Real Exchange Rate and Current Account Balance: Empirical Evidence from Bangladesh(1976-2020)

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Abstract

This paper aims to study the effect of real exchange rate, along with and in presence of other appropriate variables, on current accounts balance of Bangladesh on the basis of data from 1976 to 2020. The Cochrane-Orcutt AR(1) hierarchical multiple regression analysis, using a new ad hoc proxy real exchange rate variable constructed with nominal exchange rate, home and world GDP deflator data, suggests that there is a negative and statistically significant relationship between real exchange rate and current accounts balance. The result suggests maintaining a stable current accounts balance requires extremely close monitoring and management of government into the foreign exchange market and domestic commodity markets.

1 Introduction

Bangladesh, as one of the highest ready made garment exporting countries, continue to transform itself into a export-based economy day by day. The country has a small, open and rapidly growing economy. The price level in Bangladesh does not affect the price level of the global economy. In other ways, it can be termed as a price taker economy. It has a booming export oriented economy which is likely to diversify more in the future. It is vital that we study the impact of real exchange rate on the current account balance for Bangladesh.

Current accounts balance or CAB records home economy's all transactions with the world economy. More specifically, net trade in goods and services of the home country, its net transfer of payments and its net earning income on international investments over a certain period are reported in the current accounts balance. CAB portrays the country's full picture of exports and imports of goods and services, international payments made to and received from foreign investors, and transfer payments received such as foreign aid, other development assistance etc. It is one of the most important indicator of an economy's health. It also measures the size and direction of international borrowing.

CAB can be surplus(positive) and deficit(negative). Economy with a current accounts surplus is earning more from the exports than the expenditure on imports and with a current account deficit is spending more on imports than earning from exports. The real exchange rate or RER Between two countries' currencies is a tool to compare the relative prices of one countrys's goods and services. It can be defined as the product of the nominal exchange rate and the relative prices of a basket of goods of the two countries.

RER tells us the amount of goods and services in the domestic economy to be exchanged with the foreign economy. RER has a significant effect on the terms of trade of the home economy. It is negatively related to CAB. Change in RER impacts CAB because RER reflect combined effect of nominal exchange rate and relative price level fluctuations.

Imbalance in CAB is normal for any open economy. The surplus and deficit in CAB is offset by the capital and financial accounts. *National Income Accounting Analysis* suggests a negative relationship between RER and CAB. However, only with the help of RER, we would not be able to explain the fluctuations in the CAB. As the *National Income Accounting Model* and open-economy *AD-AS Model* suggests, there are other important variables important to explain the behavior of CAB. Some of them includes but not limited to money supply, interest rate, foreign direct investment, remittances etc.

In this paper, we examine the relationship proposed by the short-run fluctuation model of an open economy by stacking it up with additional aand relevant variables. This paper fills the knowledge gap of examining the relationship between RER and CAB of Bangladesh, a rapidly developing South Asian economy. Due to rigorous academic study into establishing the theoretical relationship between the volume of net exports of a country and and it's real and nominal exchange rate, we can study their relationship from the viewpoint of established economic theory. The subsequent sections analyze the relationship empirically.

After the next section 2 discussing the previous studies into the relationship between RER and CAB, we dive into our empirical strategy 3.2 for investigation of the study and the model specification 3.1 based on the established theory. Due to lack of real exchange rate or real effective exchange rate data, the an ad hoc proxy variable is constructed in Section 4. Section 4 describes the data, sources and the variable summaries. After the initial OLS estimation and diagnostics, Section 5 describes the limitations and issues associated with the estimation of the original model. To bypass the problems and issues from OLS estimation, we finally deploy and estimate the model using Cochrane-Orcutt AR(1) hierchial regression model.

2 Related Literature

There is an abundance of literature studying the dynamics of current accounts balance and real interest rate. However, this paper as an empirical and applied study in nature and does not intend to study the theoretical details of the mechanism. We only intend to study few relevant previous studies as a rationale for constructing the model.

From a small-open economy perspective, (Henry and Longmore, 2003) studies the impact of real exchange rate and current account balance behaviour and policies for Jamaica. it finds that real exchange rate is not a significant factor for its current accounts balance and real exchange rate policy is ineffective in managing current accounts.

