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Financial Market Integration in Pakistan: Evidence Using Post-1999 Data

AHMED M. KHALID and GULASEKARAN RAJAGURU

1. INTRODUCTION

The recent wave of financial sector reforms and internationalisation in emerging markets has increased perceived interlinkages within various sectors of national financial markets. For example, the existence of a strong linkage between stock prices and exchange rates is a popular topic in academic research. Similarly, changes in stock prices and exchange rates are expected to influence movements in interest rates. A number of hypotheses suggest such a causal relationship. For instance, using a goods market approach, any changes in the value of currency would affect the competitiveness of multinational firms and hence influence stock prices [Dornbusch and Fischer (1980)]. Similarly, the hypotheses of 'exchange rate pass-through' and 'interest rate pass-through' suggest that changes in exchange rates and/or interest rates could affect stock prices. The portfolio balance model suggests that fluctuations in stock prices influence exchange rate changes.

Empirical research on the validity of the above stated hypotheses have returned mixed results. In this paper, we only discuss recent empirical work with a focus on emerging economies. Fukuda and Kano (1997) investigated how prices in East Asian economies correlated with those in Japan and the United States and found that overall price levels in East Asia are more correlated to the price level in the United States. Aggarwal and Kyaw (2005) studied equity market integration in the NAFTA region and found evidence supporting an integrated market. Khalid and Kawai (2003) found support for currency market linkages within the East Asian region. Khalid and Rajaguru (2006) used a multivariate GARCH model and found evidence indicating that East Asian markets are interlinked. However, they did not find inter-linkage between Indian and Pakistani currency markets. Pan, Fok and Liu (2006) examined dynamic linkages between exchange rates and stock prices for seven East Asian countries and found evidence of a causal relationship between the two markets in all countries except Malaysia.[1]

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[1]Abdalla and Murinde (1997), Chen and Rui (2002), Click and Plummer (2005), and Dekker, Sen, and Young (2001) also discuss interlinkages within exchange rate and stock markets in some emerging economies.

Like many other emerging economies, Pakistan also implemented policies of financial sector reform and liberalisation as early as the 1990s.[2] These reforms and other external factors had a positive impact on the economy and led to a slight appreciation of the currency as well as improvement in the country's credit rating. Table 1 provides a summary of the basic economic indicators for Pakistan since the 1970s with a focus on the period since 2000.[3] As a result of these reforms and deregulation of many sectors of the economy, the movements of important financial market indicators such as exchange rates, stock prices and interest rates became reflective of market forces. At the same time and due to minimum intervention by the State Bank of Pakistan in the foreign exchange and domestic money markets, these variables are subject to external and internal shocks. If markets are interlinked then a shock (positive or negative) to one market is expected to have an impact on other markets as well. This testable hypothesis is the focus of our paper.

From Pakistan's perspective, there is limited research available investigating inter-linkages and volatility spillover within Pakistan's financial market. The empirical evidence in Qayyum and Kemal (2006) suggests that volatility spillover takes place from the stock market to the foreign exchange market but not vice-versa. In this paper, we use high frequency data to investigate inter-linkages among the three sectors of the financial market in Pakistan. We investigate if the currency, stock and money markets in Pakistan are linked together. We use three financial market indicators, namely; the exchange rate, the stock price and interest rate, and investigate the presence of linkages within these three markets. We use daily observations and Granger causality, variance decomposition and impulse responses, in a VAR to establish evidence of any market inter-linkages. The paper is organised in the following manner. Section 2 following the Introduction discusses the data and methodological details. The results of the empirical model are presented in Section 3. Finally, some conclusions are drawn in Section 4.

2. DATA AND METHODOLOGICAL DETAILS

We use daily observations on the exchange rate (WMR; against US dollar), stock prices (MSCI index) and the interest rate (30-day repo) for the period 12th October 1999 (the military takeover date) to the 13th September 2006. For empirical estimation, we split the sample into two: a full sample and a sub-sample. The sub-sample covers the period from 25th September 2001 to the 13th September 2006, thus focusing on the post September 11 period. All data is obtained from the DataStream database.

