

DYNAMIC RELATION BETWEEN MACROECONOMIC VARIABLES AND EXCHANGE RATE IN PAKISTAN

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ABSTRACT: Exchange rate is characterized as host country current market price of currency in terms of other country (specifying the worth). Exchange rate fluctuates due to variation in economic conditions. Change in exchange rate will have a great impact on economy. This study investigates the relationship between stock prices, oil prices, foreign reserves and exchange rate of Pakistan. Monthly data for the period of 2001 to 2010 is collected for analysis. To find the long term relationship between observed variables, Johansen’s cointegration is used. Granger causality statistical test is used to address the causal effect between the variables. This study documented that due to increase in stock prices and foreign reserves exchange rate will depreciate causing currency to appreciate and due to increase in oil prices, exchange rate will also increase resulting in depreciation of currency. Results are beneficiary for investors to hedge risk and portfolio diversification; government and State Bank to govern policies.

Keywords: exchange rate, foreign reserves, oil prices, stock prices

1. INTRODUCTION

Currency’s value varies because of changing economic conditions in country; also variation in exchange rate enormously affects economy and is considered as indicator of economy. Currency’s value will rise when demand for it is greater than supply of it and when supply of it goes higher than demand for it, currency’s value will go down. Numerous factors have impact on increase/decrease in demand and supply of currency, due to which currency value may rise or fall.

In 1944, after the great depression of 1930s, 730 representatives of 44 developed nations assembled in Bretton woods to construct regulations for monetary system so, all participating countries to implement that system in order to develop monetary relations. Key points of Bretton woods agreement were; (1) Participant countries to fixed its exchange rate with US dollar which was fixed to gold at \$ 35 per ounce (2) Launching of International Monetary Fund (IMF) so that countries can draw funds while facing problems in payments (3) Establishment of International Bank for Reconstruction and Development (IBDR) for assistance of less developed countries. Before Bretton woods agreement, gold standard was followed by countries.

In 1971, United States ceased exchange of US dollar to gold resulting in invalidity of Bretton woods agreement and the event is called ‘Nixon shock’. After termination of Bretton woods system many currencies became free floating, also many countries got US dollar as reserve currency.

Pakistani rupees was fixed with British pound till 1970, in 1971 it was fixed with US dollar and in 1982 managed-floating regime was adopted which was continued till 1988. In 1999 General Pervaiz Musharaf again pegged Pakistani rupee with US dollar which was converted to free floating in 2008. Pakistani rupee depreciated by 43.24% from 2001-2010.

Figure 1 depicts monthly exchange rate of Pakistan from year 2001 to 2010. In year 2001 exchange rate was Rs. 59.0929, increased to 60.2034 in year 2002 against US\$. Exchange rate decreased in year 2003 i.e.; 58.1807 and keep decreasing in 2004 at the rate of Rs/US\$ 57.3949. In year 2005 exchange

rate reached 59.4481 and after that from year 2006 to year 2010 continuous increase is observed in exchange rate of Pakistan against US\$; it reached 84.6436 in year 2010. Increase in exchange rate is showing depreciation of Pak Rupees.

