The Determinants of the Real Exchange Rate in Ghana: A Focus on Inflation Using a Bound Test Approach.

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Abstract

The Exchange rate and hence the real exchange rate in Ghana has been depreciating for some time now which calls for much attention. Surprisingly, very few studies have been done on the determinants of the real exchange rate in Ghana and these studies failed to include inflation. This paper therefore using time series data from 1985-2010, adopted an Autoregressive Distributed Lag (ARDL-Bounds Test) approach to co-integration to find out the determinants of the real exchange rate in Ghana by including inflation. The study found inflation to have a
positive impact on the real exchange rate in the long run but a negative impact in the short run. Thus the study concluded that inflation depreciated the real exchange rate in the short run and appreciated the real exchange rate in the long run.

**Keywords:** Ghana, Real exchange rate, Inflation, Co-integration, ARDL (Bound test)

**INTRODUCTION**

Exchange rate management continues to be a major challenge to many economies especially developing economies like Ghana. The importance of the real exchange rate has generated a lot of attention among economists and according to Ahmed et al. (2012), one of the unresolved issues in research has to do with exchange rate modelling. It is therefore not surprising that Edwards (1994) strongly believes that the real exchange rate behaviour now occupies a central role in policy evaluation and design.

Ghana as a country has had its own challenges when it comes to prudent exchange rates management. For example, the cedi depreciated by 93.67% in 1983, 48.86% in 1987, 36.76% in 1993 and by 33.00% in 1999 against the US dollar (Bawumia and Abradu-Otoo, 2003). Further, the Ghana Cedi depreciated against the US Dollar by 25.1% in 2008 and by 17.7% in 2009 (computed from the Bank of Ghana Transaction rate estimates annual report: 2009 and 2011). This depreciating nature of the cedi therefore tends to affect the economy adversely which needs much attention.

However in spite of the seemingly persisting depreciating nature of the Cedi, which calls for much more attention on the determinants of the real exchange rate in Ghana, in the review of the relevant literature it was rather found that very few studies have been done on the determinants of the real exchange rates in Ghana as a country. For example, Iossifov and Loukoianova(2007) focused on Estimating a Behavioural Equilibrium Real Exchange Rate
Model for Ghana using a Johanson Co-integration Approach and an unconstrained Vector Auto Regressive Approach (VAR), Opoku-Afari et al. (2012) looked at Real Exchange Rate Response To Capital Inflows using a VAR approach, Mumuni and Owusu-Afriyie (2004) looked at a Monetary Approach to the determinants of the Cedi/Dollar Rate of Exchange in Ghana and Appiah and Adetunde (2011) focused on Forecasting Exchange Rate Between the Ghana Cedi and the US Dollar. Also the Bank of Ghana act 2002 sets price stability or inflation targeting as the main framework for the conduct of monetary policy but surprisingly all these studies above, with the exception of Mumuni and Owusu-Afriyie (2004) who looked at the nominal exchange rate and not the real exchange rate, failed to include inflation which is very important when it comes to the real exchange rate and economic management in Ghana. This paper therefore adopted an Autoregressive Distributed Lag (ARDL-Bounds Test) approach to co-integration to find out the determinants of the real exchange rate in Ghana by including inflation. Specifically the study sought to find out the short run (actual) and the long run determinants of the real exchange rate in Ghana and whether the real exchange rate responds to the rate of inflation in the short run or in the long run or both.

The study focused on the real exchange rate because researchers like Obadan (1994); and others believe that, it is of greater importance to developing countries like Ghana as compared to the nominal exchange rate because the traded goods sector is an essential component of gross domestic product in these countries.

**LITERATURE REVIEW**

There are several theories on exchange rates and some of these include the purchasing power parity, the interest rate parity, the absorption approach and the monetary model.
The purchasing power parity contends that it is the differences in price that causes exchange rates to move. The interest rate parity contends that, it is the differences in interest rates among countries which cause exchange rate to move. The absorption approach argues that movement in exchange rate happens when a country produces more than what it can absorb which results in a surplus which can be exported leading an appreciation of the domestic currency and otherwise. The monetary model argues that the level of money supply in both the foreign and the domestic markets is the main determinant of exchange rate movements (Zaher et al. 2011).