[2]For a detailed discussion on financial sector reforms and development in Pakistan, see Ariff and Khalid (2005). Hussain and Qayyum (2005) and Hussain (2006) also look at stock market liberalisation in Pakistan and the region.

[3]It can be seen from Table 1 that by 2003, for the first time in the last three decades, Pakistan experienced a growth rate of 5.1 percent with single digit inflation (3.3 percent). This momentum continued until 2004 when the economy registered a growth rate of 6.8 percent. Although the overall economic growth rate continued to increase in 2005 (reaching a level of 7.8 percent), some other indicators showed a slowing down in the economy. For example, inflation jumped from 4.5 percent to 9.3 percent in 2005. Fiscal deficit (as a ratio to GDP) increased from (–) 2.1 percent to (–) 4.1 percent. Similarly, trade balance (as a ratio to GDP) rose from (–) 1.3 per cent to (–) 4.1 percent. These declining trends suggest that the economy experienced some negative shocks during 2004.

Table 1

Basic Economic and Social Indicators of Development in Pakistan

Indicators	1961–70	1971–80	1981–90	1991–95	1996–2000	2000	2001	2002	2003	2004	2005
National Accounts											
GDP Growth (%)	3.35	4.81	6.19	4.85	3.07	4.26	2.72	4.41	5.0	6.4	7.8
Per Capita GDP (US$)	138.86	180.18	327.06	404.85	438.82	426.64	380.54	439	542	610	709
Private Consumption/GDP	77.71	79.00	76.92	70.81	73.99	74.43	75.15	74.96	73.6	73.3	80.0
Government Consumption/GDP	12.51	13.79	17.06	18.16	15.51	15.01	13.65	15.25	8.9	8.4	7.8
Financial Indicator (%)											
Gross Domestic Savings/GDP	–	13.81	13.83	14.81	13.29	14.4	14.6	13.6	17.5	18.4	12.2
Fixed Capital Formation/GDP	15.37	15.38	16.96	18.07	15.41	14.37	14.29	12.33	16.9	17.3	17.8
Inflation (per Year)	3.51	12.42	6.98	11.20	7.30	4.37	3.15	3.29	3.19	4.49	9.32
M2/GDP	36.14	41.76	41.25	43.39	46.63	46.92	48.30	51.74	47.0	49.4	48.9
Fiscal Balance/GDP	–5.17	–7.41	–6.74	–7.67	–6.91	–5.47	–4.71	–4.62	–4.1	–2.1	–4.1
Trade Balance/GDP	–	–8.06	–9.31	–5.15	–3.73	–2.4	–2.3	–0.5	–0.4	–1.3	–4.1
Current Account Balance /GDP	–	–5.35	–2.91	–4.49	–3.17	–0.14	3.41	4.5	4.9	1.9	–1.4
Total Trade/GDP	21.20	28.00	33.59	36.73	35.16	34.30	37.37	35.75	–	31.7	34.1
Debt/Exports	403.90	606.09	509.28	–	–	550.66	260.7	211.2*	189.1*	176.3*	–
Debt/GDP	33.91	61.96	64.15	–	–	90.00	45.7**	48.7**	44.8**	38.0**	–
Foreign Reserves/Imports	21.27	17.98	11.52	14.24	10.56	14.23	34.05	71.86	–	–	–

Source: IMF International Financial Statistics (CD-ROM), *World Development Report* (Various Issues) and *Asian Development Outlook* (Various Issues); Ariff and Khalid (2005).
* Numbers are for external debt to exports ratio. ** Numbers are for Debt to GDP ratio.

Unit Root Testing

The time series property of the data is examined by conducting ADF, PP and KPSS unit root tests on the logarithm of exchange rates, stock prices and interest rates. If the variables are non-stationary then these three tests are conducted on a logged differenced series in order to determine the correct order of integration. Both ADF and PP tests set the null of non-stationary while the KPSS tests the stationary null hypothesis. Together these three results determine the most robust estimates for the order of integration.

