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Effects of interest rate, exchange rate and their volatilities on stock prices: evidence from banking industry of Pakistan

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Abstract. *This study investigates the effects of exchange rate, interest rates, and their volatilities on stock prices of banking industry of Pakistan. Cointegration results suggests the existance of significant negative long run relationship between exchange rate and short term interest rate with stock prices. On the other hand, positive and significant relationship exists between volatilities of exchange rate and interest rate with stock prices. Causality analysis confirms bidirectional causality between exchange rate and stock prices. Whereas, unidirectional causality runs from short term interest rate to stock prices. Sensitivity analysis confirms that the results are robust. It is suggested that investors should invest in banking sector stocks when exchange rate and interest rates are highly volatile. The result also supports the view that exchange rate and interest rate can be used as an indicator for investment decision making in banking sector stocks.*

Keywords: interest rate; exchange rate; GARCH; cointegration.

JEL Codes: C32, G11, G21, E43.
REL Code: 11B.

1. Introduction

Interest rate and foreign exchange rate risks are two important economic factors affecting the common stocks (Hyde, 2007, Vazz et al., 2008). Interest rate has a more direct effect on financial market, an increase in interest rate leads investing decisions to make a change in the structure of investment, generally from capital market to fixed income securities. Variability in interest rates directly generates a momentum to the money market from capital market. The stocks are sensitive to interest rates, as the changes in interest rates are inversely related to stocks (Alam, Uddin, 2009). Theoretically, the relation between exchange rate and stocks can be postulated as either positive (currency depreciation makes local firms more competitive, leading to an increase in exports as a result stocks prices increase), or negative (if the production is dependent on imported input, cost of production would rise as a result of currency depreciation, thus reducing profitability and a resulting decline in stocks returns), and a weak or no relation (an export oriented firm's prices rises with currency depreciation, since the input cost is also affected by this currency depreciation than the effect would be nullified to some extent because of increased cost of production).

Number of macroeconomic indicators which influence stock markets have been analyzed in past and recent empirical literature(1). Most of the previous studies only focused on the stock market as a whole ignoring the effects of these variables on different sectors of the economy (Ahmed et al., 2010, Hussain, Mahmood, 2001), while this is significant but investor must understand that different sectors of the economy react differently to changes in macroeconomic variables(2).

The last decade has seen exceptional growth and profitability in the banking industry of Pakistan. Even during the recent financial crises in world which saw liquidation of huge financial institutions, this sector came out without major loses, in fact the profitability of this sector kept climbing, making it a lucrative sector in the stock market. At this stage we cannot set a specific relationship of interest rate and exchange rate with stock prices of banking industry unless the empirical analysis is done. Thus in the this paper we intend to shed some light on the existing relationship of interest rate, exchange rate and banking sector stock prices, based on empirical evidence from Pakistan.

Rest of the paper is structured in this manner, following introduction, section 2 represents some selected reviews of literature. Modeling frame work

is discussed in section 3, Section 4 shows estimation and results while section 5, concludes the study and give some policy implications.

2. Review of literature

Choi et al. (1992) estimate a multi-index model for measuring sensitivity of commercial banks stock returns to interest rate and exchange rate. Dummy models are used to separate the results attributable to money center banks from other banks. A significant exchange rate effect occurs for money center banks after October 1979, while interest sensitivity is stronger before October 1979. The exchange rate effect is attributed to increased foreign loan exposure of money center banks.

Habibullah and Baharumshah (1996) studied the relationship between money, output and stock prices in Malaysia. They employed co integration test on data from January 1978 to September 1992. Six different indices of stock exchange were tested by using money supply (both M1 and M2) and GDP as a proxy of output.(3) They concluded that Malaysian stock market is informationally efficient with respect to both these variables.

Bashir and Hassan (1997) analyzed interest rate sensitivity to stocks in UAE. Data covering a period of January 1990 to December 1994 are analyzed. Simple OLS technique was adopted. Results showed that interest rate fluctuations have a significant and negative effect on the stocks of banking sector. Furthermore, even in absence of an official stock market, investors in UAE do take in to consideration the interest rate factor while dealing in stocks.