However the literature on the determinants of the real exchange rate in developing countries was pioneered by Edwards (1988, 1989). Edwards (1989) built a model for developing countries to explain the determinants of the real exchange rate using a panel of twelve developing countries. According to Edwards, some of the fundamental (long-run) determinants of the real exchange rate are the terms of trade, level and composition of government consumption, controls on capital flows, exchange and trade controls, technological progress and capital accumulation and the short run determinants of the real exchange rates are nominal exchange rate and domestic credit. His model inspired a lot of studies on the determinants of the real exchange rate in developing countries. Some of these studies include Elbadawi (1994) for Chile, Ghana and India, Amin and Awung (1997) for Cameroon, Congo and Gabon, Parikh (1997), Mungule (2004) for Zambia, Obadan (1994) for Nigeria and Eita and Sichei (2006) for Namibia.

On the empirical literature, Ahmed S. e tal. (2012) analysed the determinants of the exchange rate for the US dollar in terms of the Pakistani Rupee. They found that foreign exchange reserves, Stock of money and total debt of Pakistan all in relative terms are significant determinants of exchange rate between the Pakistani Rupee and the US dollar. Oriavwote e
tal. (2012) found that, the ratio of Government spending to GDP, technological progress and the terms of trade were not significant determinants of the real effective exchange rate in Nigeria while capital flow, nominal effective exchange rate and the price level (inflation) were very important determinants of the real effective exchange rate in Nigeria. Opoku-Afari e tal. (2012) using a VAR technique, found that in Ghana, capital inflows tend to appreciate the real exchange rate in the long-run whiles technology change, trade (exports) and terms of trade were all found to depreciate the real exchange rate.

Abass et al. (2011), using quarterly data from 1980 to 2008 examined the Indian Rupee, Indonesia Rupiah, Korean Won, Pakistani Rupee and Sri Lankan Rupee against the United States Dollar. They found that, there is a long term relationship between exchange rates and macroeconomic fundamentals (relative interest rate, foreign terms of trade, trade restrictions and net capital flows) of the sampled economies. Obi e tal. (2010) found that in Nigeria, high inflation, improvement in productivity and investment to GDP ratio led to exchange rate appreciation. Conversely, it was found that, interest rate differentials, rise in foreign exchange reserves and higher degree of openness led to depreciation in the exchange rate. Iossifov and Loukoianova (2007), estimated a behavioural equilibrium exchange rate model for Ghana. Their results showed that most of the real effective exchange rates (REERs) long-run behaviour can be explained by real interest rate differentials, real GDP growth and the real world prices of Ghana’s main export commodities.

Zakari Mumuni and Owusu-Afriyie (2004), employed the technique of co-integration to investigate the principal factors driving the Cedi/Dollar rate of exchange since the adoption of floating exchange rate regime in Ghana using a Monetary model approach. It was found that macroeconomic fundamentals (Treasury bill rate, Inflation rate, domestic and foreign
money supply, interest rate differentials and the previous values of the exchange rate) play an important role in the cedi-dollar rate dynamics.

MacDonald and Ricci (2003) estimated the equilibrium real exchange rate for South Africa using the Johansen co-integration estimation. Their results revealed that the long run behaviour of the real effective exchange rate in South Africa can be explained by relative GDP per capita (productivity), real interest rate differentials, real commodity prices (terms of trade), trade openness, the fiscal balance and the extent of net foreign assets.

Mkenda (2001) analysed the main determinants of the real exchange rate in Zambia. He found that aid and openness depreciate the real exchange rate in the short run. The study further revealed that in the long run, an increase in central bank reserves, a decrease in the terms of trade and trade taxes appreciate the real exchange rate for exports. Ghura and Grennes (1993) used a panel of Sub-Saharan countries, excluding South Africa, to investigate the determinants of the real exchange rate. They found that the real exchange rate becomes appreciated with a capital inflow, an improvement in the terms of trade, an increase in excess domestic credit, a decrease in openness, and an improvement in technology.

**METHODOLOGY**

Annual time series data on Ghana between 1985 to 2010 drawn from the World Bank Development indicators (WDI) was used in order to achieve the objectives of the study. The paper tried to find out the determinants of the real exchange rate in Ghana focusing on inflation by developing a simple real exchange rate model for Ghana as below:

\[
REER_t = \beta_0 + \beta_1 INF_t + \beta_2 OPEN_t + \beta_3 POL_t + \mu_t \quad (1)
\]
Where:

REER is the real effective exchange rate which is used in this study for the real exchange rate. Data was obtained from the WDI.

