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Research Article

PANEL MONETARY MODEL AND DETERMINATION OF MULTILATERAL EXCHANGE RATE WITH MAJOR TRADING PARTNERS

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ABSTRACT

Ever since humans started barter trade there is existence of exchange rate. Considering several countries simultaneously trading,hence this study has used the panel data models to incorporate the spill over effects of trade and heterogeneous technology effects in long run and short run.By using Common Correlated Effect Mean Group panel data model between 4 trading partners based on their contribution in Pakistan's trade and capital inflow for the years of 1992 to 2012, it can be concluded, Monetary model has significantly determined the exchange rate. For this group of countries only interest rate and monetary differential is significant in managing exchange rate. It takes 13 months to recover any disequilibrium in this Model suggesting that any exchange rate management policy option can be realized in a year. The monetary model superseded the random walk model in terms of in-sample forecasting.

INTRODUCTION

Ever since humans started to trade, there had been a scale which is used to determine how goods are exchanged. This mechanism was continued from the barter trade to gold currency and now still visible in our fiat currency. Change in this rate influences the seller and the demander drastically, hence most of the time these agents are trying to foresee this. Similarly instead of humans if two countries are trading with each other then they need a scale that can help to compare their different currencies, this rate is called exchange rate.[1]Since exchange rate is determined by value of local currency and foreign currency so any chance in the demand and supply of these currencies causing value to change will alter exchange rate too.

Managing the exchange rate is very important for the countries that are excessively trading, and most of their trading is based on payments deferred from the transfer goods. Hence, altering of the exchange rate when this deferred trade is in progress can cause serious repercussions in affordability of the good purchased or the profitability of the goods sold. For developing country like Pakistan having to import crude oil which is highly inelastic and major exports are agricultural commodities which are highlypriceelastic, upon this if exchange rate varies against their favour this could lead to magnification of trade deficit.[2] Hence from the implications of changing exchange rate we can see that there is a dire need to device a way to stabilize and predict the change of exchange rate, so that policy makers and traders can have confidence on the future exchange rate expectations and they can adjust out trade agreements and policies accordingly. Exchange rate model will help the policy makers to understand the internal and external factors which led to change, which can be controlled in order to manage exchange rate.

The first breakthrough in understanding the patterns of exchange rate is Law of One Price or Purchasing Power Parity (PPP) proposed by Cassel (1918). According to this theory, if prices in domestic economy rise it makes foreign products relatively cheaper and lead to increase in imports. For theseimportsdomestic people demand foreign currency as foreign products are listed in terms of foreign currency. Hence it can be said that, while keeping supply of foreign currency

[1]Exchange rate is defined as the amount of local currency required to buy 1 unit of foreign currency.

[2]Economic Survey of Pakistan 2013-14

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constant, increasing its demand will lead to increase in the value of foreign currency and depreciation of exchange rate.
PPP model is focused on the goods market, similar to it, capital market is also tending to affect the demand and supply of currencies and determine exchange rate. In this regard the first theory is knownas Uncovered Interest Parity (UIP), according towhichthe investors / arbitrageurs tend to get benefit from the investment return differential.[3] If domestic interest rate (return on investment) is higher, then investor will acquire capital from foreign country and invest in domestic country. In this process the domestic investor will increase demand for foreign currency and hence depreciate exchange rate. While, the Traditional Flow Model proposed by Mundell (1962) and Fleming (1962), suggests that if domestic interest rate (return on investment) is higher, then investor in foreign country will send their capital to domestic country to avail higher returns. This inflow of capital will lead to supply of foreign currency and appreciation of exchange rate. So by comparing these two theories it can be observed thatUIP and Traditional Flow Model are describing the influence of domestic investors and foreign investors respectively. If the foreign capital market is strong it is expected to show dominancy of Traditional Flow Model as they will dominate in movement of capital from foreign country to domestic country if interest rate is high.

Other than Goods market and Capital market theories there are some policy having influence on exchange rate too. The supply of currency is directly linked to the money supply of respective country; hence if money supply of Pakistan is higher as compared to foreign currency then the domestic currency supply will also be higher and cause depreciation of exchange rate. Similarly there is Output Effect. If domestic country has higher amount of output, it will ensure that domestic people have higher variety of goods and services available domestically discouraging them from accessing foreign markets through imports, consequently appreciating exchange rate.

This study will incorporate price, interest rate, money and output differential discussed above to build a Monetary Model of exchange rate. The validity of this Monetary Model for Pakistan Rupee and US Dollar has been confirmed using Time Series models by [Bhatti 2001; Zakaria and Ahmad 2009; Khan and Qayyum 2011]. Since in present day economy trading is very complex one country is trading with several economies simultaneously hence this study will use a panel data model using Pakistan's major trading (table 1) and Foreign Direct Investment (FDI)(table 2) partners.

These partners include Germany, Hong Kong, UK and USA, traditional panel data models like Fixed Effect and Random Effect models do not incorporate economic and econometric phenomenon's like Spill Over effect (Cross sectional correlation) and country specific technology effect (Slope Heterogeneity). Hence this study will fulfil its objectives by using more efficient dynamic panel data models in order to find an appropriate model which is valid and encompassing to the exchange rate phenomenon [Eberhardt& Tea 2010].