Nishat and Shaheen (2004) investigated the long run relation between macroeconomic variables and KSE index. Quarterly data covering a period of 1973- 2004 are used. Industrial production index, inflation, broad money, value of an investment earning and money market rate are tested with error correction model and Granger causality technique. The cointegration results indicate a long term relation among these variables. It is further concluded that industrial production and inflation are the largest positive and negative determinants respectively. There also existed a casual relation between stock market and interest rate.

Maysami et al. (2004) studied co integration between economic variables and sector indices, as well as stock market index of the stock exchange. Sectors whose relation was analyzed comprises finance index, property index and hotel index using monthly data covering a period from January 1989 to December 2001. Short and long term interest rates, industrial production, price levels,

exchange rate and money supply were tested by applying co integration and Vector Error Correction Model (VECM). Results show significant relationship of stock index and property index with all the variables. While significant relationship with selected variables only was established for finance and hotel indices(4).

Hyde (2007) explored the sensitivity of stock returns of 33 industry portfolios of four European economies to exchange rate, interest rate and market risk. Data covered a period from January 1973 to December 2004. Results revealed that both exchange rate and market risks are significant and positive for all four economies, while interest rate risk is positively significant for France and Germany.(5) Further decomposition of the risks showed that news relating to future dividends, real interest rates and excess returns are the main determinants.

Vardar et al. (2008) analyze the impact of interest rates and exchange rate on volatility of different sectors (financial, industrial, services and technology) and composite indices in Istanbul stock exchange. Daily data covering a period within interval 2001-2008 was analyzed using GARCH model. Results show strong power of prediction of the two variables on the volatility of the composite index. Specifically exchange rate changes are strongly predictive for all the indices except technology index. Moreover interest rate volatility showed significant positive relationship with all indices except services sector, which shows a negative relationship. It is suggested that investors should follow the monetary policies in order to effectively manage risk while taking investment decision in these sectors.

Vaz et al. (2008) examined the changes in interest rates on stocks returns of major Australian banks during the period from January1990 to June 2005. The study used market model event study methodology. Results show no negative impact on Australian banks stock returns after announced increased in interest rates, in comparison to banks in US, where a negative impact is observed with an increase interest rate. Also there is a net positive abnormal return in the event of cash rate increase. It is concluded that Australian banks working in less competitive and concentrated environment are able to advantageously manage earnings impacts when cash rate changes are announced.

Adjasi et al. (2008) analyzed the effect of exchange rate fluctuations and their impact on the Ghana stock exchange. The monthly data covered period of 1951:1 – 2005:6. EGARCH model is used to determine and forecast the variance. It is concluded that volatility in stock return is not the sole result of

exchange rate volatility, but it is also affected by other macroeconomic factors. Furthermore, results also showed an inverse relationship between exchange rate volatility and stock market returns. It is recommended that measure should be taken to ensure stable macroeconomic environment, for better investor inflow and informed and decision making for future investment.

Aydemir and Demirhan, (2009) explored causality between stocks and exchange rates in Turkey. Data from 23rd February 2001 to 11th January 2008 was tested using cointegration and error correction model. Five indices(6) were selected to represent the stocks. The results show existence of bi directional causality between exchange rate and all stock market indices. Four out of five selected indices showed a negative causality (running from indices to exchange rate) except technology.

Beirne et al. (2009) analyzed the relationship between macroeconomic variables and stock returns in three financial sectors i-e banking, financial services and insurance in 16 different countries. Furthermore they studied the causality in mean and volatility. A four variate GARCH model was used. The variables include three financial sector indices, T-bills, govt bonds, exchange rates, long and short term interest rates. Results showed a negative significant effect of interest rate, while exchange rate showed a mixed significant effect with stock prices.