(Karadam, Özmen, et al., 2016), with the help of panel ARDL model, studies the impact of real exchange rate on economic growth on a panel of developed and developing countries.They find that external variables representing global financial conditions are strongly significant in explaining growth in developing countries along with the conventional variables like trade openness, human capital and domestic savings.

From a regional economic perspective, (Arghyrou, Chortareas, et al., 2008) supports the conventional theories associating real exchange rate and current accounts balance. Although the panel study is conducted for a relatively major economic zone with a common currency and a large free trade area, it may not represent all of the countries in the globe, specially a developing country like Bangladesh.

In case of Bangladesh, (Islam and Hossain, 2014) studied the relationships between exchange rate, export and GDP of a time period of 1981 to 2013 and This study suggests increasing exchange rate and export to increase economic growth. The analysis presented a positive relationship between exchange rate and exports, one of the major components of currents accounts balance.

(Lee and Chinn, 2006) established negative relationship between real exchange rate and current accounts for a panel of developed and influential economies perspective. However, only UK economy was found to have violated the overall result while other countries provided similar results. The study finds that temporary shocks on the real exchange rate and currents accounts have large effect on short run but doesn't have large effect in the long run. While permanent shocks on real exchange rate have large effect of real exchange rate, it has a smaller effect on current accounts. But surprisingly (Longe et al., 2019) presents a differing causality between current accounts balance and official exchange rate of Nigeria. It finds current accounts balance in addition to oil price to be strong determinant of official exchange rate of Nigeria.

The (Rajković et al., 2020) study shows us some of the very insightful behavior of exchange rate policy during economic crises. The study concludes that exchange rate policy for home currency is a powerful tool only when the economic conditions are stable in the home country, conducted in the context of Western Balkan and Central & Eastern European countries.

(Paleologos and Bitzis, 2006), using Johansen and Juselius cointegration analysis (Johansen and Juselius, 1990), establishes both long and short run relationship between current accounts deficit and the real effective exchange rate for Greece. (Kim, 2015) using the data of 18 industrial countries and Panel VAR model, examines the effects of government consumption shocks on current accounts and real exchange rate along with country fixed effects. Some interesting findings from the paper is that the depreciation of real exchange rate and improvement of current accounts have larger effect in countries with low international capital mobility. The study also finds that depreciation of real exchange rate leading to improvement of current account are more likely to happen in countries with flexible exchange rate regimes.

From an emerging market perspective, (Gervais et al., 2016) finds that real exchange rate adjustment helps reduce current accounts imbalances and the adjustment of deficits with fixed exchange rate economies occurs through the mechanisms of exchange rate crisis. The study also found out that current account recuperate faster in countries with a flexible exchange rate regime.

(Affandi and Mochtar, 2013) studied the impact of structural changes on the dynamics of Indonesia's current account and real exchange rate caused by the 1997 Asian financial crisis. The study concluded that the the real exchange rate behavior of Indonesia has altered since 2000. Permanent shocks have been identified as the primary cause of real exchange rate fluctuations in the study.

3 Model

3.1 Model Specification

We choose a number of variables for our study including Current Account Balance, Nominal Exchange rate, Inflation(GDP Deflator), M2 Money Supply growth, FDI outflow, Real Interest Rate and GDP growth of Bangladesh. We specify the model as follows,

$$CAB_t = f(RER_t, FDIO_t, REMIT_t, M2G_t, R_t, GDPG_t) \tag{1}$$

The choice of variables has been restricted on the basis of theory, data availability(for the longest time period) and regression model diagnostics. We deploy a multiple regression model based on the model specification in equation 1,

$$\begin{aligned} CAB_t = \alpha_1 + \alpha_2 \ln REXRT_t + \alpha_3 FDIO_t + \alpha_4 REMIT_t + \alpha_5 M2G_t \\ + \alpha_6 R_t + \alpha_7 GDPG_t + \epsilon_t \end{aligned} \tag{2}$$

In the multiple regression model, CAB_t= Current Account Balance (% of GDP) , $FDIO_t$= Net Outflow of FDI (% of GDP), $REMIT_t$= Personal Remittances Received (% of GDP), $M2G_t$= Broad Money(M2) Growth (Annual %), R_t= Real Interest Rate (%), $GDPG_t$= GDP Growth(Annual %), ϵ_t= Error Term and $REXRT_t$= Proxy variable for Real Exchange rate (Calculated Annual % change in RER). Here $_t$= Time Period, 1976 to 2020 and $\alpha_1, \ldots, \alpha_7$ are the parameters.

