

TESTING BALASSA-SAMUELSON MODEL TO EXAMINE PURCHASING POWER PARITY (PPP) OF BANGLADESH WITH REFERENCE TO 1972-2016

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ABSTRACT

This paper has investigated Balassa-Samuelson hypothesis in Bangladesh to examine purchasing power parity (PPP) during 1972-2016. The broad objective of this study is to analyse whether purchasing power parity (PPP) holds in Bangladesh or not during the analysed period. Johansen Long Run Co integration test has been used through regression analysis to test the long run relationship among real exchange rate, relative price, relative productivity, government share and terms of trade of Bangladesh during 1972-2016. Descriptive statistics of the variables have also been shown. ADF Unit Root test has been used to test the stationary state of panel data. ECM Model, CUSUM & CUSUMQ tests have been applied to test the stability of the model. Johansen Long Run Co integration test has showed that there exists a long run relationship among the variables and purchasing power parity (PPP) does not hold in Bangladesh. It recommends better understanding of volatility and persistence of real exchange rate as transaction costs and nonlinearity matter for purchasing power parity (PPP).

Keywords: Balassa-Samuelson Model, Purchasing Power Parity (PPP), Johansen Long Run Co-integration Model, Error Correction Model (ECM), Stability.

INTRODUCTION

Balassa-Samuelson hypothesis depicts that high wage rate in tradable goods sector leads high wage rate in non-tradable goods sector in emerging economy in any country. Consequently, high wage rate leads to high productivity rate which results in high real exchange rate. Purchasing power parity (PPP) states that if and only if, purchasing power of two countries are same then exchange rates between those countries are in equilibrium.

The objective of this study is to analyse the influence of real exchange rate changes on relative price, relative productivity, government share and terms of trade in Bangladesh during 1972-2016 by applying the Johansen long-run test for co integration. Consequently, this paper intends to estimate whether there is any correlation among real exchange rates, relative price, relative productivity, government share and terms of trade of Bangladesh during 1972-2016. Has Balassa-Samuelson hypothesis any effect on purchasing power parity in Bangladesh? This research seeks to evaluate the foresaid questions. Unlike previous studies, the paper applied ADF test, Johansen long-run test for co integration, ECM, CUSUM and CUSUMQ tests to estimate long run relationships. The results of the Johansen long-run test for co integration suggest that there exists a long-run relationship among the said variables.

The rest of the paper is structured as follows. Section 2 describes a brief review of the relevant literature. Section 3 depicts a theoretical model that captures a Balassa-Samuelson

model. The econometric estimations for the long run relationship among the variables are set out in Section 4. Section 5 concludes with some concluding remarks.

LITERATURE REVIEW

Mihaljek (2002) analysed Balassa-Samuelson model on six central European countries like Slovenia, Slovakia, Poland, Hungary, Croatia and the Czech Republic and found that productivity growth of tradable industries enhances relative prices and inflation.

Sinn & Reutter (2000) analysed 11 euro countries and found that relative prices change frequently because of Balassa-Samuelson effect. They calculated minimum aggregated inflation rate to test Balassa-Samuelson effect on relative prices.

Motonishi (1999) estimated balanced productivity growth and capital accumulation using 1970-1990 sectoral data, explored the determinants of relative price such as fluctuations in real exchange rate and found that there could be a negative or positive effect of balanced growth on relative price.

Faria & Ledesma (2003) used bounded testing and time series approach to examine purchasing power parity on some of the counties like US, UK, Germany and Japan and found that ppp holds without any supportive evidence of Balassa-Samuelson model. They also found that there is no real impact of real exchange rate in economy.

Grauwe & Schnabl (2005) explored the conflict of monetary and real convergence based on Balassa-Samuelson model regarding productivity, inflation, fiscal policy. Fiscal contraction could be the second best solution regarding nominal appreciation. They found nominal appreciation and fiscal contraction as the major options for achieving EMU membership.