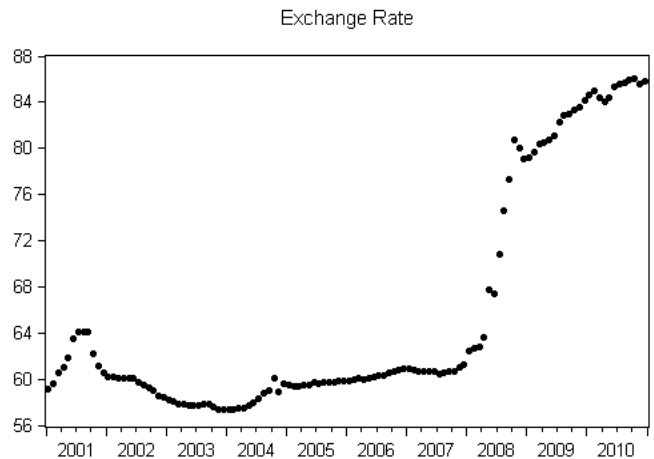


Fig .1 Monthly Exchange Rate of Pakistan

Many factors influence exchange rate; inflation rate, interest rate, income level, balance of payment, political stability and GDP are said to be the determinants of exchange rate. Increase in relative inflation in country will tend to increase exchange rate because residents of country will demand more foreign currency to purchase foreign goods/services. Same case will be true for increase in income level. Due to increase in interest rate, balance of payment, GDP and political stability reverse will happen. Many others factors like stock prices, oil prices, foreign reserves and foreign remittances also affect exchange rate of a country; which are said to be the unconventional factors.

2. THEORITICAL JUSTIFICATION

A large body of empirical and theoretical literature is available on the relationship exchange rate and macro-economic variables. Eminent scholars have investigated the

influence of exchange rate on the macro-economic conditions of country.

Study was conducted to investigate relationship between exchange rate and stock prices in four South Asian countries (Pakistan, India, Sri-lanka and Bangladesh) using monthly data for the span of January 1994 to December 2000 employing cointegration and granger causality tests. Bi-directional long-run causality was found between stock prices and exchange rate in Bangladesh and Sri lanka; while no short run relationship between said variables for all four countries and no long run relationship was found between stock prices and exchange rates in Pakistan and India [1]. Researchers studied relationship between stock prices and exchange rate in four Asian countries namely Philippines, Malaysia, Thailand and Indonesia by dividing whole period in two sub-periods, one from 1 Jan to 1 Jul 1997; before and second from 2 Jul to 31 Dec 1997 during Asian Financial crisis. No causality was found for all of four countries during crisis period; while unidirectional causality was found before financial crisis period for Indonesia and Thailand running from exchange rate to stock prices and for Malaysia it was in reverse direction i.e. from stock prices to exchange rate [2]. Positive relation running from stock prices to exchange rate and negative relation running from exchange rate to stock prices is reported for US and UK for the period of Jan 1990 to Aug 2004 [3]. Bidirectional causality is reported in Turkey [4]. Long run relationship is reported among stock prices, real exchange rate and oil prices in Egypt, Oman and Saudi Arabia while for Kuwait same relationship exists only for stock prices and oil prices [5]. Research was conducted to examine relationship between stock prices and exchange rate of three South Asian countries which are Pakistan, Bangladesh and India using monthly data from Jan 2003 to June 2008 by employing cointegration and granger causality. The study concluded that there is no cointegration and no way causality between these variables in sample period for the three countries [6]. Negative relation among stock returns and exchange rate is concluded in India and Ghana, employing granger causality and factor model respectively [7]. No cointegration among both variables is reported in Australia, Canada, Japan, Switzerland and UK for time span of 1992:1 - 2005:12 [8].

Study was conducted to check association among oil prices and exchange rate employing monthly data from Jan 1973 to Jun 1993 in USA, Germany and Japan using cointegration and granger causality models, found that both variables are cointegrated in each country and uni-directional causation sprouts from oil prices to exchange rate. Due to 10% increase in oil prices, mark depreciates by 0.9%, Yen by 1.7% and dollar appreciates by 2.6% [9]. Research was conducted to check relationship between oil prices and exchange rate in Republic of Dominican (oil importing country) using monthly data from Sept 1991 to April 2005 employing cointegration, VAR and VECM, and explored that as oil prices increase by 1% Dominican Peso depreciates by 2.9%; this is because oil trading is denominated in US dollar, the supply of Dominican Peso and demand for US dollar increases while import [10]. Study was conducted to investigate association between oil prices and exchange rate in Norway, an oil exporting country using daily data from 1st

Jan 1986 to 12 Aug 1998 and reported negative relationship between both variables [11].

Research was conducted to study impact of oil prices, GDP, trade balance, FDI on exchange rate of UAE Dirham by considering annual data from 1977 to 2007, using granger causality and Johansen's cointegration. They found that all four variables have both short and long run causality with real exchange rate [12].

