchange Rate Models:**
  - Treated capital account as significant determinants of exchange rate dynamics.
  - Under these models value of financial assets are determined by:
    - PV of future cash flow
    - Expectations about the movements in financial asset prices.
  - Exchange rate volatility may affect stock prices, which may affect investors investment decisions.

Motivation

- Given the important role of exchange rate volatility and stock market volatility in consumption and investment decisions, the present study examines the dynamic linkages between stock market and Forex market in the context of Pakistan.
  - Particularly, the study focuses on the nature and direction of volatility transmission between stock market and Forex market using **weekly data from 02 July 1997 to 04 July 2012**.
  - The study also addresses the question whether spillover effect is asymmetric?

Methodology

We consider the following VAR-EGARCH (p, q) conditional mean models:

$$S_t = \alpha_{s,0} + \sum_{i=1}^{p} \alpha_{s,i} S_{t-i} + \sum_{i=1}^{p} \alpha_{e,i} E_{t-i} + \lambda ec_{t-1} + \varepsilon_{s,t}$$

$$\varepsilon_t \mid \Omega_{t-1} \sim N[0, (\sigma^2_{S,t})]$$

$$E_t = \alpha_{E,0} + \sum_{i=1}^{p} \alpha_{E,i} E_{t-i} + \sum_{i=1}^{p} \alpha_{S,i} S_{t-i} + \lambda ec_{t-1} + \varepsilon_{E,t}$$

$$\varepsilon_t \mid \Omega_{t-1} \sim N[0, (\sigma^2_{E,t})]$$

Where S_t is stock price returns and E_t is exchange rate returns, ec_{t-1} is error correction term and ε_t's are error terms

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- The conditional variance models of stock returns and exchange rate returns are specified as follows:

$$Ln\left(\sigma_{S,t}^{2}\right)=\alpha_{s,0}+\sum_{j=1}^{ps}\delta_{S,j}Ln(\sigma_{S,t-j}^{2})+\theta_{S}z_{S,t-1}+\beta_{S,S}\left(\left|z_{S,t-1}\right|-E\left(\left|z_{S,t-1}\right|\right)\right)$$
$$+\theta_{S,}EzE,_{t-1}+\beta_{S,E}\left(\left|z_{E,t-1}\right|-E\left(\left|z_{E,t-1}\right|\right)\right)$$

$$Ln\left(\sigma_{E,t}^{2}\right)=\alpha_{E,0}+\sum_{j=1}^{ps}\delta_{E,j}Ln(\sigma_{E,t-j}^{2})+\theta_{E}z_{E,t-1}+\beta_{E,E}\left(\left|z_{E,t-1}\right|-E\left(\left|z_{E,t-1}\right|\right)\right)$$
$$+\theta_{E,}SzE,_{t-1}+\beta_{E,S}\left(\left|z_{S,t-1}\right|-E\left(\left|z_{S,t-1}\right|\right)\right)$$

Empirical Results

Table 2: Summary of Descriptive Statistics

Statistic	$LSPI_t$	$LEXR_t$	E_t	S_t
Mean	8.40	4.13	0.0011	0.003
Maximum	9.65	4.54	0.07	0.11
Minimum	6.70	3.70	-0.05	-0.18
Std. Dev.	0.94	0.20	0.008	0.03
Skewness	-0.30	0.35	1.79	-1.00
Kurtosis	-1.53	-0.62	20.75	3.28
Jarque-Bera	88.37 [0.000]**	28.76 [0.000]**	14466 [0.000]**	480.95 [0.000]**
ARCH 1-10 test: F(10, 762)	63752 [0.000]**	60433 [0.000]**	9.32 [0.000]**	14.97 [0.000]**
Q-statistic (50)	34809.6 [0.000]**	28539.8 [0.000]**	152.96 [0.000]**	134.27 [0.000]**
Q^2-statistic (50)	34766.2 [0.000]**	28846.1 [0.000]**	235.15 [0.000]**	273.84 [0.000]**
ADF Test (constant)	-0.43	-0.97	-11.68**	-19.96**
ADF Test (Constant and Trend)	-1.75	-2.11	-11.67**	-19.96**
Observations	784	784	784	784