Table 2 Capital movement patterns

Country wise contribution in net FDI (Percentage of total net FDI)					
	2007-08	2008-09	2009-10	2010-11	2011-12
USA	32.21	13.32	34.34	24.99	35.45
UK	6.17	5.79	10.80	11.61	23.37
Germany	1.27	2.40	1.96	0.98	3.69
Hong Kong	1.74	4.94	1.06	7.44	-6.95
Total % Share	41.39	26.45	48.17	45.03	55.57

Source: State Bank of Pakistan

The rest of the study organized such as following, in second section there will be brief review of empirical work discussing the significance of each theory regarding exchange rate. The knowledge from the empirical theories will be used to build econometric model for estimation. Lastly, this study will conclude and suggest policy implication based on this model.

Exchange rate of Pakistan

Pakistan is currently experiencing floating exchange rate. Historically Pakistan had fixed exchange rate till 1981 with few depreciating adjustments in 1972 and 1973 on the wake of separation of Bangladesh (previously known as East Pakistan) from Pakistan (previously known as West Pakistan). After 1981 there has been persistent devaluation of exchange rate with respect to US dollars. Pakistan being exporter of agricultural products and textiles, devaluating of exchange rate seems to favour Pakistan in terms of a jump in export orders. The devaluation continued till 2001 where there as small time period of stable exchange rate between the years of 2002 – 2005, this was the time period of military dictator Gen. Pervez Musharraf whose policies led to this scenario. Beyond 2005 there depreciation continued and Pakistan reached 93.40 Rupees per Dollar in 2012 which was only 60.27 Rupees per Dollar around 2006.

Although this devaluation of exchanger rate benefited Pakistan in terms of increase in the textile sector exports specially, but there is a major downturn to this. Every time exchange rate depreciates it lead to increase in the debt burden on the economy (Zaidi, 2005).

Table 1 Trade patterns

Trade shares for major trading partners of Pakistan															
	2007-08			2008-09			2009-10			2010-11			2011-12		
	Exports	Imports	Total	Exports	Imports	Total	Exports	Imports	Total	Exports	Imports	Total	Exports	Imports	Total
USA	19.5	6.1	25.6	18.9	5.4	24.3	17.4	4.6	22	16	4.5	20.5	14.9	3.3	18.2
UK	5.4	1.9	7.3	4.9	2.6	7.5	5.3	1.7	7	4.9	1.6	6.5	5	1.2	6.2
Germany	4.3	3.2	7.5	4.2	3.8	8	4.1	3.4	7.5	5.1	2.3	7.4	4.5	2.5	7
Hong Kong	2.7	1.0	3.71	2.1	0.8	2.9	2.2	1.0	3.2	2	1.3	3.3	1.7	1.3	2.9
Total share	31.9	12.2	44.1	30.1	12.6	42.7	29	10.7	39.7	28	9.7	37.7	26.1	8.2	34.3

Source: Economic Survey of Pakistan and State Bank Reports

Hence this study is focusing in studying the exchange rate of Pakistan with its major trading partners with aim to understand

[3]Investment return differential = domestic investment return - foreign investment return.

and evaluate the factors which can help to slow down and manage the devaluation process without harming the exports of the economy.

LITERATURE REVIEW

A vast literature is available which tried to understand the exchange rate suggesting the significant influence of foreign economies on us through exchange rate. In introduction the insights to exchange rate theories were presented, whose significance will be explored in this section.

Domestic and Foreign Prices play their role in Price differential (Domestic Prices - Foreign Prices), studies like [Corbae and Ouliaris, 1988; Kim, 1990; Bhatti, 1996; Quyyum *et al.*, 2004] advocated the presence of Purchasing Power Parity using cointegration approach such that the resulting real exchange rate is stationary. While studies like [Mohsin and Rhee, 1992; Sarno and Giorgio, 2006; Janjua and Ahmad, 2006] failed to prove the presence ofPPP, and reasoned post Breton Woods era and increasing trade restrictions for its failure. By comparing these studies it can be said that the effect of price differential is dependent upon the share of goods in the total output which are traded, trade restrictions between the countries and proximity between the trading partners. Macdonald (2007) compared the limitations of PPP and suggested that the convergence power of PPP equilibrium can be increased by increasing sample frequency or adopting a panel data approach.

In capital market, the maturity of the market and the sensitivity toward risk determines how capital will flow. Both competing theories of UIP and Traditional Flow Model explain the deviations on the exchange rate. According to [Lothian and Wu, 2003; Chinn and Meridth, 2004; Huisman *et al.*, 2007] UIP effect is significant in long run only and it is dependent upon the maturity of the interest rate and it gets week when tested in post Breton Wood period. Further studies like [Davidson, 1985; MacDonald and Torrance, 1990] reasoned the non-homogeneous maturity of bonds and difference in sensitivity to risk by the investors to be the reason for the failure of UIP.While some joint studies like [Gaab *et al.*, 1986; Camarero and Tamarit, 1996; Juselis and Macdonald, 2004; Bhatti *et al.*, 2013] suggested that the influence of capital market (interest rate differential) is only visible when it is modelled in parallel with goods market (which is known as Capital Enhanced Equilibrium exchange rate System (CHEERs) Model), suggesting that both markets are complementing each other in describingexchange rate. Kamal and Haider (2004) suggested against the significant role of CHEERs model in effecting exchange rate.