3. Modeling framework

On the basis of theoretical and empirical discussion above this paper attempts to examine the effect of interest rate, exchange rate and their volatilities on stock prices of banking sector by using the following functions:

$$SP = f(I, F) \quad (3.1)$$

$$SP = f(I, VF) \quad (3.2)$$

Where *SP* represents stock prices of banking sector, *F* shows the focus variables of the study which are exchange rate (*ER*) (Beirne et al., 2009), short term interest rate (*SIR*) and long term interest rate (*LIR*). "*I* " represents the control variables in the model, comprising of foreign direct investment (*FDI*), trade balance (*BOT*) and inflation (*CPI*) (Pilinkus, 2009) portfolio investment as a percentage of total foreign investment (*PI*),(7) foreign reserves (*FR*) (Mohammad et al., 2009) remittances (*REM*), whereas *VF* shows the volatilities of exchange rate, and interest rates.

In this study six vectors have been examined, *ER*, *SIR* and *LIR* along with their volatilities with all control variables. The equations used for this purpose are:

$$SP = \alpha_0 + \alpha_1 \times F + \alpha_2 \times I + \varepsilon_t \quad (3.3)$$

$$SP = \alpha_0 + \alpha_1 \times VF + \alpha_2 \times I + \varepsilon_t \quad (3.4)$$

Here "ε_t" represents the error term. Volatilities of exchange rate and interest rates are measured by GARCH(1,1) model.[8] Monthly data from January 2004 to December 2010 are used. All data is acquired from Karachi stock Exchange, and the State Bank of Pakistan.

4. Estimation and results

Since our data is time series therefore preliminary stationarity check is performed by using Dickey and Fuller (1979) statistics as well as Philips and Perron (1988) methodolgy. Results of the tests are presented in Table 1.

Table 1

Stationarity test results

Variables	ADF test				PP test			
	I(0)		I(1)		I(0)		I(1)	
	C	C&T	C	C&T	C	C&T	C	C&T
ER	-0.05	-1.80	-3.55	-3.55	0.34	-1.67	-5.22	-5.25
SIR	-2.52	-3.04	-5.52	-5.67	-1.95	-2.31	-7.14	-7.27
LIR	-1.68	-1.85	-5.29	-5.26	-1.02	-1.86	-8.15	-8.10
FDI	-4.64	-4.79	-10.40	-10.35	-6.04	-6.12	-12.76	-12.69
PI	-5.57	-5.64	-10.45	-10.38	-9.01	-9.07	-17.72	-17.60
CPI	-1.36	-1.69	-3.81	-3.78	-1.22	-1.39	-6.17	-6.12
REM	-1.74	-2.15	-5.51	-5.47	-1.39	-1.72	-5.78	-5.74
AVB	-0.96	-1.97	-6.01	-6.07	-0.67	-1.85	-5.93	-5.95
LFDI	-8.54	-8.53	-9.1880	-9.1270	-8.63	-8.61	-60.67	-59.80
LPI	-7.37	-7.49	-14.24	-14.16	-7.35	-7.39	-33.10	-33.11
VER	-2.55	-2.53	-14.87	-14.78	-4.35	-4.39	-14.70	-14.62
VSIR	-2.54	-2.53	-14.87	-14.76	-4.34	-4.38	-14.70	-14.62
VLIR	-5.14	-5.08	-10.86	-10.80	-5.14	-5.08	-14.26	-14.13

Note: The critical values for ADF and PP tests with constant (C) and with constant & trend (C&T) 1%, 5% and 10% level of significance are -3.711,-2.981,-2.629 and -4.394,-3.612,-3.243 respectively.

Source: Author's estimations.

The result shows existence of non-stationary in all variables at level. Here equation is used to check stationary in the data first with intercept and then with trend and intercept. Assuming null hypothesis to be representing non-stationary in the data and alternative hypothesis means stationary in the data. All the given variables are non-stationary at level. Analyzing the stationary in the data at level consequently checking stationary at first difference the result indicates that all the variables becomes stationary at first difference {*i.e.I(1)*}. Since the data is stationary it means that it is significant in revealing a long run relationship respectively, and the regression estimates are not superior (Gujrati, 2004, p. 806).