3.2 Empirical Strategy

The multiple variable regression model is used to study the effect of RER over CAB. The econometric model has been for estimation using equation 2. A hierarchical multiple regression model allows us to see the effect RER has on CAB in the presence of other variables.

Due to the nature of variables (described in Section 4) and the percentage format of all the variables chosen for the analysis, we have refrained from deploying any natural logarithm transformation of any variables. In addition to everything, this analysis lacks real exchange rate or real effective exchange rate data. For that reason, we at first construct a proxy variable from the available data, using the theoretical definition of equation 3. We finally define a new proxy variable to use from equation 4 in the subsequent section (Section 4). This newly constructed variable is a proxy for the actual real exchange rate. The $REXRT_t$ variable itself is an interaction term of RER, nominal exchange rate, and relative price change ratio of home economy relative to the world economy. The proxy variable, $REXRT_t$, captures the central theoretical basis for real exchange rate and the very fundamental theoretical formula of equation 3.

Here, α_2 is the real exchange rate elasticity of current accounts balance for Bangladesh. α_2 measures the impact RER has on the CAB of the home economy. The parameter shows the direction and sensitivity of CAB with respect to RER. If the α_2 is significant and exhibits negative relationship with CAB, we can conclude that the results are in line with the short-run open economy models.

To have a proper and unbiased estimation of the model specified by the equation 2, we estimate the model using ordinary least square estimation method and obtain the results (Section 5). Due to limitations of OLS estimation method and violations of key assumptions for OLS assumption obtained by various OLS diagnostic tests, we deploy Cochrane-Orcutt AR(1) method for estimation 5, which is an improved reiterative version of Feasible Generalized Least Square (FGLS) Method.

3.3 Constructing $REXRT_t$

Due to absence of adequate real exchange rate or real effective exchange rate data for Bangladesh, we construct an ad hoc proxy variable named $REXRT_t$, which can be defined as the proxy for percentage change in real exchange rate. The standard formula for real exchange rate, RER, is,

$$RER_t = \text{Nominal Exchange Rate} \times \frac{\text{Foreign Price Level}}{\text{Domestic Price Level}} \tag{3}$$

The formula in equation 3 can also be expressed as,

$$\begin{aligned} \Delta RER_t = \Delta \text{Nominal Exchange Rate (Annual \% change)} + \Delta \text{Foreign Price Level (Annual \% change)} \\ - \Delta \text{Domestic Price Level (Annual \% change)} \end{aligned} \tag{4}$$

Based on the formula for RER, the construction of the proxy variable has been made with the help of available nominal exchange rate and Inflation(GDP Deflator) data for both home and world economy. We define $REXRT_t$, based on equation 3 and 4, as,

$$REXRT_t = \text{\% Change in } NOMEXRT_t + WORLDINFLATION_t - HOMEINFLATION_t \tag{5}$$

Here, $NOMEXRT_t$= Nominal Exchange rate, $WORLDINFLATION_t$= Inflation (World GDP Deflator, annual %) and $HOMEINFLATION_t$= Inflation (Home GDP Deflator, annual %). All these variables are described in the Section 4. This newly constructed $REXRT_t$ provides us the with the information of joint impact of fluctuations in nominal exchange rate in addition to home and world economy's increase in price levels.

4 Data Sources, Variables and Summaries

The data on these variables were collected from various sources including World Bank, IMF, World Development Indicators etc. The variables and a summary of statistics are presented in the below table. All the data are collected from World Bank (WB), International Monetary Fund (IMF), Organisation for Economic Co-operation and Development (OECD) and United Nations Conference on Trade and Development (UNCTAD) sources. All variables are in percentage form.