Asea & Mendoza (1994) tested Balassa-Samuleson model regarding relative price of non-tradable and purchasing power parity by the ratio of marginal product of labour that could be expressed by investment output or capital output ratio. They found that labour productivity explains slight movements in relative prices and relative prices explain deviations from ppp.

Dedu & Dumitrescu (2010) estimated Balassa-Samuelson model regarding productivity growth of tradable and non-tradable goods and inflationary differences between Romania and the other Euro countries. They found that Balassa-Samuelson effect explained inflationary differences marginally which has a major implication in interpreting inflation and exchange rate. They concluded with the finding that productivity differences very unlikely endanger the nominal convergence.

Funda et al. (2007) assessed Balassa-Samuelson model during 1998-2006 to quantify inflation and real exchange rate in Croatia. Inflation differentials of euro countries and Croatia were compared with the productivity growth of tradable and non-tradable goods. They concluded with the finding that Balassa-Samuelson effect was not statistically significant in Croatia.

Hassan (2011) provided evidence on the price-income relationship of low income countries which is non-linear, negative and robust. The findings of this paper were that the estimation and measurement of ppp of low-income countries were biased.

Egert et al. (2003) examined Balassa-Samuelson model in 9 East European and Central countries and found that productivity growth differentials lead to inflation of non-tradable goods, misleading consumer price index and price hike of non-tradable and food items for the effect of Balassa-Samuelson model using panel data and co integration techniques. They also found appreciation in real exchange rate and increasing trend in price of tradable goods because of Balassa-Samuelson effect.

Konopczak (2013) estimated Balassa-Samuelson effect on the effectiveness of labour and product market in Slovakia, Czech Republic, Poland and Hungary and found inflation differentials as a systematic component relative to Euro countries. Monetary policy inadequacy was also been assessed and in the context of Euro areas, inflationary pressure found to be a non-negligible issue. It was suggested that ignoring non-fulfilment of assumptions of wages and mark-ups distort estimated results.

Romanov (2003) explained Balassa-Samuelson hypothesis and found the volatility of real exchange rate by productivity differential of tradable and non-tradable goods and the appreciation of import/export to product price ratio during 1993, 1997-1998 and 2001. It was suggested that the depreciation of real exchange rate is unitary regarding the appreciation of non-tradable goods.

Angjelkovska (2012) pointed out that because of low productivity; wage and price transmission mechanism has no application after Balassa-Samuelson effect in Macedonia. It was found that productivity growth is not reason of price hike of tradable and non-tradable goods rather it was caused by the changes of economic system.

Pancaro (2010) showed that the Penn effect is only explained by Balassa-Samuelson effect either for low degree and high trade elasticity of home bias regarding incomplete market, high complementarity between non-tradable and tradable goods and low consumption of tradable goods which are coherent with empirical evidence that generally supports Balassa-Samuelson model. The controversial issue was appreciation of real exchange rate in tradable goods regarding productivity gains.

Taylor & Taylor (2004) interpreted that PPP may hold on long run but does not hold on short run as there is significant real exchange rate mean reversion. They addressed the gap on the basis of general equilibrium model between theory and empirics and found that there is long lasting and large effects of monetary shocks on real exchange rate.

Tica & Sonora (2014) investigated HBS hypothesis in 11 Eastern European and Central countries like Poland, Hungary, Croatia and Bulgaria, etc., and found strong statistical evidence by using panel data and co integration tests. Finally, they concluded by stating that HBS holds if law of one price of tradable goods does not hold and relative prices are negatively influenced by government consumption. They suggested implementing suboptimal monetary policy that results from transition process.

Petrovic (2012) tested HBS to investigate whether real exchange rate of dinar/euro has been affected by labour productivity in sectorial differences or not by applying Johansen and Engle-Granger tests. It was found that there is no evidence that labour productivity and relative prices affect real exchange rates of dinar/euro. It was concluded that labour productivity does not solely determine the real exchange rate of dinar/euro in Serbia and EMU based on the findings.