Test results of regression analysis are given in Table 2.

Table 2

Long run determinant of stock prices

	Model of ER			Model of SIR			Model of LIR		
Variables	Coefficient	t-stats	Prob.	Coefficient	t-stats	Prob.	Coefficient	t-stats	Prob.
Constant	215.545	3.624	0.000	290.163	4.695	0.000	317.764	4.674	0.000
F	-1.000	-4.263	0.000	-2.243	-2.350	0.023	-0.695	-0.620	0.538
FDI	9.128	2.026	0.049	13.870	2.835	0.007	13.647	2.635	0.012
PI	2.712	1.537	0.132	10.178	2.426	0.019	11.570	2.674	0.010
CPI	-2.062	-4.311	0.000	-2.914	-6.333	0.000	-3.132	-6.422	0.000
REM	0.029	4.926	0.000	0.044	9.300	0.000	0.051	11.176	0.000
FR	-32.823	-1.924	0.058	-67.170	-4.367	0.000	-77.604	-4.523	0.000
BOT	0.027	4.695	0.000	0.026	3.707	0.001	0.021	2.314	0.025
Adj. R^2	0.939			0.923			0.914		
D-W stats	2.022			2.107			2.021		
F-stats(prob)	112.514 (0.000)			88.341 (0.000)			78.520 (0.000)		

Source: Author's estimation.

From Table 2 it is clear that exchange rate and short term interest rate has significant negative effect on stock prices, which is logical when interest rate and exchange rates are high, investors do not invest more in stocks because of increased returns in bank deposits and forex market. On the other hand *LIR* has insignificant effect on stock prices, this is so because usually the long-term changes in interest rate does not effect the short-term investment of stocks. Results of equation 3.4 indicates the existence of autocorrelation in the model, which is removed by using Cochrane-Orcutt iterative procedure (Gujrati, 2004, p. 507). Table 3 shows the GARCH results after removing autocorrelation. Here log of *FDI, CPI* and *FR* have been used for estimation.

Table 3

Long run determinants of stock prices

Variables	Model of Volatility Of ER			Model Of volatility Of SIR		
	Coefficient	t-stats	Prob.	Coefficient	t-stats	Prob.
Constant	185.252	16.101	0.000	55.281	19.897	0.000
VF	0.937	23.398	0.000	0.957	23.776	0.000
FDI	1.959	7.555	0.000	1.983	7.631	0.000
PI	-23.546	-24.637	0.000	-23.324	-24.511	0.000
CPI	0.008	5.227	0.000	0.010	5.729	0.000
FR	-16.632	-13.812	0.000	-0.003	-13.780	0.000
REM	0.050	51.345	0.000	0.051	51.331	0.000
BOT	0.013	9.245	0.000	0.015	9.83043	0.000
Adj. R^2	0.988			0.988		
D-W stats	1.663			1.682		
F-stats(prob)	854.926 (0.000)			851.823 (0.000)		

Source: Author's estimation.

It is evident from table 3 that volatility of exchange rate and short term interest rate are positive and significant, if the exchange rate and interest rates are more volatile than the flow of investment would be shifted from exchange rate and bank deposits to stocks, thus increasing the value of stocks. The higher the volatility in the exchange rate and interest rate the higher the diversion from it towards a relatively more secure investment like stocks.

Johanson and Juuselieus (1990) cointegration method is applied to estimate the Long run relationship among the variables. The two test statistics used for cointegration are Trace statistics and maximum eigen value statistics. The calculated values of these two stats and their respective critical values for equation 3.3 are presented in Table 4.