OPEN measures the extent of openness of the economy measured as the sum of exports and imports (Trade) as a percentage of GDP. It is used as a measurement of trade liberalization. This measure of openness has been used by studies such as Mkenda, (2001), Edwards, (1994), Takaendesa (2006) and others. Theoretically, the more opened an economy the higher the rate at which the real exchange rate will depreciate. The implication is that, openness is expected to have a negative sign. Data was obtained from the WDI.

INFL represents inflation rate which is the general price levels (consumer prices) in Ghana. Theoretically, inflation is expected to have a positive sign and hence an appreciating effect on the real exchange rate. Thus an increase in prices may come as result of a rise in demand in both the tradable and non tradable sectors which can cause the real exchange rate to appreciate. Data was obtained from the WDI.

POL is a dummy variable representing election year. So if the year is an election year is 1 and if not an election year 0. This is to capture the effect of non-monetary factors and to be precise, the impact of the election year on the real exchange rate since the argument in Ghana and other parts of the world is that, during an election year, the ruling Government out of desperation to win power may engage in profligate spending and mismanagement which can affect the real exchange rate. Thus POL is expected to have a depreciating effect on the real exchange rate and hence a negative sign. Data was obtained from author’s own computation.

Therefore the long relationship of the variables can be shown below as:
\[ \ln REER_t = \theta_0 + \beta_1 \ln INF_t + \beta_2 \ln OPEN_t + \beta_3 POL_t + \mu_t \] (2)

Since it is known in the literature that most time series variables have are non-stationary, it is necessary to verify the stationarity properties of the variables used in order to avoid the risk of spurious regression. Thus, this study therefore tests for stationarity by adopting the Augmented Dickey-Fuller test developed by Dickey-Fuller (1979). The Auto Regressive Distributed Lag (ARDL) Model or bounds test developed by Pesaran et al (2001) was used in order to analyse the long run relationship between the real exchange rate and the explanatory variables as shown in equation 2. The paper adopted the ARDL approach or the bounds test approach because it is relatively more efficient in small sample data sizes as is in the case of this paper. Also, with the ARDL, it is possible for variables to have different optimal number of lags. Finally the ARDL enables the co-integration to be done using the ordinary least square (OLS) method once the lag of the model is identified. This is however, not the same in other multivariate co-integration techniques.

In order to apply the bounds test procedure for co-integration, the following Conditional Vector Error Correction Model (VECM) was estimated to test the long-run relationship between the real effective exchange rate and its determinants:

\[ \Delta \ln REER_t = \theta_0 + \beta_1 \Delta \ln REER_{t-1} + \beta_2 \Delta \ln INF_{t-1} + \beta_3 \Delta \ln OPEN_{t-1} + \beta_4 POL_{t-1} + \sum_{i=1}^{p} \theta_{1i} \Delta \ln REER_{t-i} + \sum_{k=1}^{q} \theta_{2i} \Delta \ln INF_{t-k} + \sum_{j=1}^{q} \theta_{3j} \Delta \ln OPEN_{t-j} + \sum_{l=1}^{q} \theta_{4l} \Delta \ln POL_{t-l} + \mu_t \] (3)

Where, all variables are as previously defined and \( \Delta \) is the first difference operator. \( \beta_i \) are the long run multipliers and \( \theta_0 \) is the drift and \( \mu_t \) are the error terms.
The ARDL bounds test involves three steps

In the first step, equation (3) was estimated by the ordinary least square (OLS) in order to test for the existence of a long-run relationship among the variables. This was done by conducting an F-test for the joint significance of the coefficients of lagged levels of the variables.

The hypothesis would be:

\[ H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0 \] (No existence of a long run relationship or co-integration)

\[ H_1: \beta_1 = \beta_2 = \beta_3 = \beta_4 \neq 0 \]

If the F-statistic is above the upper bound, the null hypothesis of no long-run relationship is rejected. On the other hand, if the F-statistic falls below the lower bound, the null hypothesis is accepted, implying that there is no long-run relationship among the series. Lastly, if the F-statistic falls between the lower and the upper critical bounds, the result is inconclusive.