Co-integration Analysis

In order to capture the dynamic relationships between the three variables, we tested for any co-integration relationship among the logarithm of exchange rates, stock prices and interest rates. If all three variables are I (1) and are co-integrated then the linear combination (co-integrating vectors) of one or more of these series may exhibit a long-run relationship. And the dynamic linkages (causality) between the variables could be determined through the vector error correction model. On the other hand, it could be modelled as vector autoregression (VAR) if either (i) all of these series are stationary or (ii) these series are non-stationary but are not co-integrated. In our study, we use the multivariate co-integration test based on the Johansen-Juselius (1990) procedure to test for the existence of long-run relationships between the exchange rate, stock prices and interest rate.

We begin the analysis by letting a vector of *n*-variables z_t possess the *p*-th order Gaussian vector autoregression (VAR) process

$$z_t = \mu + \sum_{i=1}^{p} \Pi_i z_{t-i} + \varepsilon_i, t = 1,2,\cdots,T \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

Where μ is a vector of constants and ε_t is a normally and independently distributed n-dimensional vector of innovations with zero-mean non-singular covariance matrix Ω. And z_t is a vector of an endogenous variable. It is convenient to rewrite the above process in the following error correction form:

$$\Delta z_t = \mu + \sum_{i=1}^{p-1} \Gamma_i \Delta z_{t-i} - \Gamma_0 z_{t-1} + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

Where $\Gamma_0 = I - (\Pi_1 + \Pi_2 + ... + \Pi_p)$ and $\Gamma_i = -\sum_{j=i+1}^{p} \Pi_j$, i = 1,2,…, *p*. The long run $n \times n$ matrix Π is equal to Γ_0 and it determines how many linear combinations of z_t are stationary. In particular, the rank of the matrix Π *r* gives the number of independent co-integrating vectors. The co-integrating ranks *r* ($0<r<n$) and hence, the number of distinct co-integrating vectors can be formally tested with λ_{trace} and λ_{max} statistics. The λ_{trace} statistic tests the null hypothesis that H_0: $r = g$ vectors against the alternative that H_1: $r \leq g$ and it is given by

$$\lambda_{trace}(g) = -T \sum_{i=g+1}^{n} \ln(1-\lambda_i), \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

The λ_{max} statistic tests the null hypothesis that H_0: $r = g$ vectors against the alternative that H_1: $r = g+1$ and it is given by

$$\lambda_{\max}(g) = -T\log(1-\lambda_{g+1}) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

where λ_i's are the Eigen values of Π such that $\lambda_1 > \lambda_2 > \ldots > \lambda_n$. The optimal lag length p is determined by Schwartz criteria.

Error Correction Models and Vector Autoregressions

As discussed earlier, if all variables are co-integrated then they are modelled as a vector error correction model to capture both long-run and short-run linkages between exchange rates, stock prices and interest rates. On the other hand, if these three markets are not co-integrated then they will be modelled as a vector error correction model. As we shall see later, all three markets are not co-integrated; thus we proceed with the discussion on vector autoregressions. The vector autoregression (VAR) is commonly used for analysing the dynamic impact of random disturbances on a system of variables. The VAR approach models every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system and can be specified as:

$$y_t = A_1 y_{t-1} + \ldots.. + A_p y_{t-p} + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

Where y_t is a k vector of endogenous variables, A_1, …, A_p are matrices of coefficients to be estimated, and ε_t is a vector of innovations that may be contemporaneously correlated with each other but are uncorrelated with their own lagged values and uncorrelated with all of the lagged endogenous variables. It is very important to determine the lag length before estimating a VAR. Rather than using a lag length arbitrarily, we use three different criterions, namely, Akaike information criteria (AIC), Schwartz information criteria (SIC) and likelihood ratio (LR) to determine the appropriate lag length. Surprisingly, a lag length of one was justified by both the AIC and SIC while the LR was inconclusive. We therefore chose a lag of one for the VAR system used in this study. Since we have the same lag length, the system may be estimated using Ordinary Least Squares (OLS).