Table 4

Cointegration test results of ER & SIR

Models	Hypothesis No. of CE(s)	Trace statistics	5% critical values	Max. Eigen value statistics	5% critical values
Model 1 ER	None	208.777	143.669	62.453	48.877
	At Most 1	146.323	111.78	49.17	42.772
	At Most 2	97.153	83.937	43.599	36.63
	At Most 3	53.553	60.061	25.648	30.439
	At Most 4	27.904	40.174	11.576	24.159
Model 2 SIR	None	176.853	143.669	57.18	48.877
	At Most 1	119.672	111.78	47.048	42.772
	At Most 2	72.624	83.937	26.38	36.63
	At Most 3	46.243	60.061	19.433	30.436
	At Most 4	26.81	40.174	13.731	24.159

Source: Authors' estimations.

Table 4 reports rejection of null hypothesis at five percent level of significance, for both the trace statistics and the maximum eigen value statistics, in favour of alternative that there are three cointegration vectors for the first model of *ER*, and two cointegration vectors for the model of *SIR*. Therofore, based on the results it is concluded that long-run relationship exists between the considered variables.

Table 5

Cointegration test results of volatility of ER & SIR

Models	Hypothesis No. of CE(s)	Trace statistics	5% critical values	Max. eigen value statistics	5% critical values
Model 1 VER	None	176.988	143.669	54.085	48.877
	At Most 1	122.902	111.78	43.953	42.772
	At Most 2	78.949	83.937	29.705	36.63
	At Most 3	49.243	60.061	22.677	30.439
	At Most 4	26.566	40.174	14.879	24.159
Model 2 VSIR	None	206.538	143.669	69.365	48.877
	At Most 1	137.173	111.78	54.165	42.772
	At Most 2	83.007	83.937	33.252	36.63
	At Most 3	49.754	60.061	23.444	30.439
	At Most 4	26.31	40.174	15.514	24.159

Source: Authors' estimations.

Table 5 presents the results for the volatility equation 3.4. The results show existance of two cointegration vectors for both models of volatilitis of exchange rate and short-term interest rate. These results also show the existence of long-term relationship for the volatilitis of focus variables. While performing cointegration the proxy of long-term interest rate was not considered because it was found insignificant during our initial results.(9)

Causality analysis

In this section Granger causality analysis has been performed to find the causal relationship among the focus variables (*ER, SIR & LIR*) and stock prices. Standard Granger (1969) structure has been used. Jones (1989) expresses that ad hoc selection method for lag length in Granger causality is better than some of the statistical method used to determine optimal lag. Consequently two lag lenghts are assumed for the whole model. The results of Granger causality are reported in Table 6.

Table 6

Granger causality

Dependant variables	AVB	ER	SIR
AVB	–	3.49154 (0.03536)	3.31385 (0.04163)
ER	3.834406 (0.02563)	–	5.42734 (0.00624)
SIR	0.05227 (0.94911)	1.98691 (0.14409)	–

Note: Lag length in each case is two as per Akaike Information Criteria (AIC). Critical values for F-statistics can be found in Gujrati (1995), p. 814.
Source: Author's estimations.

Table 6 shows the existance of bidirectional causality among exchange rate and stock prices(10). However, unidirectional causality was found running from short-term interest rate to stock prices. These findings supports the results of Nishat and Shaheen (2004), who found causal relation between interest rate and stock exchange prices. Since the result of long-term interest rate was insignificant therefore its causality analysis is not logical.

Sensitivity analysis

This section covers the sensitivity analysis of initial results to check the robustness. Levine and Renelt (1992) established degree of confidence between the dependent and explanatory variables. After placing additional variables in the model if the coefficient of focus variables remains unchanged and significant than this shows that the results are robust. If there is a change either in the sign of the coefficient of focus variable or it loses its significance then this means that the relation between variables is weak and the result is fragile.