Summary of Variables in the Model

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
CAB	45	-0.727	1.842	-5.020	3.470
GDPG	45	5.072	1.645	0.819	8.153
R	45	5.470	6.629	-12.27	33.80
M2G	45	17.41	7.189	9.743	43.00
REMIT	45	4.675	2.838	0.185	10.59
FDIO	45	0.0373	0.0803	0	0.365
NOMEXRT	45	49.48	23.03	15.02	84.87
HOMEINFALTION	45	6.717	6.223	-17.63	25.62
WORLDINFLATION	45	5.926	2.826	1.685	13.35
REXRT	44	-1.399	4.946	-16.85	12.96

5 Model Diagnostics & Estimation

Due to having a time series annual data from 1976 to 2020, the model is likely to be prone to some limitations which increase risk of obtaining an incorrect estimation from OLS estimation method, like high risk of multicollinearity, heteroscedasticity and specification bias. To control for these issues with OLS estimation method, we have taken resort to visual and other econometric tools to detect issues in the final model. All the analysis are done using STATA 14.1.

From OLS estimation 5 and a visualization of residuals 11.7, we can't confirm that the residuals are exhibiting random pattern thus signaling a possibility of heteroscedacticity. Now we conduct Breusch-Pagan-Godfrey test (Breusch and Pagan, 1979) 11.2 and obtain p-value way higher than 5% ($Chi^2(1) = 1.39, Prob > Chi^2 = 0.2383$) conclusively confirming absence of heteroscedasticity in the estimated model. Now we check for autocorrelation using Durbin-Watson test (Durbin and Watson, 1950; GS et al., 1951) and the result shows a definitive positive autocorrelation by the d-statistic(7, 44)=1.604653. Again, We check for the presence of multicollinearity using variance inflating factor. The result 11.6 shows that none of variables in the model have high score(ranged from 1.08 to 4.67). It confirms that the estimated model does not suffer from multicollinearity.

OLS Regression Results

VARIABLES	(1) CAB
REXRT	-0.140*
	(0.0727)
FDIO	-2.309
	(3.000)
REMIT	0.471***
	(0.102)
M2G	0.0119
	(0.0239)
R	0.234***
	(0.0713)
GDPG	-0.150
	(0.115)
Constant	-3.612***
	(0.813)
Observations	44
R-squared	0.692

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

We check for specification bias using Link Test (Tukey, 1949) 11.5 and Ramsey Reset Test (Ramsey, 1969) 11.1. None of the tests fail to reject that the model is correctly specified, thus confirming the model free from specification bias. We further check this model for normality of the residuals. The visualization of the predicted residual value 11.8 and 11.9 shows little deviation from a standard normal distribution. We further check using Shapiro-Wilk W Test (Shapiro and Wilk, 1965) 11.3 for normal data, and the result indicate that we can't reject that the residuals are normally distributed.

From various tests to detect the violation of OLS assumptions, it is clear that OLS estimation method 5 is not fit for the data and model. To bypass the issues with autocorrelation, we deploy Cochrane-Orcutt AR(1) regression method (Kadiyala, 1968; Prais and Winsten, 1954) 5 to control autocorrelation in the model.

Cochrane-Orcutt AR(1) Model Results

	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
REXRT	0.0105	0.0121	0.0275	0.0276	-0.159	-0.173*
	(0.0377)	(0.0386)	(0.0368)	(0.0372)	(0.0829)	(0.0826)
FDIO		0.929	-2.720	-2.721	-2.409	-2.357
		(3.324)	(3.176)	(3.218)	(3.049)	(2.995)
REMIT			0.572***	0.572***	0.430***	0.463***
			(0.123)	(0.125)	(0.111)	(0.113)
M2G				-0.00188	0.00978	0.0106
				(0.0260)	(0.0246)	(0.0242)
R					0.236**	0.244**
					(0.0843)	(0.0845)
GDPG						-0.162
						(0.108)
_cons	-0.462	-0.504	-3.256***	-3.223***	-4.159***	-3.572***
	(0.611)	(0.604)	(0.630)	(0.788)	(0.769)	(0.865)
N	43	43	43	43	43	43
R^2	0.002	0.004	0.402	0.402	0.570	0.584
adj. R^2	-0.022	-0.046	0.356	0.340	0.512	0.514

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The six step hierarchical regression model used to study the effect of real exchange rate on current account balance while in the presence of additional variables in the subsequent models. $FDIO_t$ variable was introduced to the model at the second stage. $REMIT_t$ & $M2G_t$ variables were introduced to the thirds and fourth models, respectively.R_t & $GDPG_t$ were introduced to the analysis at the last steps, consecutively.