The parameter estimates obtained from the estimated VAR model are then used to identify any causal relationships among different markets. This is accomplished by testing Granger causality and running a VAR on the system of equations and testing for zero restrictions on the appropriate VAR coefficients.

Next, we compute the variance decomposition to evaluate dynamic linkages between the three markets. Variance decomposition decomposes the forecast error variances (at different time-horizons) of one variable into all variables in the system.

Later we analyse the impulse responses by introducing a shock in each of the markets to analyse its impact on other markets. An impulse response function traces the effect of one unit of shock of the innovations on current and future values of the endogenous variables. A shock to *i*-th variable directly affects the *i*-th variable, and is also transmitted to all of the endogenous variables through the dynamic structure of the VAR. Since innovations are usually correlated, one cannot isolate the effect of the *i*-th variable on the *j*-th variable without disturbing other variables. These shocks can be

orthogonalised by applying Cholaskey decomposition. However, orthogonalising the shocks through Cholaskey decomposition add additional problems to this impulse response analysis as the response functions are very sensitive to the ordering of variables.

3. EMPIRICAL RESULTS

In this section we perform econometric tests to determine if the three markets are interlinked over the sample period. We first perform a unit root test to determine the order of integration of the three series. The results reported in Table 2 indicate that all three series are stationary in first differences. These results are consistent using the three different tests (ADF, PP and KPSS) on both sample periods. The next step is to determine if the series have any long-run relationships. The co-integration test results are reported in Table 3 and do not support any long-run relationship between the three variables for either of the sample periods. Since the series are not co-integrated, any possible market inter-linkages can be tested using the Granger causality method. The results of Granger causality for the full sample period are reported in Table 4a. These results suggest that changes in exchange rates did cause fluctuations in stock prices in Pakistan during the sample period. However, the same changes did not have any influence on interest rates. There is also empirical evidence of a causal relationship between stock prices and interest rates. Finally, the results suggest that conversely, changes in interest rates did not affect exchange rates or stock prices over the period under investigation. The results of Granger causality for the sub-sample period (see Table 4b) are consistent with the above findings. In summary, these results establish a link between the three markets where changes in the currency market influence the stock market which then lead to some changes in the money market.[4]

Table 2

Unit Root Tests

	Full Sample (12 October 1999 – 13 September 2006)			Sub-sample (25 September 2001 – 13 September 2006)		
	ADF	PP	KPSS	ADF	PP	KPSS
ER	–2.26	–2.24	1.29***	–2.81	–2.86	0.91***
SP	–1.88	–1.91	0.79***	–3.01	–3.01	0.49***
IR1	–1.39	–1.98	1.41***	–2.68	–1.92	1.26***
ΔER	–26.9***	–38.72***	0.34	–15.77***	–35.88***	0.32
ΔSP	–41.1***	–41.09***	0.12	–35.18***	–35.18***	0.12
ΔIR1	–44.7***	–51.9***	0.17	–37.98***	–45.04***	0.28

[4] These findings are consistent with Khalid and Kemal (2005) and Khalid and Rajaguru (2004).

Table 3

Co-integration Test
Co-integration between the Exchange Rate, Stock Prices and Interest Rate

	Full Sample (12 October 1999 – 13 September 2006)		Sub-sample (25 September 2001 – 13 September 2006)	
	Trace	Max	Trace	Max
r = 0	14.67	9.74	29.06	16.99
r = 1	4.93	4.50	12.07	11.35
r = 2	0.43	0.43	0.72	0.72

Table 4a

Granger Causality between the Exchange Rate, Stock Prices and Interest Rate
(Full Sample: 12 October 1999 – 13 September 2006)

	ΔER	ΔSP	ΔIR
ΔER	–	2.54**	0.29
ΔSP	0.12	–	2.20*
ΔIR	1.01	1.38	–

Table 4b

Granger Causality between the Exchange Rate, Stock Prices and Interest Rate
(Sub-sample: 25 September 2001 – 13 September 2006)

	ΔER	ΔSP	ΔIR2
ΔER	–	2.53**	0.74
ΔSP	0.12	–	2.44*
ΔIR2	0.09	1.55	–

Next, we perform variance decomposition analysis using the same two sample periods. The results of these tests are presented in Tables 5a (full sample) and 5b (sub-sample). These results suggest that most of the variations in each market are due to its own lag(s). The impact of cross-market variations is very small. These results are consistent with the results obtained using the Granger causality tests.