In our basic model exchange rate and short-term interest rate are the two focus variables. Table 7 shows the results of sensitivity analysis after introducing three new variables Industrial Production Index (*IPI*) (Mohammad et al., 2009), Exports (*EXP*) and Imports (*IMP*).(11)

Table 7

Sensitivity analysis of ER and SIR

Variables		Coeff. of F	t-stat. (prob)	Adj.R^2	F-Stat (prob)
Model of ER	Basic Model	-1.00	-4.263 (-0.001)	0.939	112.514 (0.000)
	Model 1 IPI	-1.11	-4.82 (0.000)	0.944	104.957 (0.000)
	Model 2 EXP	-1.31	-5.897 (0.000)	0.946	111.741 0
	Model 3 IMP	-1.21	-5.59 (0.000)	0.942	104.899 (0.000)
Model of SIR	Basic Model	-2.243	-2.53 (-0.023)	0.923	88.341 (0.000)
	Model 1 IPI	-2.406	-2.279 -0.028	0.911	63.741 (0.000)
	Model 2 EXP	-4.648	-3.608 (-0.001)	0.923	77.829 (0.000)
	Model 3 IMP	-4.295	-3.39 (-0.001)	0.921	75.556 (0.000)

Source: Authors' estimations.

This analysis is also performed for the volatilities of two focus variables namely exchange rate and short term interest rate, results of this are given in Table 8.

Table 8

Sensitivity analysis of volatility of ER and SIR

Variables		Coeff. of volatility of F	t-stat. (prob)	Adj.R^2	F-Stat (prob)
Model of ER	Basic Model	0.937	23.398 (0.000)	0.988	854.926 (0.000)
	Model 1 IPI	0.935	22.831 (0.000)	0.989	683.237 (0.000)
	Model 2 EXP	0.939	22.765 (0.000)	0.987	678.958 (0.000)
	Model 3 IMP	0.938	22.961 (0.000)	0.989	681.361 (0.000)
Model of SIR	Basic Model	0.957	23.776 (0.000)	0.988	851.823 0.000
	Model 1 IPI	0.949	22.667 (0.000)	0.987	655.555 (0.000)
	Model 2 EXP	0.948	22.924 (0.000)	0.987	672.267 (0.000)
	Model 3 IMP	0.952	22.705 (0.000)	0.987	650.324 (0.000)

Source: Authors' estimations.

As clear from the tables, that even after inclusion of additional variables there is not much change in the coefficient of focus variables, also their sign and significance remains unchanged as well. This confirms that the results are robust.

5. Conclusions

Number of studies have been conducted to find the relationship among macroeconomic variables and stock prices, but a very few studies focused on sector wise relationship. This study investigates the effects of exchange rate, interest rates, and their volatilities on stock prices of banking industry of Pakistan. Cointegration results suggests the existence of significant negative long-run relationship between exchange rate and short-term interest rate with stock prices. On the other hand, positive and significant relationship exists between volatilities of exchange rate and interest rate with stock prices. Causality analysis confirms bidirectional causality between exchange rate and stock prices. Whereas unidirectional causality runs from short-term interest rate to stock prices. Sensitivity analysis confirms that the results are robust. It is suggested that investors should invest in banking sector stocks when exchange rate and interest rates are highly volatile. The result also supports the view that exchange rate and interest rate can be used as an indicator for investment decision making in banking sector stocks.

Notes

(1) Some studies are: Ryan and Worthington, (2004), Zafar et al. (2008), Pilinkus (2009), Wong et al. (2005).
(2) Bernie and Caporale, (2009) concluded the effect of interest rate is different for banking, insurance and financial services.
(3) The indices were composite, industrial, finance, property, plantation and tin.
(4) These variables were IR, inflation, ER, IPI and money supply.
(5) German and French stocks are more sensitive to interest rate risk.
(6) These indices were National 100, services, financial, industrial and technology.
(7) Being part of total Foreign investment, theoretically it should effect the stock prices.
(8) For details see Gujrati (2004).
(9) To test the short run relationship error correction model has been used, but the results were insignificant in all variables.
(10) This result is consistent with Aydemir and Demirhan (2009).
(11) Pilinkus (2009) used EXP & IMP.

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