After comparing price and interest rate differential, the focus is on the role of policy and economic condition of the country. Most of the studies used monetary and output differential together building it from quantity theory of money. Studies such as [Macdonald and Taylor,1991, 1994;Liew*et al.*, 2009; Zakaria and Ahmed, 2009] used monetary and output differential in determining exchange rate and found significant evidence in favour of this model. While only few studies such as [Baillie and Selover, 1987; Abbot and Vita, 2002] failed to find significant evidence of this Monetary model. Macdonald and Taylor (1994) compared the estimated exchange rate from the Monetary Model with simple Random Walk Model and proved that this monetary model has better power to explain exchange rate patterns as compared to its counterparts PPP, UIP and CHEERs model.

Comparing the empirical studies, firstly it can be said that in order to incorporate trade complexities, none of the study opted for the Panel data approach to monetary model, though time series models of Monetary Model are successful but these model only incorporate a small portion of country's trading. Secondly this study will use dynamic panel data models which are more efficient as compared to static panel data models. The estimated model will help to provide average estimates which can help to manage exchange rate of 4 trading partners simultaneously rather than only one done by previous studies.

Theoretic and Econometric model

In order to construct model for exchange rate determination following theories are incorporated below. According to Purchasing Power Parity, exchange rate bridges between the price differential between two countries,

$$Pdom = Ex + Pfor \quad (1)$$

$$Ex = Pdom - Pfor \quad (2)$$

Here Ex is exchange rate, P_{dom} is Logged Domestic Prices and P_{for} is Logged Foreign Prices.

In stochastic form it can be expressed as.

$$Ex_t = \alpha + \beta_1 (Pdom - Pfor)_t + \upsilon_t \quad (3)$$

Similarly according to Uncovered Interest Parity or Traditional Trade Flow model, change in exchange rate or the rate of depreciation / appreciation of the currency is because of interest rate differential.[4]

$$\Delta Ex^e_{t+1} = Idom - Ifor \quad (4)$$

Here I_{dom} is Domestic interest rate,I_{for} is foreign interest rate and $\Delta Ex_{t+1}{}^e$expected change in the future exchange rate
In stochastic form we have

$$\Delta Ex_{t+1} = \alpha + \beta_1 (Idom - Ifor) + \gamma_t \quad (5)$$

$$Ex_{t+1} = \alpha + \beta_1 (Idom - Ifor) - \beta_2 Ex_t + \gamma_t \quad (6)$$

From PPP model we can substitute value of Ex and this joint model is called CHEERS model.

$$Ex_{t+1} = \alpha + \beta_1 (Idom - Ifor) + \beta_2 (Pdom - Pfor) + \gamma_t \quad (7)$$

Now we will incorporate the monetary extensions to this model using Cegan Money demand model. This Monetary Model has some assumptions which are as following; there are 2 countries having 2 different money and bond types (both have same maturity) and trading homogeneous good. Here M_{dom} is logged domestic money supply, M_{for} is logged foreign money supply, Y_{dom} is logged domestic real GDP,Y_{for} is logged foreign real GDP and Ex_{t+1} is future exchange rate.

$$Ex_{t+1} = \alpha + \beta_1 (Idom - Ifor) + \beta_2 (Pdom - Pfor) + \beta_3 (Mdom - Mfor) - \beta_4 (Ydom - Yfor) + \gamma_t \quad (8)$$

[4]Coefficient signs are opposite for Traditional Trade model.

The extended model includes time period from 1992 to 2012 for the cross sections of Germany, Hong Kong, UK, and USA. Here Pakistan is used as base cross section which is used as the domestic country for each cross section. These countries are selected as they hold major share of trade (imports and exports) as well as major share of net capital flow in terms of FDI. Below are the indicators used in the study; the patterns of each indicator will help to determine the coefficient of the differential as if the foreign component is larger on average then the sign of the coefficient will be reversed.

Exchange rate

The importance of exchange rate is described earlier, is used as dependent variable in this study. The data of exchange rate with respect to dollars is taken from World Development Indicators [WDI(2014)] and it is converted into base of local currency unit. In the figure below it can be seen that for the case of Germany, Hong Kong and USA the pattern of exchange rate is almost similar but the devaluation is highest for the case of USA which is because USA is the top trading partner shown in table 1 and lowest for the case of Hong Kong as it is the smaller of other three trading partners, it can be seen from highest and lowest value of exchange rate on the vertical axis. For the case of UK the depreciation is consistent and showing highest rise in all of its trading partners which is probably because of the fact that UK is prime destination of all the migrants of Pakistan and source of remittances.

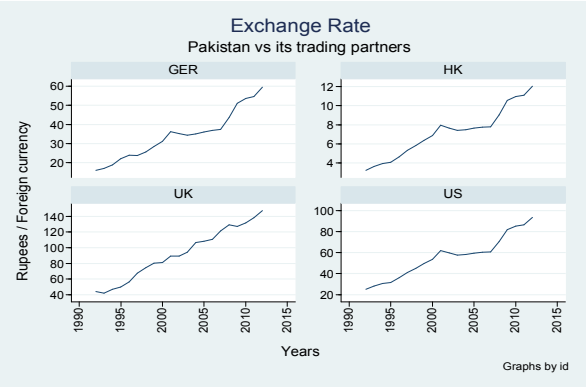

Figure 1 Exchange rate of Pakistan

Source: WDI (2014)

Price Differential

The indicator of price differential is the difference of domestic logged prices and foreign logged prices and the data is taken from WDI (2014). If the price differential is positive then it will suggest that the domestic country is relatively expensive as compared to foreign country, which will increase demand for foreign products in Pakistan and hence cause exchange rate depreciate through increased demand of foreign currency and vice versa. Form the figure below it can be concluded that for all trading partners the price level of Pakistan crossed the foreign prices since the year 2005 which is because of the fact that Pakistan experienced double figure inflation during this time period (Zaidi, 2005). Hence the price differential is positively sloped and promoting domestic people to buy from abroad and put pressure on exchange rate.