Table 5a

Variance Decomposition of Exchange Rate, Stock Prices and Interest Rate
(Full Sample: 12 October 1999 – 13 September 2006)

	Decomposition of ΔER			Decomposition of ΔSP			Decomposition of ΔIR1		
	ΔER	ΔSP	ΔIR1	ΔER	ΔSP	ΔIR1	ER	SP	IR1
1	100.00	0.000	0.000	0.04	99.96	0.00	0.16	0.02	99.83
2	99.98	0.001	0.022	0.04	99.88	0.07	0.16	0.35	99.50
3	99.96	0.009	0.027	0.07	99.86	0.07	0.18	0.35	99.47
4	99.80	0.027	0.177	0.49	99.28	0.23	0.20	0.38	99.43
5	99.80	0.028	0.177	0.49	99.27	0.23	0.20	0.38	99.43
6	99.79	0.028	0.180	0.50	99.27	0.24	0.20	0.38	99.42
7	99.79	0.028	0.182	0.50	99.27	0.24	0.20	0.38	99.42
8	99.79	0.028	0.182	0.50	99.27	0.24	0.20	0.38	99.42
9	99.79	0.028	0.182	0.50	99.27	0.24	0.20	0.38	99.42
10	99.79	0.028	0.182	0.50	99.27	0.24	0.20	0.38	99.42

Table 5b

Variance Decomposition of Exchange Rate, Stock Prices and Interest Rate (Sub-sample: 25 September 2001 – 13 September 2006)

	Decomposition of ΔER			Decomposition of ΔSP			Decomposition of ΔIR1		
	ΔER	ΔSP	ΔIR1	ΔER	ΔSP	ΔIR1	ER	SP	IR1
1	100.00	0.000	0.000	0.08	99.92	0.00	0.14	0.02	99.84
2	99.97	0.000	0.026	0.08	99.84	0.08	0.14	0.36	99.49
3	99.97	0.001	0.026	0.08	99.84	0.08	0.14	0.37	99.49
4	99.97	0.001	0.026	0.08	99.84	0.08	0.14	0.37	99.49
5	99.97	0.001	0.026	0.08	99.84	0.08	0.14	0.37	99.49
6	99.97	0.001	0.026	0.08	99.84	0.08	0.14	0.37	99.49
7	99.97	0.001	0.026	0.08	99.84	0.08	0.14	0.37	99.49
8	99.97	0.001	0.026	0.08	99.84	0.08	0.14	0.37	99.49
9	99.97	0.001	0.026	0.08	99.84	0.08	0.14	0.37	99.49
10	99.97	0.001	0.026	0.08	99.84	0.08	0.14	0.37	99.49

Finally, we use impulse response analysis to verify the robustness of our findings. Here, we introduce a shock in each of the markets and observe the intensity and duration of these shocks across markets. The results are reported in Figure 1a (full sample) and 1b (sub-sample) which are, again, consistent with the earlier results. In general, the results of these three different empirical methodologies suggest that there is no long-run relationship between the three financial market variables but one can find a short-term link from the currency market to the stock market to the money market.