Research was performed using quarterly data from 1994 to 2009 to study the impact of oil prices on GDP, real exchange rate and inflation rate in Russia (oil-exporting country) using cointegration and impulse response function. It was documented that due to 1% increase (decrease) in oil prices, exchange rate depreciate (appreciate) by 0.17% in long run and GDP increase (decrease) by 0.46%. In short run due to rise in oil prices not only GDP increases and exchange rate depreciates but also minor increase in inflation is found [13]. Study was performed to check the relationship between foreign reserves and exchange rate using monthly data from Jan 1982 to Nov 2005 in Turkey. They used Cointegration model to examine the long run relationship between these financial variables. Long run and short run unidirectional causality was also found running from foreign exchange reserves to exchange rate [14].

Pakistani rupee is depreciating day by day against US dollar. Depreciation of currency with high intensity and on regular basis, cause the nation's economy weak. A part from determinants (interest rate, inflation rate, balance of payment and GDP) of exchange rate there are also other macroeconomic variables which may have considerable effect on exchange rate of any country. Pakistan is an oil importing country, and it imports more than 80% of its need. Oil price scrambles may affect exchange rate. Oil prices and foreign reserves play an important role in economic development of a country; therefore it is important to empirically study the relationship foreign reserves, oil prices and exchange rate. As far as Pakistan is concerned limited research is conducted to study the impact of oil prices and foreign reserves on exchange rate.

3. METHOD AND MATERIAL

The present study investigates the long run and short run relationship between stock price, oil price, foreign reserves and exchange rate in Pakistan. For empirical analysis, ten years monthly data is collected for the period January 2001 to December 2010. Oil price monthly data is extracted from OPEC data base. While exchange rate, stock prices and foreign reserve data is collected from State Bank of Pakistan website. The comprehensive definitions of variables are presented below.

Stock Prices

In the current era, emerging economies tend to shift their financial structures from bank based to security market based; which is a basic reason of launching of several stock markets. Importance of financial markets and attempts to predict performance of markets is attached with rising of recognition academicians, market analysts, and policy makers of amplifying influence of macroeconomic variables on both markets. Association among stock prices and exchange rate is necessary to find out for any economy as it helps

governments and central banks to design monetary and fiscal policies; as due to increase in stock prices aggregate demand also increase [3]. Exports may be increased by depreciating currency; while due to depreciation of currency stock market goes down. Also, Multinational corporations may get benefit to finalize their foreign contracts and to alleviate earnings by predicting way of exchange rate. Most of the times, currency is included in investment funds’ portfolios; information of relation between different stocks and currency may improve performance of fund. Crisis in any of one financial market may also be predicted by behavior of other financial market. It is vital to check relation between both variables in crisis period and impact of exchange rate on other assets; as policy makers intervene exchange rate at the time of crisis also these are important for investors for diversification and hedging purpose [2]. Return on stocks is higher than that of other risk free financial instruments like T-bills; because high risk is associated with it and most of the investors tend to invest in stocks with the aim of high return irrespective of the affects of macroeconomic variables on stock prices [15].

3.1 Oil Prices

Energy has vital role in world’s economy. In spite of significant preference of substitutes of energy e.g; wind, water, nuclear and solar power, the part of crude oil in macroeconomic movements has not declined so far. Oil contracts are denominated in US dollars; variation in oil prices has important impact on exchange rates of oil importing and exporting countries as well [10]. Increase in oil prices causes high liquidity, increase in asset prices, high consumer prices resulting in increase in inflation. Home currency should be pegged with basket of currencies instead of only one currency; as basket of currencies may reduce negative effect of depreciation of one currency on home currency [12]. Oil shock is most important problem; due to which not merely oil importers but also oil producers suffer. It asserts negative effect on global economy, causing economic depression especially in industrial countries (USA, Japan, Germany e.t.c) which are highly reliant on oil and are the major importers of oil. Rise in oil prices cause increase in the financial surpluses of the oil exporting countries, resulting in significant changes in their pattern of spending and investment. Whenever upset in oil prices occur; oil exporting countries have to bear huge and unexpected consequences due to alteration in liquidity which will give a boost to asset prices, lessen control on price constancy, and cause to increase in inflation; resulting in depreciation of currency value [10]. As oil and currencies are included in portfolios of many of the investors; so relationship is much important to know. Oil is the mostly traded commodity so investors get benefit of it to hedge risks. [16].