If the existence of co-integration (long run relationship) is established, then we can proceed to the second stage. Therefore the long-run model for \( \text{REER}_t \) can be estimated as:

\[
\ln \text{REER}_t = \theta_0 + \sum_{i=1}^{p} \beta_1 \ln \text{REER}_{t-1} + \sum_{i=0}^{q_1} \beta_2 \ln \text{INF}_{t-1} + \sum_{i=0}^{q_2} \beta_3 \ln \text{OPEN}_{t-1} \\
+ \sum_{i=0}^{q_3} \beta_4 \text{POL}_{t-1} + \mu_t \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (4)
\]

This process involved selecting the orders of the ARDL \((p, q_1, q_2, q_3)\), model in the four variables using the Schwarz Bayesian Criterion.

Finally, the third step in the ARDL bounds approach involved estimating an Error Correction Model (ECM) to capture the short-run dynamics of the system. The ECM generally provides
the means of reconciling the short-run behaviour of an economic variable with its long-run behaviour.

The error correction version of ARDL model therefore specified as follows:

\[
\Delta \ln REER_t = \gamma + \sum_{i=1}^{p} \theta_{1i} \Delta \ln REER_{t-i} + \sum_{k=1}^{q} \theta_{2k} \Delta \ln IF_{t-k} + \sum_{j=1}^{q} \theta_{3j} \Delta \ln OPEN_{t-j} \\
+ \sum_{i=1}^{q} \theta_{4i} \Delta POL_{t-i} + \rho ECM_{t-1} \\
+ \mu_t \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (5)
\]

From equation (5) above, \( \theta_i \) represents the short-run dynamics coefficients of the model’s convergence to equilibrium. ECM_{t-1} is the Error Correction Model and \( \rho \) which is the coefficient of the Error Correction Model, represents the speed of adjustment for short run divergence to the long run equilibrium following a shock to the system.

RESULTS AND DISCUSSION

Data for the study was analysed using E-views 7.0 for the test for Unit root and Microfit 5.0 for the ARDL model.

1.1 Test for Unit root

The Unit root test was done to find the stationarity status of the variables and the results can be seen in Table 1.0 below.
Table 1.0 Results of the Unit Root Test

<table>
<thead>
<tr>
<th>Variables</th>
<th>Augmented Dickey Fuller – Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Log Level</td>
</tr>
<tr>
<td>$LnREER$</td>
<td>-10.09410***</td>
</tr>
<tr>
<td>$LnINFL$</td>
<td>-3.056462**</td>
</tr>
<tr>
<td>$LnOPEN$</td>
<td>-1.935982</td>
</tr>
</tbody>
</table>

*** (**) denotes the rejection of the null hypothesis of unit root at 1% (5%) 10%

**Co-integration Test**

Having established that all the variables were stationary at least at the first difference and some at both the log level and the first difference, we now proceeded with the ARDL bounds test approach to co-integration since none of the variables was I(2).

**Table 1.1 Bounds Test for Long Run Relationship**
Since the F-statistic lied above the upper bound, it means the null hypothesis of no level relationship is rejected and hence there is co-integration. Based on this we therefore run our ARDL model.

### Diagnostic and Stability Tests

The diagnostic test was carried out to find any possible spurious results and ensure that the results meet the standard classical linear regression assumptions.

#### Table 1.2 Results of Stability and Diagnostic Test

<table>
<thead>
<tr>
<th>Test Statistics</th>
<th>LM Version</th>
<th>F Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Serial Correlation</td>
<td>( \text{CHSQ}(1) = .71638 ) &amp; [.397] ( F(1,16) ) &amp; ( .49228 ) &amp; [.493] ]</td>
<td>( F(1,16) ) &amp; ( .49228 ) &amp; [.493] ]</td>
</tr>
<tr>
<td>B: Functional Form</td>
<td>( \text{CHSQ}(1) = .11218 ) &amp; [.738] ( F(1,16) ) &amp; ( .075139 ) &amp; [.788] ]</td>
<td>( F(1,16) ) &amp; ( .075139 ) &amp; [.788] ]</td>
</tr>
<tr>
<td>C: Normality</td>
<td>( \text{CHSQ}(2) = 1.1994 ) &amp; [.549] ]</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

Critical Values

<table>
<thead>
<tr>
<th>F-statistics</th>
<th>Lower Bound ( I(0) )</th>
<th>Upper Bound ( I(1) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>3.9223</td>
<td>5.3082</td>
</tr>
<tr>
<td>10%</td>
<td>3.1217</td>
<td>4.3232</td>
</tr>
</tbody>
</table>