Fig. 1a. Generalised Impulse Response Function for the Exchange Rate, Stock Prices, and Interest Rate (Full Sample: 12 October 1999 – 13 September 2006)

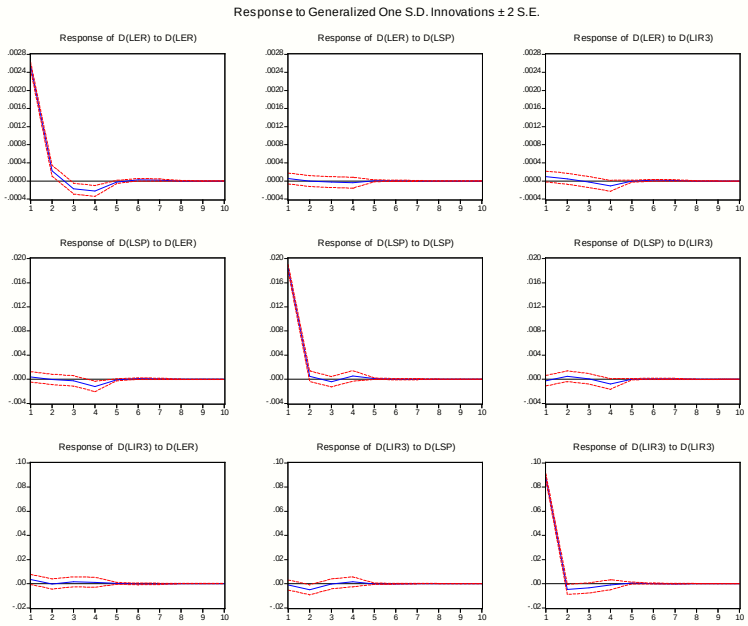
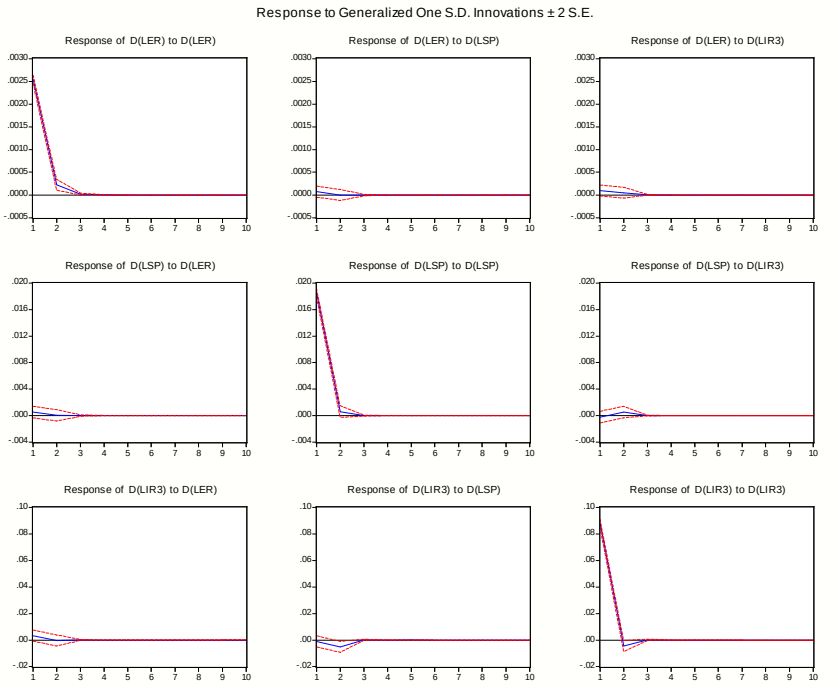


Fig. 1b. Generalised Impulse Response Function for the Exchange Rate, Stock Prices, and Interest Rate (Sub-sample: 25 September 2001 – 13 September 2006)



4. CONCLUDING REMARKS

This study examined whether dynamic linkages existed amongst the currency (foreign exchange), stock and money markets in Pakistan. We used high frequency data (daily observations for the exchange rate, stock prices and interest rate) and three different empirical testing procedures to determine if the three markets are interlinked in Pakistan. Based on co-integration tests, the empirical results failed to find support for a long-run relationship among the three markets. The Granger causality tests, however, found empirical evidence suggesting a causal relation from the currency market to the stock market and from the stock market to the money market, thus suggesting a link amongst the three markets. The results for the sub-sample are similar. The empirical findings based on variance decomposition and impulse response analysis are consistent with the above findings where most of the variations in each market variable can be explained by its own lag. It is interesting to note that our results are consistent with the theoretical hypothesis mentioned in Section 1 of this paper. Given that the three markets are linked, any internal or external shock would affect all three markets in a direct or indirect way. This is an important finding and could have important policy implications. For example, policy makers, while making a decision on internal policy should be mindful of the implications of their decision. On the flip side, policy makers could take *a priori* measure in one of the markets (e.g. interest rate) if an external shock is forthcoming and expected to hit a market (e.g. foreign exchange). A possible future