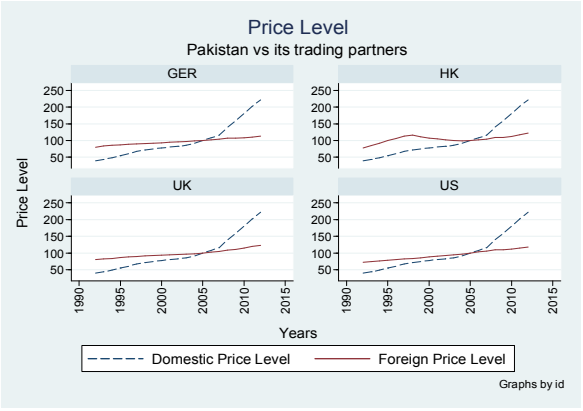

Figure 2 Price Comparison of Pakistan and Trading Partners

Source: WDI (2014)

Interest Rate Differential

The indicator of interest rate differential is the difference of domestic long run interest rate and foreign long run interest rate. In this study Government Bond Rate with maturity more than a year is used as long term interest rate and this data is taken from International Financial Statistics [IFS (2013)]. If the interest rate differential is positive this will suggest that domestic interest rate is higher than foreign interest rate, which will invite foreign capital and appreciate exchange rate because of increase in supply of foreign currency and vice versa. There is another competing theory named as Uncovered Interest Parity which suggests signs to be opposite to what above theory has proposed. From the figure below it can be said that generally interest rate is stable except for the case of Pakistan which has seen drastic changes in history while the capital markets of the country are in developing stage. Comparing both domestic and foreign interest rate for all trading partners, the interest rate differential is positive as Pakistan's interest rate is higher for all.

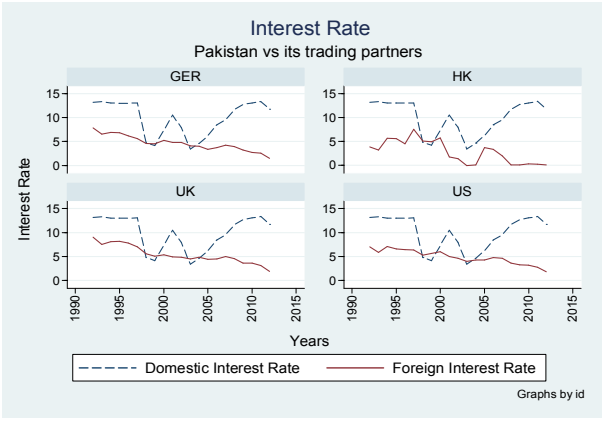

Figure 3 Interest Rate comparison of Pakistan and Trading Partners

Source IFS (2013)

Monetary Differential

The indicator of monetary differential is the difference between logged domestic money supply and logged foreign money supply. The data of money supply is taken from WDI (2014). A positive differential means that the local currency supply is higher as compared to foreign currency which will lead to

depreciation in exchange rate and vice versa. As the all trading partners are large economies and large financial sector as compared to Pakistan hence their money supply is also higher, making monetary differential negative and can be seen in following figure.

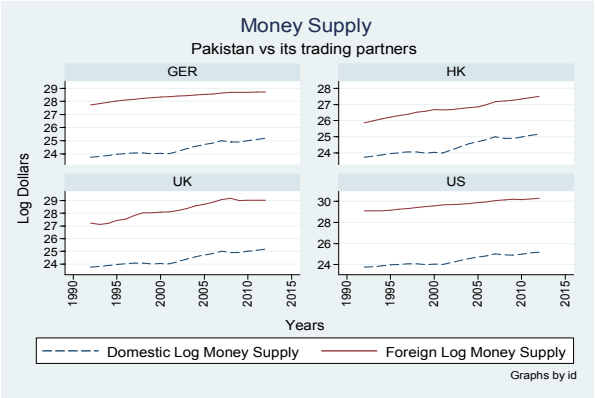

Figure 4 Money Supply comparison of Pakistan and Trading Partners

Source: WDI (2014)

Output Differential

The indicator of output differential is the difference between logged domestic real GDP and logged foreign real GDP. This data is taken from WDI (2014). If the output differential is positive then it means that the local supply of goods and services is higher than the foreign supply of goods and services, which will consequently reduce imports and demand of foreign currency and appreciate exchange rate andvice versa. Similar to money supply, larger economies have larger real GDP too, from the figure below all of the trading partners have higher output as compared to Pakistan hence the output differential will be negative.