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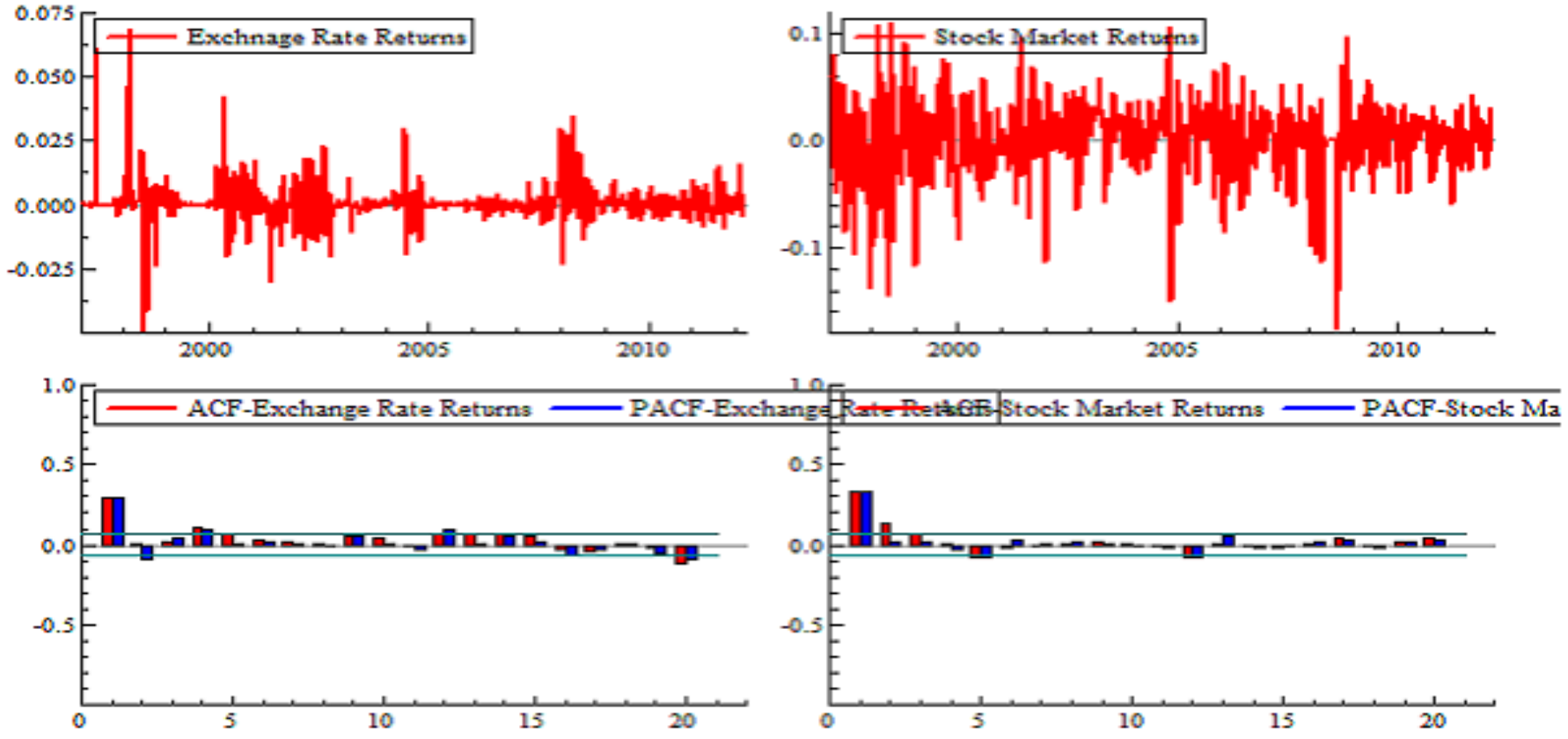
- Volatility clustering can be seen by the following Fig.

Figure 1: Volatility Clustering of Weekly Stock Market Returns and Exchange Rate Returns

(July 02, 1997 to July 04, 2012)



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- The presence of volatility clustering could be due to:
  - Increase in interest rate
  - Increase in dividend yields
  - Oil prices,
  - margin requirement,
  - information patterns
  - Participant's expectations, etc.

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- Before estimating the EGARCH model, first we determine the cointegration between SP and ER.

Table 3: Johansen Cointegration Test (Stock Market Index and Exchange Rate).