The hierarchical regression model at the first stage revealed that real exchange rate, $REXRT_t$, did not contribute significantly to the variations in current account balance, CAB_t. The model only accounted for 0.2% variation in CAB_t. Introducing the next $FDIO_t$ variable improved the explained variation by a meagre 0.2% improvement. However, the next variable, $REMIT_t$, the remittance flow is a statistically significant variable in the model. It's introduction led adjusted R-squared value to 35.6% variations in the model which is a very big increase in magnitude. Still, with the introduction of this variable doesn't make our variable of interest, $REXRT_t$, statistically significant.

Introducing $M2G_t$ in the model reduces the explained variation in the model to 34.0%.With the subsequent introduction of next variable, R_t, in our 5th model, the explained variations in the model jumps up to 51.2% in the model. Adding the final $GDPG_t$ variable to the model, increases Adjusted-R^2 to 51.4% signaling another meagre increase in explained variations in the models due to an additional independent variable.

The most important parameter, $REXRT_t$, has been statistically significant in only the final model. The variable has been more significant with the introduction of more and more variables in the model. When all variables are present in the model, $REXRT_t$ becomes significant and the estimated parameter becomes negative (in the final two models) indicating a negative relationship with the dependent variable, CAB_t.

6 Discussion

The regression results clearly show that the real interest rate proxy $RERXRT_t$ negatively impacts the CAB_t. One interesting distinction of our model is that we have used FDI-outflow instead of inflow in this model. The personal remittance flow $REMIT_t$ are closely associated with the inflow of foreign direct investment of Bangladesh. Adding FDI-inflow in the model night increase the risk of multi-collinearity. However, the risk of specification bias has been cleared by multiple tests, 11.5 and 11.1. In spite of seemingly arbitrary choice of variable, our model remains free of specification error.

The results from final model from Section 5 shows that three variables are significant in the model. These variable are $REXRT_t$, $REMIT_t$ and R_t, real exchange rate change rate, remittance flow as percentage of GDP and real interest rate for Bangladesh. Overall, over final model performs a very average performance by explaining the variance in CAB_t by only 51.4% with the help of independent variables. The negative Adjusted-R^2 value in Model 1 and Model 2 5 can be interpreted as zero since the model has only 45 observations thus leading to low statistical power. However, from the predicted value vs actual value plot 11.10 we see a clear indication that the values lie closer to a 45^0 line indicating our model performs somewhat better at explaining the fluctuations in current accounts balance with the help of variations from independent variables.

It is clear from the regression results is that the net outflow of FDI negatively impact the current accounts balance. A 1% increase in net outflow of FDI will lead to 2.357% drop in current accounts balance. A puzzling insight from these results are that GDP growth negatively impact current accounts balance. This may be explained with the fact that the increase in purchasing power due to economic growth results in a high demand for foreign goods leading to a negative impact on the CAB_t. Also, money growth positive impacts the CAB_t, although in a very sensitive manner. An increase of 0.0106% in money supply growth will lead to 1% increase in CAB_t. In addition to everything, a 0.244% change in real interest rate will improve the current accounts balance by 1%.

One other important insight from the model is that the impact of remittance flow on current accounts balance. The $REMIT_t$ variable is highly significant. A 0.463% increase in remittance flow will improve CAB_t by 1%. The total picture derived from the model tells us that the current accounts balance of Bangladesh is positively sensitive to remittance flow, monetary growth and real interest. On the other hand, it is negatively sensitive to FDI-outflow, GDP growth and real exchange rate growth rates.

The results from the model, an analysis of the impact of real exchange rate on current accounts balance, is in line with the other studies conducted internationally and with the standard theory. The α_2 parameter is significant and negative. A 0.173% increase in real exchange rate would result in a 1% decrease in current accounts.