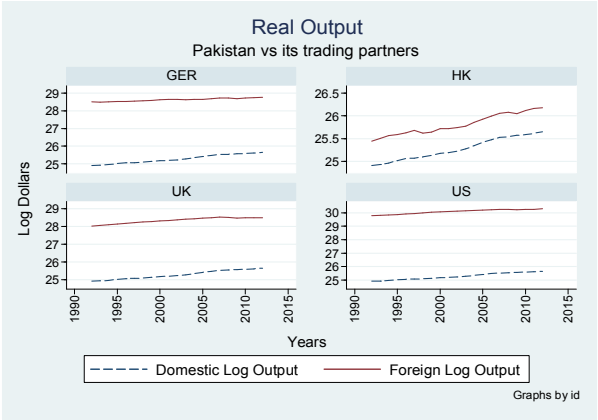

Figure 5 Real GDP comparison of Pakistan and Trading Partners

Source: WDI (2014)

Econometric Model

The linear econometric specification of exchange rate monetary model is as follows. In this specification the intercept and slope coefficients (β_{ij}) are allowed to vary across cross sections. According to Pesaranand Smith (1995) and Lee *et al*. (1997) assuming homogenous slopes could lead to biasness in the model which will not diminish with increase in cross sections and time. Incorporating this property indicates that we are allowing country wise economic indicators to influence the target variable differently; this extra information will lead the model to be more efficient.

$$EX_{it+1} = \beta_{i0} + \beta^{m}{}_{i1} PD_{it} + \beta^{m}{}_{i2} BD_{it} + \beta^{m}{}_{i3} MD_{it} + \beta^{m}{}_{i4} YD_{it} + e_{it} \quad (9)$$

Here PD is the domestic to foreign prices differential, BD is the domestic to foreign interest rate differential, MD is the domestic to foreign money supply differential and YD is the domestic to foreign output differential. The annual time periods used for the estimation of equation (9) is 1992 to 2012 for all the countries.

Here the error term could be function of all other indicators not in the model assumed to be random. Where $f_t$is indicator for joint effect of all other variables not included in the model also called common factor. The intercept and slope (α and λ) have subscripts i for each cross sections means that the effect of all other variables is allowed to change across cross sections. Eberhardtand Teal (2010) revealed that assuming same effect of technology (other factors) could lead to inefficiency and spuriousness.[5]

$$e_{it} = \alpha_i + \lambda_i f_t + \varepsilon_{it} \quad (10)$$

In this model all of the independent variablesare expected to follow below stated pattern. Here the component $g_t$includes all the indicators which specifically influence the dependent variable which is function of its lag.[6] This specification incorporates the property of variable to be non-stationary with cross sectional specific lag effects (δ_i).[7] The use of $f_t$shows that the other indicators are allowed to influence the independent variable too which makes independent variable expected to correlate with error term e_{it} and correlate with itself incorporating phenomenon's of cross sectional correlation and endogeneity.[8, 9, 10]

$$PDi_{mit} = \pi_{mi} + g'_{mt}\,\delta_{mi} + \rho_{1mi} f_{1mt} + \cdots + \rho_{nmi} f_{nmt} + \upsilon_{mit}\ ^{11} \quad (11)$$

$$f_t = f'_{t-1}\psi + \mu_t \quad (12)$$

Hence the above model has described all the possible econometric issues with its economic implications which are allowed to exist in the model in order to make an efficient model. Eberhardtand Teal (2010) provided a table (summarized in table 3) based on the characteristics defined in the mathematical model, which can help in selecting an appropriate model for production function which will comprehend the possible economic dynamics.

[5]Eberhardtand Teal (2011) proposed the cross sectional specific common factor incorporating the influence of business cycles to the production functions.

[6]g_t also includes the lag of dependent variable too.

[7]Lee *et al*. (1997) &Pedroni (2007) indicated for each variable which is based on value addition in the economy like GDP then the series is expected to depend on its past causing non stationarity. And it is expected that the dependence on past could be different for different countries depending on the economy conditions.

[8] From illustration of Eberhardtand Teal (2010) it can be said that cross sectional correlation is the property of models where there is spill over effect of the policy through trade and current account for the case of exchange rate model.

[9] Having heterogeneous$\lambda_i$each country has different economic and political nature which enables all other variables to have different slope.

[10]Endogeneity can exist if the independent variables are reversely caused with the independent variable; one example is the PPP model where exchange rate can affect price levels. To counter the endogeneity the cointegration approach is used which is suggested by Pedroni (2000). This endogeneity can be solved using instrumental technique model of GMM like Arellano and Bond (1991) etc. but as per Pesaranand Smith (1995) these models assume common knowledge and production environment.

[11]similar specification for all included independent variables in the model

Table 3 Model Selection Matrix

Common Factor Slope Coefficient		**Homogenous**		**Heterogeneous**	
Common Factors		Unrestricted		Linear	Unrestricted
Long run Slope Coefficients	Homogenous	Intercept	POLS, FD		CCEP
	Heterogeneous	Slope	FE , RE RCM	MG	AMG, CMG

Panel Unit Root Tests

Unit root tests will be used to identify if there is any specific factor $g_t$which is significantly dependent on its past. This study has used two tests; first one is Maddalaand Wu (1999) Fisher Unit root test which allows the presence of cross sectional specific unit roots, whereas the second one is Pesaran (2007) Unit root test which allows the presence of cross sectional dependence. According to these tests, it is confirmed that all of these indicators have specific factors which are function of their past making it non stationary at level and stationary at first difference.