3.2 Foreign Reserves

Foreign exchange reserves are different foreign financial assets in command of central banks or monetary authorities used to intervene in exchange markets, manage the monetary and exchange rate policies, back bank notes in use and for other functions. Sterilization defines the relationship between foreign exchange reserves and exchange rate of country; excess in increase or decrease of exchange rate is controlled by buying or selling local currency respectively against foreign reserves.

3.3 Theoretical Model

The Theoretical model of the study is presented in figure 2. Exchange rate is taken as dependent variable, while stock prices, oil prices and foreign reserves used as independent variable in the model.

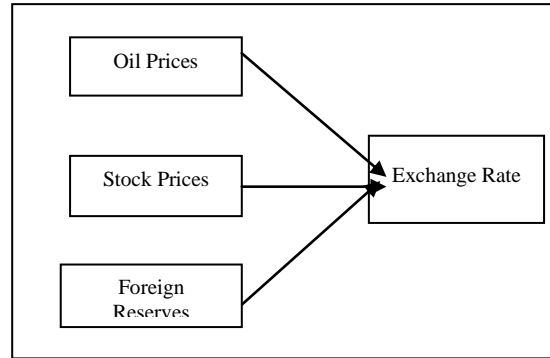


Fig. 2 Theoretical Model

3.4 Empirical Model

To study the relationship between oil prices, stock prices, foreign reserves and exchange rate following empirical model is specified.

$$ER = \alpha + \beta_1(OP) + \beta_2(SP) + \beta_3(RES) + \epsilon_i$$

Where;

- ER = Exchange rate,
- OP = Oil prices,
- SP = Stock prices,
- RES = Foreign reserves
- ϵ_i = Error term

This research investigates dynamic relationship of exchange rate with macroeconomic variables like stock prices, oil prices and foreign reserves. Objectives of this research study are:

- To probe weather there is long run or short run relationship between oil prices, stock prices, foreign reserves and exchange rate in Pakistan.
- To investigate the direction of relationship between exchange rate, oil prices, foreign reserves and stock prices.

Augmented Dickey-Fuller statistic is used to check stationarity of data. Johansen’s cointegration is applied to check long-term relationship between dependent (exchange rate) and independent (stock prices, foreign reserves & oil prices) variables. To check direction of relation among exchange rate, stock prices, foreign reserves, and oil prices Granger causality is used and lastly linear regression model is used to check variation in dependant variable (exchange rate) due to independent variables (stock prices, foreign reserves & oil prices).

4. RESULTS

Before applying Johansen’s cointegration statistic; Augmented Dickey-Fuller (ADF) unit root test is applied to check stationarity of data. There are three types of different conditions in the ADF test for every time series. First, random process includes intercept (c) and trend (t). Second, random process includes intercept (c) but no trend (0). Third, random process includes no intercept (0) and trend (t).

Table 1 shows results of ADF unit root test for variables (exchange rate, stock prices, oil prices & foreign reserves). It may be explored from above-mentioned table that all the variables are stationary at their first difference having unit root at level.