This insight proposes new challenge for us. Policy makers might take advantage of this analysis by implementing exchange rate targeting policies to improve current accounts, but this also provides us with a challenge. Taking into consideration of the results from this analysis, in order to maintain a stable current accounts balance, we must ensure a stable real exchange rate. Since the components for real exchange rate include nominal interest rate, price level of home and world economy, the home country authority must maintain an extremely close watch and market intervention approach to ensure stability. The government can in no way take measures to upset the optimal balance of current accounts to worse off the capital and financial accounts of the country.

7 Limitation

This paper lacks advanced time series analysis. This paper tries to meet this lack of time series analysis with the help of Cochrane-Orcutt AR(1) regression method. However, that is not a true substitute for the demanding analysis the subject matter requires. The subsequent versions of the paper will improve on the theoretical concept and other insights derived from this study. The next versions of this paper will provide an appropriate time series analysis of the data and the respective model.

8 Conclusion

The relationship between real exchange rate and current accounts balance, although an established economic theory, needs a good revisit since a good chunk of economic theories behave differently in real life. For Bangladesh, a rapidly developing country, it needs to turn all the stones to pull through the finish line of economic development. The country specific study provides us with a statistically significant and negative relationship between current account balance and real exchange rate of Bangladesh. Taking into account of the results from this analysis, the policymakers must maintain an extremely close watch and frequent intervention in foreign exchange market and domestic goods markets to ensure a stable balance of payments.

9 Note

- The earlier version of this paper was titled "Impact of Real Exchange rate on Current Account Balance: Findings from Bangladesh" and submitted as part of coursework for *ECON 310: International Finance* course of Department of Economics, University of Dhaka, Bangladesh.
- The data and the Stata codes for this paper is available in the internet as a GitHub Repository. The repository link is here, link.

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11 Appendix

11.1 Ramsey Reset Test for Specification Error

```
Ramsey RESET test using powers of the fitted values of CAB
      Ho:  model has no omitted variables
                F(3, 34) =      2.03
                Prob > F =      0.1281
```

11.2 Breusch-Pagan Test for Heteroscedasticity

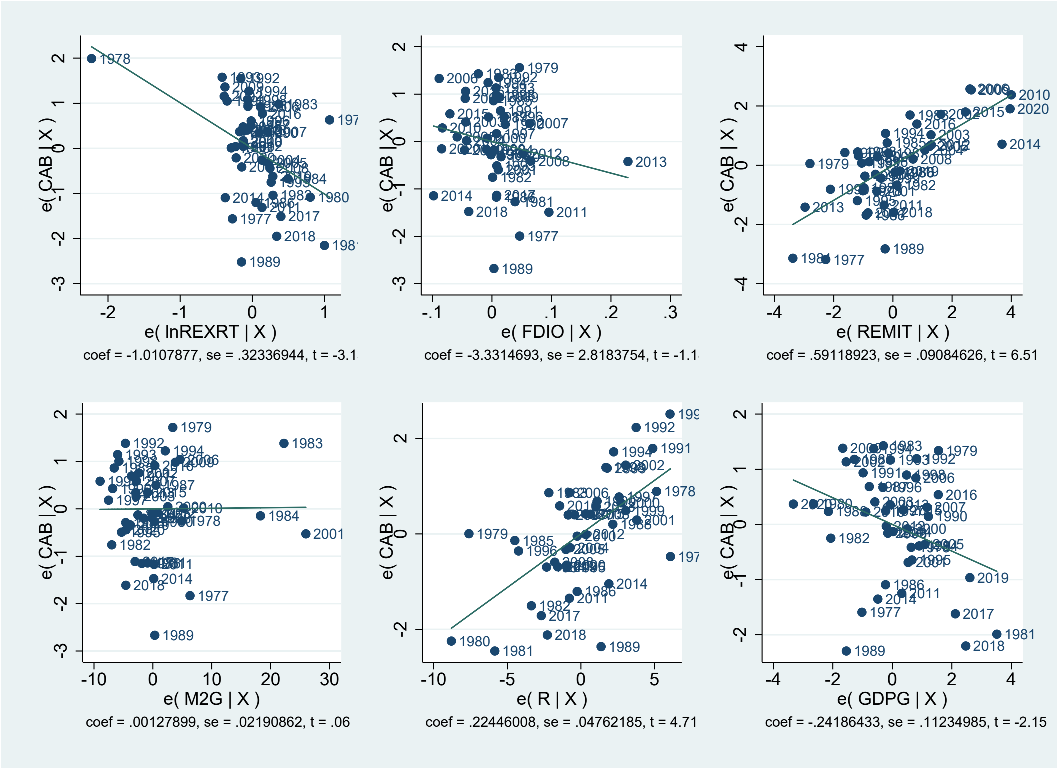
```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
        Ho: Constant variance
        Variables: fitted values of CAB

        chi2(1)      =     1.39
        Prob > chi2  =   0.2383
```