Table 4 Panel Unit Root Test

Unit Roots Tests				
Variables	Maddalaand Wu (1999) Test		Pesaran (2007) Test	
	Level	First Difference	Level	First Difference
Log exchange rate	I(1)	I(0)	I(1)	I(0)
Price differential	I(1)	I(0)	I(1)	I(0)
Interest rate differential	I(1)	I(0)	I(1)	I(0)
Monetary differential	I(1)	I(0)	I(1)	I(0)
Fiscal differential	I(1)	I(0)	I(1)	I(0)

Cross sectional Correlation Test

In econometric modelling cross sectional correlation can be a cause of problem but realistically this shows the degree of spill over effects of one cross section to another. Panel data models which ignore the presence of cross section correlation lead to spuriousness of the results. Following table using Pesaran (2004) cross sectional dependence test, it can be seen that all the indicators used in this model are significantly dependent across cross sections and other than Monetary Differential, there is high degree of cross sectional correlation. This correlation is as expected because all of these variables are related to trade and open economy hence if countries trade with each other then they can influence the prices, interest rate and output of its trading partners.

Table 5 Cross Sectional Dependence Test

Pesaran (2004) Cross Sectional Dependence Test				
	Level		**First Difference**	
	P- Values	Cross Sectional Correlation	P- Values	Cross Sectional Correlation
Log exchange rate	0.00	0.984	0.00	0.445
Price differential	0.00	0.988	0.00	0.708
Interest rate differential	0.00	0.954	0.00	0.902
Monetary differential	0.00	0.447	0.00	0.657
Fiscal differential	0.00	0.661	0.00	0.567

Panel Cointegration Test

Since all of the variables are I(1) with specific effects function of its past, in order to avoid the problem of endogeneity, the residuals of the model should be I(0) and the process to test residuals is cointegration test. Following table 6 shows 7 specifications of Pedroni (1999, 2004) Panel cointegration tests, first 4 are based on alternative hypothesis that residuals are stationary with homogenous cross sectional effects whereas last 3 are based on the alternative hypothesis that the residuals are stationary with heterogeneous cross sectional effects. The majority of the results show that there is cointegration between the selected variables for the exchange rate Model.

Table 6 Panel Cointegration Test

Pedroni Panel Cointegration Test	
Test	Probability
Common Cointegration	
Panel v-Statistic	0.00
Panel rho-Statistic	0.98
Panel PP-Statistic	0.06
Panel ADF-Statistic	0.00
Group Specific Cointegration	
Group rho-Statistic	0.99
Group PP-Statistic	0.01
Group ADF-Statistic	0.00

Long Run& Short Run Estimates

Based on econometric model, and the skeleton chart (table 7) which can tell how to select the model, following table has estimated all of these models. The results of diagnostics including Cross sectional dependence of residuals, I(1) nature of residuals and presence of hetroskedasticity in residuals, the purpose of wide variety of models is that the difference in the estimates and its diagnostics indicate which economic phenomenon is ignored and causing problems.

The first column of mean values helps in interpreting the coefficient, for the case of price differential the value is -0.09 which means that the logged price level of Pakistan is slightly lower than the logged prices of all other countries, similarly the positive value of interest rate differential shows that on average the value of interest rate in Pakistan is higher than the interest rate of all other countries. The value of monetary and fiscal differential are negative, means that logged money supply and logged real GDP are lower in Pakistan as compared to all other countries on average.

Estimation models like Pooled OLS, Fixed Effect, Random Effect and Random Coefficient models are spurious as their residuals are non-stationary. Advanced models like Mean Group and Augmented Mean Group also have spurious nature as there is cross sectional autocorrelation in the residuals. Hence there is only common correlated effects mean group model which has passed through all the diagnostic tests and it has lowest root mean square value too.

According to CMG model, Price Differential and Output Differential are insignificant in effecting the exchange rate in terms of global average. On the other hand the coefficient of interest rate differential is positive which means that if interest rate of Pakistan rises 1% as compared to foreign interest rate then it will lead to depreciate of exchange rate by 0.025%. This is because if Pakistan's interest rate is higher than domestic people will use foreign market in order to access capital for loans which will increase demand of foreign currency and depreciate exchange rate. For the case of monetary differential

the average slope coefficient is negative and from its negative mean value, it can be said that if money supply of Pakistan is increased by 1% as compared to foreign money supply then it will lead to depreciation of exchange rate by 0.20% on average. This is because if country prints more money than it increases the supply of domestic currency and lead to depreciation.

According to finalized model it can be said that interest rate differential and monetary differential are crucial fundamentals which determine the equilibrium exchange rate, following chart is showing the difference between the equilibrium exchange rate and the actual exchange rate.[12] It can be seen that for the case of Hong Kong and USA the disequilibrium is relatively smaller as compared to Germany and UK. This means that using within sample forecasting criteria this model is performing well in Hong Kong and USA as compared to Germany and UK.

model and the disequilibrium produced by Random Walk model of exchange rate. The purpose of this comparison is to determine whether this model is at least performing better than a simple random walk model in terms of its forecasting power. Following table shows that for each country, the variability in disequilibrium from the monetary model is lower than the disequilibrium from the Random Walk Model, suggesting that this model is more useful compared to Random Walk Model.