extension of this research could be to use data from actual shocks and analyse its impact in one of the markets and then see if the shock is transmitted to the other two markets. This issue will be explored in a separate paper.

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Comments

The study investigates the linkages among three markets of the financial sector of Pakistan, namely, currency, stock, and money, using three financial market indicators for them—exchange rate, the stock price, and the interest rate. It uses various methods, namely, Granger causality, variance decomposition, and impulse responses to explore the linkages among the three markets. However, I have the feeling that I should read all their papers before giving comments. Because it seems to me that they assume that the readers have sufficient knowledge for the terms used in the studies. Or they assume that the readers have read all their papers.

Here are some aspects on which they may focus.

(1) The title of the paper indicates that the main object of the paper is to measure the impact of political shocks. Whereas in the paper it is a secondary issue, the first issue is to find the linkages between three markets, currency, stock and money.

(2) Impulse response analysis has been conducted to verify the robustness of the findings by introducing a shock. The study does not mention what type of shock it is? However, in the beginning of the paper study mentioned about 9/11 event. Is it that?

(3) The authors use the terms like 'Political event' or 'certain political event' but did not say explicitly which political event? Though, in the introduction the event of September 11 has been discussed? If you are referring September 11 event. Do you consider it a political event?

(4) In the presentation it is said that 9/11 led to stability in financial market. So what you suggest from these results? I think we should explicitly mention that large foreign capital inflow causes the stability. Link is from 9/11 to capital inflow and to stability.

(5) Variance decomposition for dynamic analysis show that 99 percent variation in each market is due to its own lag. The impact of its cross market variation is very small even less than 0.5 percent (Table 5a). How robust the results are to conclude that markets are interlinked.

(6) It will be good if authors give full reference for various methods/terms used in the paper such as Cholaski decomposition, Markov Switching process, Impulse response, Akaik information criteria, Schwartz information criteria and likely hood ratio. The interested reader can read the detail.

(7) The authors wrote that the results of Granger causality for the sub-sample period are consistent with the results from the results of the full sample period without any empirical testing. There are some statistical methods to test if the two regressions are same or not i.e., chow test. If we want to test change in impact over two periods then we have to brake down sample into two and estimate two separate function then we can test the difference in the impact.

(8) The results need to be explained more as they show that there is a causal relationship which run from exchange rate (currency market-CM) to stock prices (stock market-SM) and then to interest rate (money market-MM). The reverse relationship does not exist from MM to SM to CM. But they did not explain the reasons. Or is it plausible or not?

(9) The results show that the recursive model as causation runs from money market to stock market to currency market, but not in the reverse order. This type of model can be estimated by SURE method.

(10) Abstract should be changed as it does not seem to fit the paper. From the title and the abstract it seems to me that main objective is to investigate the impact of a political shock. Whereas I found a very small part of the paper focusing on this issue. Most of the time it discusses the various methods to find linkages between the markets.

(11) ADF, Phillip-Perron (PP) and KPSS unit root test are used to check the stationary property of the data. The authors wrote that 'all the three tests determine the most robust estimates for the order of integration'. But, they did not mention the order of integration.

(12) I found missing references or proper references. For instance, they used data stream data base. It is fine but it will be better if they give exact web address.

(13) Last I would say that the relationship between the three markets may be strong and valid in the case of complete flexible exchange rate and if all prices are determined by valid in the case of complete flexible exchange rate and if all prices are determined by market forces. Week link between the market show that economy is still under control.

If authors can clarify the above-mentioned points, the paper will become more reader-friendly.

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