It has been observed that the literature of Balassa-Samuelson hypothesis is relatively bold but lacks any research to examine PPP for a country like Bangladesh. This research attempts to fill this gap. Besides most of the studies examined PPP in accordance with real exchange rate and relative price only but this research considered relative productivity, government share and terms of trade also to justify PPP properly. The paper also seeks to fill the gap by estimating the structural stability of the developed model by developing ECM and applying CUSUM and CUSUMQ test.

OBJECTIVES

The objective of this research is to analyse the influences of the real exchange rate changes on relative price, relative productivity, government share and terms of trade in Bangladesh during 1972-2016 by testing the Johansen long-run co integration model in accordance with Balassa-Samuelson hypothesis. The specific objectives of this paper are to explain the effects in the relationships among real exchange rate, relative price, relative productivity, government share and terms of trade, to estimate how real exchange rates respond to changes in relative price, relative productivity, government share and terms of trade, to evaluate the stability of Balassa-Samuelson effect in Bangladesh during the period 1972-2016 and to recommend policy guidelines to improve trade imbalance in Bangladesh.

METHODOLOGY

This research is descriptive in nature and the data is quantitative in nature. Only the secondary data were used. Secondary data were collected from the world development indicators report, internal database and websites. An OLS model of long-run equilibrium relationship among the variables such as real exchange rate, relative price, relative productivity, government share and terms of trade has been developed which is specified in Equation (1) and Johansen co integration technique has been applied. Descriptive statistics of the variables have been shown. ADF test has been applied to test the stationary state of time series data. ECM, Cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) of recursive tests have been developed and tested respectively to examine the stability of the real exchange rate model and to test the structural stability of ECM respectively.

THEORY & MODEL

Structural and transitory nature might cause inflation rate differentials among the countries which results in catching up process, shift in business cycle, asymmetric shocks in monetary and fiscal policy, changes in prices, excise tax or VAT, changes in import-production ratio and production inputs endowment. The inflation rate differentials which is adjusted for and determined by transitory effect and structural components respectively, called the Balassa-Samuelson effect (Balassa, 1964; Samuelson, 1964). Purchasing power parity (PPP) is a simple theory that dictates that the value of one unit of currency of one country will have the same purchasing power in other countries if nominal exchange rate between those countries be equal to aggregate price ratios of those countries (Taylor & Taylor, 2004).

In accordance with Balassa-Samuelson model and Purchasing power parity (PPP) theory, an OLS regression model has been developed among real exchange rate, relative price, relative productivity, government share and terms of trade to examine PPP in Bangladesh by imposing symmetry condition during 1972-2016 which is as follows:

$$r_t = \alpha + \beta_0 + \beta_1 p_t + \beta_2 a_t + \beta_3 g_t + \beta_4 ToT_t + \epsilon_t \quad (1)$$

Where r_t is the real exchange rate, p_t , a_t , g_t and ToT_t are the relative price, relative productivity, government share and terms of trade respectively (Tica & Sonora, 2014). An ECM model has been developed to estimate the short-run dynamics in the relationship among the variables. The ECM model is specified as:

$$\Delta \ln r_t = \alpha_0 \alpha_1 \Delta \ln p_{t-i} + \alpha_2 \Delta \ln a_{t-i} + \alpha_3 \Delta \ln g_{t-i} + \alpha_4 \Delta \ln ToT_{t-i} + \Delta \ln r_{t-i} + \alpha_5 U_{t-1} + \epsilon_t$$

$$\text{Where: } U_{t-1} = \ln r_{t-1} - \beta_0 - \beta_1 \ln p_t - \beta_2 a_t - \beta_3 g_t - \beta_4 ToT_t \quad (2)$$

Where $\alpha_5 U_{t-1}$ is the error correction term, it is the residual from the co-integrating equation, is α_5 the error correction coefficient and α_i are the estimated short-run coefficients (Jammeh, 2012).