Table 1. Unit root test results

Variables	Types of test (c, t, n)	ADF test Statistics	D-W Stat	Prob.
Exchange rate	C 0 1	0.633285	2.20	0.9901
Δ Exchange rate	C 0 1	-4.450525*	2.04	0.0004
Stock prices	C 0 1	-1.109681	1.73	0.7105
Δ Stock prices	C 0 1	-9.463608 *	1.98	0.0000
Oil prices	C 0 1	-1.192767	2.22	0.6760
Δ Oil prices	C 0 1	4.379627 *	1.84	0.0005
Reserves	C 0 1	-1.272723	1.95	0.6406
Δ Reserves	C 0 1	-10.57178 *	2.00	0.0000

Note:

- Rejected null hypothesis at 1% significant level
- Term c, t, and n represent intercept, trend, and lags respectively.
- Probability means MacKinnon (1996) one-sided p-values.
- Δ Indicate the first differential of variable.

Table 2 shows results of optimal lag selection. Lag 1 is selected in VAR model using Final Prediction Error (FPE), Akaike Information criterion (AIC), Schwarz Information criterion (SIC), and Hannan-Quinn Information (HQ).

Table 3 depicts result of Johansen’s cointegration approach with trace and max-eigen statistic. Ist column illustrates null hypothesis (Ho) which are at most none (r=0), at most one (r ≤ 1), at most two (r ≤ 2), at most three (r ≤ 3) cointegration relationships; 2nd column depicts eigen values while third shows trace/max-eigen statistics.4th and 5th column presents critical values at 5% and probability respectively.

Table 2. VAR lag order selection criteria

Lag	LR	FPE	AIC	SC	HQ
0	NA	1.97e+37	97.22675	97.32017	97.26468
1	1554.808*	3.08e+31 *	83.85699*	84.32407*	84.04666*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table 3. VAR cointegration statistic

Hypothesized No. of CE(s)	Eigenvalue	Trace/ Max-Eigen Statistic	5 Percent Critical Value	Prob.**
Unrestricted Cointegration Rank Test (Trace)				
None *	0.370236	88.46703	47.85613	0.0000
At most 1 *	0.186153	36.67712	29.79707	0.0069
At most 2	0.092461	13.60698	15.49471	0.0944
At most 3	0.024176	2.740942	3.841466	0.0978

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-value

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

None *	0.370236	51.78991	27.58434	0.0000
At most 1 *	0.186153	23.07014	21.13162	0.0264
At most 2	0.092461	10.86604	14.26460	0.1610
At most 3	0.024176	2.740942	3.841466	0.0978

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Trace statistic indicated 2 cointegration equations at 5%. Max-eigen statistic depicted same results. So, there are two cointegration equation among four variables (r=1) at 5% significance level. Both trace and eigen-statistic are showing that there is long run associationship/cointegration among four variable exchange rate, oil prices, foreign reserves and stock prices.

Exchange rate, stock prices, foreign reserves and oil prices are important macroeconomic variables; cointegration among these will be beneficial in many ways.

Regression is used to check dependency of variables; in other words regression checks variation of dependent variable due to independent variables taken into account.

Table 4 shows regression analysis of variables; by converting into equation form it looks as follows:

$$ER = 2.23 - 0.000090 SP - 0.000000 Res + 0.000551 OP$$

Table 4. Regression Analysis

Predictor	Coef	St. Dev	t-value	P
Constant	2.2302	0.5368	4.15	0.000
Stock prices (SP)	-0.0000900	0.00003191	-2.82	0.006
Reserves (Res)	-0.0000000	0.0000000	-3.03	0.003
Oil Prices (OP)	0.00055108	0.00006537	8.43	0.000
S = 0.6027 R-Sq = 99.6% R-Sq(adj) = 99.6% h-value = 0.112				

It is very clear from coefficient signs of model that increase in oil prices have a positive while increase in stock prices and foreign reserves have negative effect on exchange rate. Due to increase in oil prices exchange rate will also increase while due to increase in stock prices and foreign reserves exchange rate will decrease. Furthermore, foreign reserves have a minor effect on exchange rate.

p-value of stock prices in model is 0.006, foreign reserves is 0.003 and that of oil prices is 0.000 showing each variable is highly significant in model. Coefficient of determination and adjusted coefficient of determination of model is 99.6% which illustrates that 99.6% variation in exchange rate may be explained by stock prices, foreign reserves and oil prices while just 0.4% variation in exchange rate is due to other factors.