11.3 Shapiro-Wilk W Test for Normality Assumptions

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
r	44	0.96996	1.278	0.520	0.30162

11.4 Two Variable Regression Plots for Visualization



11.5 Link Test for Specification Error

Source	SS	df	MS
Model	101.554769	2	50.7773846
Residual	43.5983634	41	1.06337472
Total	145.153133	43	3.37565425

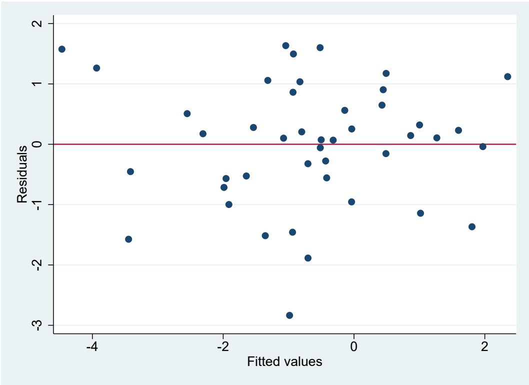
Number of obs	=	44
F(2, 41)	=	47.75
Prob > F	=	0.0000
R-squared	=	0.6996
Adj R-squared	=	0.6850
Root MSE	=	1.0312

CAB	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
_hat	1.093759	.1364191	8.02	0.000	.8182552	1.369263
_hatsq	.0508325	.0485456	1.05	0.301	-.0472074	.1488723
_cons	-.0756999	.185223	-0.41	0.685	-.4497653	.2983655

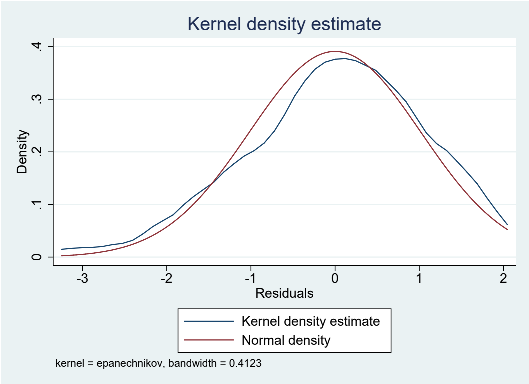
11.6 Variance Inflating Factor for Multicollinearity

Variable	VIF	1/VIF
R	4.67	0.213908
REXRT	4.60	0.217463
REMIT	2.85	0.350951
FDIO	2.10	0.475898
GDPG	1.30	0.767711
M2G	1.08	0.928878
Mean VIF	2.77	

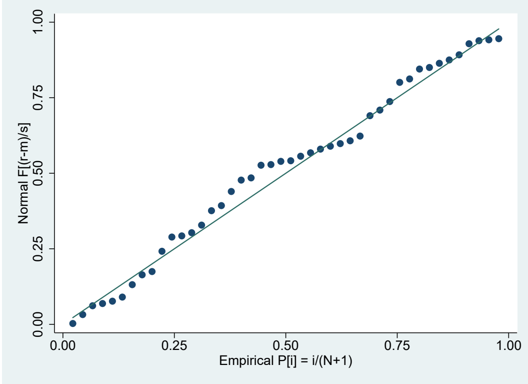
11.7 Residual vs Fitted Value Plot for Heteroscedasticity



11.8 Kernel Density Plot for Normality Assumption



11.9 Visualization for Sensitivity to Non-normality in Data Middle Range



11.10 Predicted Values vs Actual Value Plot