ECONOMETRIC ESTIMATIONS

From Table 1, it appears that real exchange rate, relative productivity and terms of trade are asymmetrically distributed. On the other hands, relative price and government share are symmetrically distributed. As for the positive Kurtosis of the variables, the distributions of the variables are more peaked than the Gaussian distribution.

	r	p	a	g	ToT
Mean	1.550794	-0.908184	1.549862	-0.568466	1.967584
Median	1.604226	-1.154902	1.520706	-0.522879	1.973543
Maximum	1.913072	-0.045757	2.290211	-0.045757	2.020734
Minimum	0.886491	-1.698970	0.798513	-1.000000	1.903144
Std. Dev.	0.293902	0.566455	0.386848	0.329124	0.035558
Skewness	-0.718270	0.602628	-0.009553	0.092064	-0.306505
Kurtosis	2.551355	1.861588	2.284878	1.689216	1.929601
Jarque-Bera	4.246742	5.153668	0.959559	3.285110	2.852878
Probability	0.119628	0.076014	0.618920	0.193485	0.240163
Sum	69.78574	-40.86827	69.74379	-25.58096	88.54130
Sum Sq. Dev.	3.800639	14.11835	6.584657	4.766184	0.055631
Observations	45	45	45	45	45

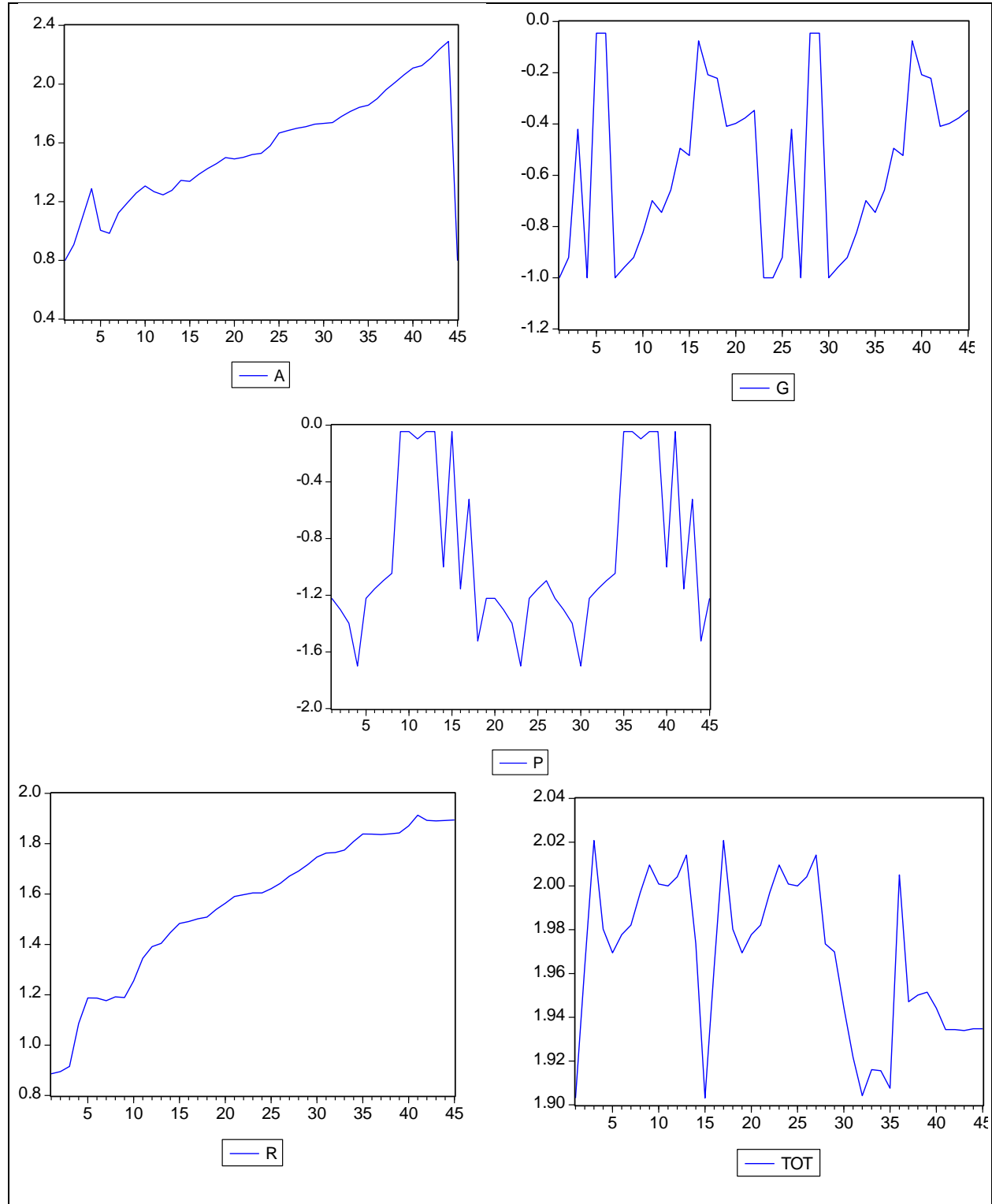
Source: Estimated (r=Real Exchange Rate, p=Relative Price, a=Relative Productivity, g=Government Share & ToT=Terms of Trade)