Since it has been confirmed that the monetary model follows heterogeneous slopes and common factors hence in order to estimate short run estimates, usage of pooled OLS might not be advisable. Hence the ECM specification for short run model is estimated using CMG model same as the long run estimates. These short run estimates (in table 8) also passed the diagnostic tests of Cross sectional dependence, stationarity of residuals and presence of heterogeneity.

Table 7 Long Run Estimates Comparison Models

Long Run Estimates (Dependent Variable: ER_{t+1})									
Variables	**Mean[a]**	**PLS[b]**	**FD[c]**	**FE[d]**	**RE[e]**	**RCM[f]**	**MG[g]**	**CMG[h]**	**AMG[i]**
Price Differential	-0.09	1.38 (0.00)	0.19 (0.27)	0.94 (0.00)	1.38 (0.00)	0.95 (0.00)	0.96 (0.00)	-0.81 (0.33)	-0.10 (0.17)
Interest Rate Differential	5.47	-0.05 (0.00)	-0.001 (0.54)	-0.01 (0.00)	-0.05 (0.00)	-0.01 (0.00)	-0.01 (0.00)	0.02 (0.02)	0.003 (0.37)
Monetary Differential	-3.86	0.63 (0.02)	-0.18 (0.01)	-0.27 (0.00)	0.63 (0.02)	-0.37 (0.00)	-0.38 (0.00)	-0.20 (0.03)	-0.08 (0.21)
Output Differential	-2.94	-0.86 (0.00)	-0.28 (0.21)	0.39 (0.01)	-0.86 (0.00)	0.13 (0.72)	0.14 (0.67)	-1.29 (0.26)	-0.12 (0.17)
Intercept		3.82 (0.00)	0.05 (0.00)	3.75 (0.00)	3.82 (0.00)	3.31 (0.00)	3.31 (0.00)	0.32 (0.60)	2.53 (0.00)
Diagnostics									
RMSE [1]		0.53	0.05	0.07	0.53		0.06	0.02	0.03
Cross Sectional Dependence [1]		0.00	0.00	0.01	0.00	0.13	0.00	0.28	0.06
I(0) Residuals [1]		0.58	0.00	0.74	0.58	0.91	0.03	0.00	0.00
Hetroskedasticity[1]		2.30	0.02	64.00	10.32	67.39	2.00	10.80	1.28

a. This mean value of the independent variable will be able to identify the possible interpretation of the coefficient.
b. Pooled Least Squares assuming all cross sections and common effects are homogeneous.
c. First Difference model by using differenced variables assuming all cross sections and common effects are homogeneous. This model is not ideal at it also changes the dependent variable.
d. Fixed Effect Model assumes all cross section intercept are heterogeneous but the slopes and common effects are homogeneous.
e. Random Effect Model assumes all cross section intercept are heterogeneous and random but the slopes and common effects are homogeneous.
f. Random Coefficient Model assumes all cross section intercept and slopes are heterogeneous but the common effects are homogeneous. The significant parameter constancy test shows that CCEP model is impropriate that's why it is now shown
g. Mean Group Model assumes all cross section intercept, slope and common effects are heterogeneous and linear
h. Common Correlated Effects Mean Group Model assumes all cross section intercept, slope and common effects are heterogeneous and unrestrictive
i. i. Augmented Mean Group Model assumes all cross section intercept, slope and common effects are heterogeneous and unrestrictive. Also this model adds a common dynamic process in model.

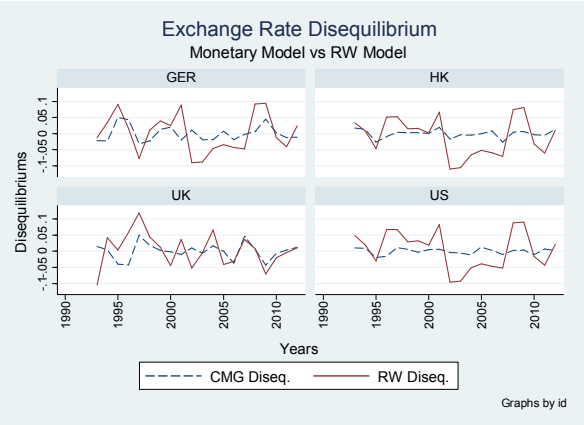

Figure 5 Monetary Model and RW Model comparison

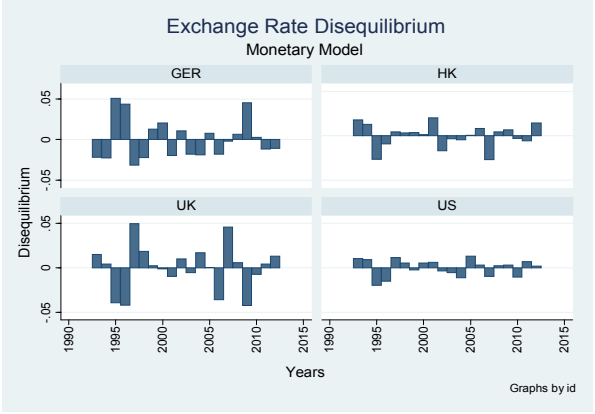

Figure 6 Disequilibrium from Monetary Model

Since forecasting of exchange rate is major task of every trading economy in order to maintain their profitability, hence this study will compare the disequilibrium produced by this

The results shows that Interest rate differential and output differential play a significant role in determining the exchange rate in short run. If the growth rate of price differential is increased by 1% then it will lead to increase the rate of depreciation by 0.04% on cross section average, similarly if the

[12]Method adopted from Macdonald and Taylor (1994) & Bhatti *et al.* (2013)

growth rate of output differential is increased by 1% then the rate of exchange rate appreciation is increased by 1.93% on cross section average.