Lag value of exchange rate is also included in regression model, as previous exchange rate effects determination of current exchange rate. As lag value of exchange rate is included in model, so to check autocorrelation in model h-value will be taken. h-value of model is 0.112, which represents absence of autocorrelation in model.

Table 5 gives results of ANOVA. It is evident from results of F-statistic that all the variables dependent and independent chosen in model are highly significant. There are no chances (p-value= 0.000) chances of incorrectness or falseness of model.

Table 5. Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	11669.8	2917.5	8032.14	0.000
Error	114	41.4	0.4		
Total	118	11711.2			

Results of Granger-causality statistic are depicted in table 6. It is evident from results that uni-directional causality runs from oil prices to exchange rate. Unidirectional causality from exchange rate to foreign reserves and stock prices to exchange rate is also reflected. Bidirectional causality between oil prices and foreign reserves is observed; while unidirectional causality from stock prices to oil prices and foreign reserves to stock prices is reported.

Table 6. Granger causality statistic

Null Hypothesis:	F-Statistic	Prob.
OP does not Granger Cause ER	43.8196	1.E-09
ER does not Granger Cause OP	0.15632	0.6933
FR does not Granger Cause ER	0.10473	0.7468
ER does not Granger Cause FR	5.87368	0.0169
SP does not Granger Cause ER	6.12091	0.0148
ER does not Granger Cause SP	0.00073	0.9785
FR does not Granger Cause OP	15.3208	0.0002
OP does not Granger Cause FR	2.97933	0.0870
SP does not Granger Cause OP	9.50200	0.0026
OP does not Granger Cause SP	1.08020	0.3008
SP does not Granger Cause FR	1.88184	0.1728
FR does not Granger Cause SP	9.74998	0.0023

5. CONCLUSION

As, result showed that due to increase in stock prices exchange rate will decrease resulting in appreciation of currency. Result support portfolio balance model according to which investors hold domestic as well as foreign assets; whenever stock prices increases domestic investors sells foreign assets to purchase domestic stocks also foreign investors buy domestic assets. This will cause increase in demand of domestic currency resulting in strengthening of it.

This relation between stock prices and exchange rate guide the investors to predict performance of one market using information of other market. By observing performance of one market crisis can be forecasted and preventive measures can be taken. It also signals government and State Bank to formulate policies. Monetary policy should be designed in a way that should have no negative effect on stock prices.

As far as oil prices are concerned, according to cointegration equation due to 1% increase in oil prices exchange rate will also increase by 0.010015% causing weakening of currency. Pakistan imports oil near about 80% of its annual requirement. Government of Pakistan may discover/explore oil resources/reserves in country so that import of oil can be decreased or whole requirement of oil may be fulfilled by country's own resources. Another option about which government can take attention is to make use of alternate sources of energy like wind energy, water power and coal energy so that, reliance on oil can be decreased. By

availing any of one option negative effects of oil price hikes can be controlled.

Also, minor negative relation between foreign exchange reserves and exchange rate is found resulting appreciating of currency due to increase in foreign reserves. Foreign reserves should be increased so that it will cause strengthening of currency.

To check association between exchange rate, stock prices, oil prices and foreign reserves is of great importance; as relation between stock prices and exchange rate will be helpful not only for domestic and foreign investors but for government as well, relation between exchange rate, oil prices and foreign reserves will be a guideline for government; so as a whole it will helpful for policy makers to formulate policies and to take measures to minimize the harmful effects of increase/decrease of exchange rate on economy.

In future, conventional variables which are inflation rate, interest rate, balance of payment, GDP should also be added along with important unconventional variables; it will helpful to find which variable brings more variation in exchange rate and extent of variation due to different variables can be checked. Also, data should be segregated on the basis of exchange rate regimes so that, impact of macroeconomic variables can be checked in different regimes.

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