From Table 2, it appears that all the variables are stationary at level except relative productivity. Relative productivity is stationary at 1st difference after testing Augmented Dicky Fuller (ADF) test. From Figure 1, it appears that all the properties of variables are properly glued.

Variable	C (constant) and T (trend) in the equation	ADF statistics	Optimum lag
r	C & T	-3.974059	2
p	C & T	-1.550526	1
a	C & T	-2.059686	0
g	C & T	-4.557730	0
ToT	C & T	-4.694237	0

Source: Estimated (r=Real Exchange Rate, p=Relative Price, a=Relative Productivity, g=Government Share & ToT=Terms of Trade)

From Table 3, it appears that there is at least 1 co integrating equation in the model (Log likelihood 180.1759) according to trace statistic and max-Eigen value after applying Johansen long-run co integrating test.



Source: Estimated (r=Real Exchange Rate, p=Relative Price, a=Relative Productivity, g=Government share & ToT=Terms of Trade)

FIGURE 1
PROPERTIES OF VARIABLES ARE PROPERLY GLUED

Hypothesized No. of CE(s)	Trace Statistic	0.05 Critical Value	Eigen value	Hypothesized No. of CE(s)	Max-Eigen Statistic	0.05 Critical Value
None *	92.79381	69.81889	0.679382	None *	48.91271	33.87687
At most 1	43.88109	47.85613	0.369281	At most 1	19.81845	27.58434
At most 2	24.06264	29.79707	0.273487	At most 2	13.73846	21.13162
At most 3	10.32418	15.49471	0.136630	At most 3	6.317238	14.26460
At most 4 *	4.006938	3.841466	0.088975	At most 4 *	4.006938	3.841466

Source: Estimated

From Table 4, it appears that there is a long-run relationship among real exchange rate, relative price, relative productivity, government share and terms of trade and relative productivity is negatively correlated to real exchange rate.