The coefficient of ECM_{t-1} which is lagged residuals of CMG long run estimates is negative significant suggesting that there is convergence in this model whenever there is disequilibrium, such that if there is 1% disequilibrium in the monetary model then the change in exchange rate will correct this disequilibrium 0.92% each time period on cross section average.

The overall convergence speed of the model is 13 months which is very good such that this model only takes 13 months to recover 1% deviation from the equilibrium position. In other words this means that if there is any policy change or the change in market conditions then the outcome of the change can be seen within almost a year.

Since this model has estimated heterogeneous slopes, hence following table has also provided the country wise convergence speeds, for the case of Germany, Hong Kong, UK and USA the convergence speeds are 9 months, 13 months, 67 months and 10 months respectively. It can be seen that the coefficient of ECM is insignificant for the case of UK because of which the convergence speed is considerably higher and it can be concluded that this model is relatively not performing well in UK.

Table 8 Short Run estimates

Short run CMG Estimates (Dependent variable : ΔER_{t+1})	
Variables	Coefficient (Prob.)
Δ Price Differential	-1.50 (0.14)
Δ Interest Rate Differential	0.04 (0.03)
Δ Monetary Differential	-0.20 (0.23)
Δ Output Differential	-1.93 (0.08)
ECM_{t-1}	-0.92 (0.00)
Constant	-0.01 (0.08)
Diagnostics	
RMSE	0.01
Cross sectional Dependence	0.79
I(0) Residuals	0.00
Hetroskedasticity	6.31
Convergence Speeds[1]	
Overall	-0.92 (0.00) [13 months]
Germany	-1.33 (0.00) [9 months]
Hong Kong	-0.95 (0.04) [13 months]
UK	-0.18 (0.85) [67 months]
USA	-1.22 (0.00) [10 months]

CONCLUSION AND POLICY IMPLICATION

This study has used the recognized monetary model of exchange rate with the hypothesis that the countries are involved in bilateral trade where benefit or loss in one trade can influence other trade agreements. Hence there is a need of incorporating this monetary model in a panel data framework where the spill over effects of trade and the heterogeneous random effects are part of the model. For this purpose the effects of price, interest rate, monetary and output differentials are tested within several assumption based panel data models. The finalized model is selected on the bases of post regression diagnostics of residual cross sectional dependence, residual stationarity and residual hetroskedasticity. Root Mean Square Error is used as a criterion for selecting between models if more than one more clears the post regression diagnostics.

Out of all the models used, CMG model came out to be most appropriate for estimating the monetary model of exchange rate. According to this model only interest rate and monetary differential play a positive significant and negative significant role respectively. Here the exchange rate is more sensitive to the changes in the money supply between trading partners as printing money is direct source of increasing supply of domestic currency.

Since this exchange rate model is an equilibrium model hence the difference between the actual exchange rate and the estimated exchange rate is the disequilibrium which is suggested by the model. For the stability of model there must be disequilibrium as small as possible deviating around zero mean. After analysing the disequilibrium it can be said that the equilibrium model is stronger for Hong Kong and USA. In order to asset the significance of monetary model, the comparison of disequilibrium from monetary model and simple random walk model is compared where monetary model has considerably smaller dispersion around the mean.

Unlike past studies which used pooled OLS for the short run model, this study has shown that the included variables are still cross sectional dependent even if they are first differenced hence Pooled OLS model is not appropriate. For this issue, this study has used same CMG model for estimating short run coefficients. In short run interest rate and output differential came out to be positively and negatively significant respectively. The lagged ECM term in short run represents disequilibrium response of the model; this value is considerably high showing strong tendency to recover equilibrium. On average it will only takes 13 months for any disequilibrium produced by the policy change of the country which is fast considering that it is around about a year. Using CMG model in short run has ensured residuals to be cross sectional independent, homoscedastic and stationary which was issue with the residuals generated from Pooled OLS model of short run. The country wise convergence speeds are similar to what average is indicating except for the case of United Kingdom where the lagged insignificant ECM term iscausing considerably long convergence speed. Hence it can be said that the long run equilibrium is strong for three trading partners like Germany, Hong Kong and USA and it is weak for the United Kingdom.

A valid monetary model implies that for the case of Pakistan, exchange rate can be managed simultaneously against its four major trading partners. And according to this model rapid depreciation of the exchange rate can be managed by tight monetary policy where decrease in money supply relative to its partner and increase in return on investment (interest rate) relative to its trading partners can help in appreciation and stability of exchange rate of Pakistan. Similar to MacDonald & Taylor (1991) this study suggests that while building an equilibrium model of exchange rate, this monetary model is appropriate and can be used for any country.

This model implies that, if country is trying to finance its domestic and international debts using easy monetary policy then this theory advises to refrain from this approach as

increasing money supply will cause depreciation of multilateral exchange rate, whose implications can be severe.

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