Eigenvalue	Loglik for Rank			
	4304.211 0			
0.013645	4309.576 1			
0.0056133	4311.774 2			
Rank	Trace Test [prob]	Max Test [prob]	Trace Test [T-nm]	Max Test [T-nm]
0	15.13 [0.224]	10.73 [0.282]	15.01 [0.231]	10.65 [0.289]
1	4.40 [0.368]	4.40 [0.367]	4.36 [0.373]	4.36 [0.372]
Standardized Bata Martix (Scaled on diagonal, Cointegrating Vector in Columns)			Standardized Alpha Matrix	
Series	β_1	β_2	α_1	α_2
$LSPI_t$	1.0000	-0.0998	9.5618e-005	0.015518
$LEXR_t$	-39.344	1.0000	3.0641e-005	-0.0023246
Constant	176.70	-3.225		

Note: VAR model include unrestricted intercept and two stability dummies (D_{553} and D_{576})

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Table 4: Results of the Multivariate EGARCH Model

Variables	S_t	z-statistics	E_t	z-statistics
Conditional Mean Equation				
C	0.40	4.16	0.12	5.86
S_{t-1}	0.28	7.40	-0.01	-2.64
E_{t-1}	− 0.46	-3.32	0.10	2.90
Conditional Variance Equation				
C	-0.05	-0.99	-0.39	-8.46
$Ln(\sigma^2_{S,t-1})$	0.87	35.14	-	-
$z_{S,t-1}$	-0.6	-2.34	-0.11	-5.53
$\left[\left\|z_{S,t-1}\right\| - E\left\|z_{S,t-1}\right\|\right]$	0.36	8.80	-0.19	-4.07
$Ln(\sigma^2_{E,t-1})$	-	4.61	0.76	43.87
$z_{E,t-1}$	-0.07	-2.51	0.21	7.29
$\left[\left\|z_{E,t-1}\right\| - E\left\|z_{E,t-1}\right\|\right]$	0.13	2.78	0.52	13.57

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- Exchange rate returns and stock returns are negatively correlated.
  - The coefficient of exchange rate return (i.e.-0.46) is larger than that of stock returns (i.e. -0.01).
  - This result implies that decrease in stock returns reduces domestic wealth, which leads to decrease in money demand and interest rates.
  - Decrease in stock returns leads foreign investors to decrease in demand for assets and domestic currency.
  - This shift in currency demand and supply of currencies causes capital outflow and depreciates domestic currency.
  - Depreciation of Pak-rupee exchange rate drags down stock prices which may induce bearish stock market.

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- Exchange rate changes have negative effect on stock returns due to its inflationary effects which discourages investors to increase their asset portfolios, thus discouraging stock market.
- We also obtained price spillover from stock market to forex market.
  - Movements of stock returns produces adverse effects on forex market which tend to fuel inflationary expectations.
  - Increase in inflation exerts downward pressure on Pak-rupee, which in turn produces negative effect on stock returns.
  - Thus, there exists two-way price spillovers

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- Conditional variance equation also supports two-way price spillovers.
  - The magnitude of spillovers from forex market to stock market is larger (i.e. 0.0.13) than that of from forex market to stock market (i.e. -0.19).
  - This implies that exchange rate volatility is positively related to stock returns, whereas stock returns volatility is negatively related to exchange rate changes.
    - This implies that movements in exchange rate causes in movements in stock returns.
  - Volatility persistence terms are positive and significant for both returns with less unity coefficients.
  - News about the volatility has asymmetric impacts on both returns

Conclusions

- No cointegration exists between stock prices and forex rate.
- Stock and forex markets are interdependent with two-way price spillovers.
- Returns of one market are affected by the volatility of other market.
- Stock returns are more sensitive to the volatility of forex market.
- Exchange rate movements are also affected by the volatility of stock returns.

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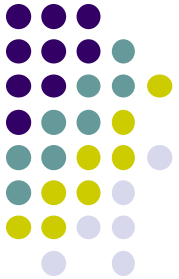
- Therefore, SBP could monitor the adverse impact of exchange rate and stock price variations on private and portfolio investment.
- There is need to design a policy that minimizes the adverse affects on exchange rate and stock price volatilities on investment decisions
  - Stability of stock and forex markets is important to guarantee foreign direct and portfolio investment which generates positive impacts on economic growth and macroeconomic stability.



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