Variable	β Coefficients	α Coefficients	Standard error	t-value
r	1.000000	-0.012876	-	-
p	-0.120494	-0.122606	0.25104	0.65413
a	12.91302	-0.039084	2.77178	2.71216
g	2.547070	-0.161278	0.50283	4.28340
ToT	5.381524	-0.001512	4.12349	2.40504
Constant	-9.061789	-	-	-

Source: Estimated (r=Real Exchange Rate, p=Relative Price, a=Relative Productivity, g=Government share & ToT=Terms of Trade)

From Table 4, it also appears that the variables are weakly exogenous which measures the speed of short-run dynamics in the model by exogenous (α s) coefficients. The retrieved co-integration equation has given below:-

$$r_t = 1.00 + 12.91a_t - 0.12p_t + 2.55g_t + 5.38ToT_t - 9.06_t \quad (3)$$

From Equation 3, it appears that there is negative association between real exchange rate and relative price and there is positive association between real exchange rate and other variables such as relative productivity, government share and terms of trade.

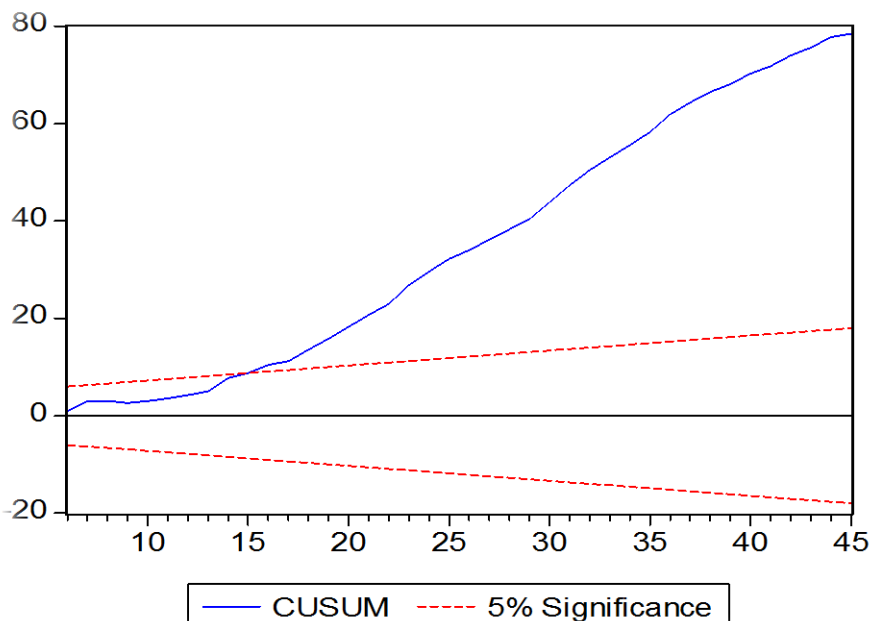
Variables	Coefficients	t-values	Standard error
Constant	0.018417	3.31944	0.00555
D(r(-1))	0.192360	1.11567	0.17242
D(r(-2))	-0.035770	-0.21906	0.16329
D(p(-1))	-0.672803	-3.94577	0.17051
D(p(-2))	0.074825	0.39545	0.18921
D(a(-1))	0.440293	0.47960	0.91805

D(a(-2))	0.233907	0.31937	0.73239
D(g(-1))	-0.328622	-1.78644	0.18395
D(g(-2))	-0.152577	-0.80543	0.18944
D(ToT(-1))	-0.324496	-1.98025	0.16387
D(ToT(-2))	-0.303483	-1.95204	0.15547

From Table 5, it appears that the relationship among the variables were not stable during 1972-2016 in Bangladesh. The F-statistics are significant enough to explain real exchange rate at 5% level. The data set is relatively good fit which has been suggested by the estimated R². Finally, the ECM has suggested that the validity of equilibrium relationship among the variables and a moderate speed of adjustments.

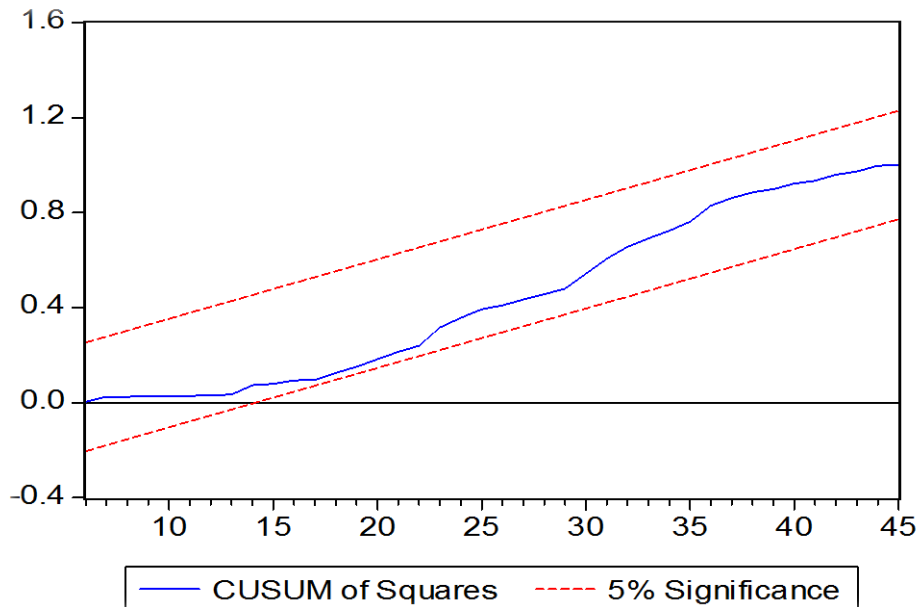
	D(r)	D(p)	D(a)	D(g)	D(ToT)
R-squared	0.691541	0.603889	0.244118	0.413513	0.287681
Adj. R-squared	0.578440	0.458648	-0.033039	0.198468	0.026498
Akaike AIC	-4.575849	1.240687	0.377766	0.867255	-4.033758
Schwarz SC	-4.079372	1.737164	0.874243	1.363732	-3.537281
F-statistic	6.114338	4.157851	0.880792	1.922910	1.101453
Sum sq. resids	0.014300	4.802087	2.026135	3.305604	0.024591
S.E. equation	0.021833	0.400087	0.259880	0.331944	0.028630
Log likelihood	108.0928	-14.05442	4.066919	-6.212356	96.70892
Mean dependent	0.023308	0.004193	0.040029	0.001748	-0.002047
S.D. dependent	0.033626	0.543769	0.255691	0.370770	0.029017

Source: Estimated (r=Real Exchange Rate, p=Relative Price, a=Relative Productivity, g=Government share & ToT=Terms of Trade)



Source: Estimated

**FIGURE 2
CUSUM STATISTIC**



Source: Estimated

FIGURE 3
CUSUMQ STATISTIC

SUMMARY OF FINDINGS

Purchasing Power Parity (PPP) didn't hold in Bangladesh during 1972-2016 as there exists a long-run relationship among real exchange rate, relative price, relative productivity, government share and terms of sale in accordance with Balassa-Samuelson model. From Equation 3, it appears that if relative price goes up then real exchange rate goes down. On the other hands, of relative productivity, government share and terms of trade go up then real exchange rate goes down. The model was also instable according to ECM, QUSUM and QUSUMQ tests during 1972-2016 in Bangladesh.

CONCLUSION & POLICY SUGGESTION

Peculiarities of relative price behavior may create problems in implementing economic policies. Existing Balassa-Samuelson mechanism and changing terms of trade might be misleading regarding real exchange rate and relative price in Bangladesh. Unlike previous studies, this paper employed Johansen test for co integration on real exchange rate, relative price, relative productivity, government share and terms of trade. Johansen co integration test demonstrated evidence for co integration in government share and relative productivity as explanatory variables. The estimated relative productivity coefficients are in line with Balassa-Samuelson effects. Relative price affects real exchange rate more than that of relative productivity. Reforms in the tradable sector may enable to increase exports parallel to appreciation in real exchange rate. Relative price, relative productivity and terms of trade might play a statistically significant role in Balassa-Samuelson effect. Further empirical and theoretical

investigations required on relative price and real exchange rate to demonstrate the impact of government consumption.

REFERENCES

- Asea, P.K. & Mendoza, E.G. (1994). *The Balassa-Samuelson model: A general equilibrium appraisal*. Review of International Economics, Working Paper No. 2-27.
- Angjelkowska, T. (2012). EU accession of Macedonia assessment of Balssa-Samuelson effect. *Research Paper Association for International Affairs*, pp. 1-18
- Balassa, B. (1964). The purchasing power doctrine: A reappraisal. *Journal of Political Economy*, 72, 584-596.
- Dedu, V. & Dumitrescu, B.A. (2010). The Balassa-Samuelson effect in Romania. *Romania Journal of Economic Forecasting*, 4, 44-53.
- Egert, B., Drine, I., Lommatzsch, K. & Rault, C. (2003). The Balassa-Samuelson effect and eastern Europe: Myth or reality? *Journal of Comparative Economics*, 31, 552-572.
- Faria, J.R. & Ledesma, M.L. (2003). Testing the Balassa-Samuleson effect: Implications for growth and the PPP. *Journal of Macroeconomics*, 25, 241-253.
- Funda, J., Lukinic, G. & Ljubaj, I. (2007). Assessment of the Balassa-Samuelson effect in Croatia. *Financial Theory and Practice*, 31(4), 321-351.
- Grauwe, P.D. & Schnabl, G. (2005). Nominal versus real convergence with respect to emu accession: How to cope with the balassa-samuelson dilemma. *International Finance, EconWPA*, 1-44.
- Hassan, F. (2011). *The Penn-Balassa-Samuelson effect in developing countries: Price and income revisited*. Centre for Economic Performance, London School of Economics and Political Science, CEP Discussion Paper No. 1056, 1-20.
- Jammeh, K. (2012). Long-and short-run determinants of demand for money and its stability in the Gambia: An empirical investigation. *Research paper submitted in fulfilment of the honours requirements for the Bachelor of Science in Economics, University of the Gambia*.
- Konopczak, K. (2013). The Balassa-Samuelson effect and the channels of its absorption in the central and eastern Europe countries. *Narodowy Bank Polski, NBP Working Paper No. 163*, 1-19.
- Motonishi, T. (1999). *Modifications of the Balassa-Samuelson model: The effects of balanced growth and capital accumulation*. Tokyo Metropolitan University Workshop, 1-11.
- Mihaljek, D. (2002). The Balassa-Samuelson effect in central Europe: A disaggregated analysis. *The International Conference on Exchange Rate Strategies during the EU Enlargement*, 1-20.
- Pancaro, C. (2010). *The Balassa-Samuelson and the Penn effect: Are they really the same?* Job Market Paper, 1-20.
- Petrovic, P. (2012). Harrod-Balassa-Samuelson effect and the role of distribution sector: An empirical case study of Serbia and EMU. *Z b rad Ekon fak Rij*, 30(1), 57-87.
- Romanov, D. (2003). *The real exchange rate and the Balassa-Samuelson hypothesis: An appraisal of Israel's case since 1986*. Research Department, Bank of Israel, Discussion Paper No. 2003.09, 1-18.
- Samuelson, P.A. (1964). Theoretical notes on trade problems. *Review of Economics and Statistics*, 46(2), 145-154.
- Sinn, H.W. & Reutter, M. (2000). *The minimum inflation rate for Euroland*. CESifo Working Paper Series, Working Paper No. 377, 1-17.
- Taylor, M.P. & Taylor, A.M. (2004). The purchasing power parity debate. *Journal of Economic Perspectives*, 18(4), 135-158.
- Tica, J. & Sonora, R.J. (2014). Harrod, Balassa and Samuelson (re)visit Eastern Europe. *Cogent Economics & Finance*, 2, 1-17.