**Critical Values**

F-statistics 5.9060***

<table>
<thead>
<tr>
<th>Lower Bound ( I(0) )</th>
<th>Upper Bound ( I(1) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
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<td>10%</td>
<td>3.1217</td>
</tr>
</tbody>
</table>

Since the F-statistic lied above the upper bound, it means the null hypothesis of no level relationship is rejected and hence there is co-integration. Based on this we therefore run our ARDL model.
D: Heteroscedasticity  

CHSQ(1) = .19480[.659] F(1,22) .18003[.675]

Note:

A: Lagrange multiplier test of residual serial correlation

B: Ramsey's RESET test using the square of the fitted values

C: Based on a test of skewness and kurtosis of residuals

D: Based on the regression of squared residuals on squared fitted values

From table 1.2, the null hypotheses of autocorrelation, incorrect functional form, heteroscedasticity and no normal distribution of the model could not be accepted at 5% level of significance since all the p-values were greater than 0.05. Thus the model had no problems with regards to heteroscedasticity, autocorrelation, correct functional form and normal distribution. Also this paper utilized the Cumulative sum and the Cumulative sum of squares of recursive residuals to test for the stability of the coefficients in the real exchange rate model and it was found that, there was no problem with stability. The stability test is a graphical test and is shown in the appendix III.

The Long Run Model

The Long run model was run to find the long run relationship between the dependent variable and the explanatory variables.

Table 1.3 Results of the Estimated Long Run Real Exchange Rate Model selected based on ARDL (1,2,0,0) selected based on Schwarz Bayesian Criterion.

Dependent Variable: lnREER
<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>T-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>lnINFL</td>
<td>.33713</td>
<td>.099962</td>
<td>3.3726</td>
<td>.004**</td>
</tr>
<tr>
<td>lnOPEN</td>
<td>-.40328</td>
<td>.10866</td>
<td>-3.7113</td>
<td>.002 **</td>
</tr>
<tr>
<td>POL</td>
<td>-.10845</td>
<td>.087893</td>
<td>-1.2339</td>
<td>.234</td>
</tr>
<tr>
<td>C</td>
<td>5.4220</td>
<td>.61922</td>
<td>8.7562</td>
<td>.000***</td>
</tr>
</tbody>
</table>

*** (**) denotes the rejection of the null hypothesis of unit root at 1% (5%) 10%

From the results above, the coefficient of inflation was found to be positive and significant at 5% level and this means it has an appreciating effect on the real exchange rate. The positive inflation coefficient of .33713 implies that a 1% rise in Inflation in Ghana will appreciate the Ghanaian real exchange rate by .33713%. Thus a rise in inflation will lead to an appreciation of the real exchange rate in Ghana in the long run. Also, the coefficient of openness or trade was found to be negative and significant at 5% level and this means that, it has a depreciating effect on the real exchange rate. Openness had a negative coefficient which is in line with the prediction of economic theory. The coefficient of -.40328 for openness implies that a 1% increase in openness will induce the real exchange rate to depreciate approximately by -.40328%. Thus the more opened the Ghanaian economy the higher the rate at which the real exchange rate will depreciate in the long run and this is in line with the findings of Macdonald and Ricci (2003), Obi et al (2010), Aron et al.(2000) and Elbadawi (1994). In addition the political dummy (POL) representing an election year was insignificant at 5% level. Thus in the long run an election year dummy (POL) does not have any significant impact on the real exchange rate in Ghana.

The Short Run Model

The Short run model was run to find the short run relationship between the dependent variable and the explanatory variables.
Table 1.4 Error Correction Representation for the selected ARDL(1,2,0,0) selected based on Schwarz Bayesian Criterion. Dependent Variable: dlnREER

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>dlnINFL</td>
<td>-.011156</td>
<td>.034598</td>
<td>-.32244</td>
<td>.751</td>
</tr>
<tr>
<td>dlnINFL1</td>
<td>-.10515</td>
<td>.033346</td>
<td>-3.1533</td>
<td>.005*</td>
</tr>
<tr>
<td>dlnOPEN</td>
<td>-.18562</td>
<td>.066107</td>
<td>-2.8079</td>
<td>.012**</td>
</tr>
<tr>
<td>dPOL</td>
<td>-.049920</td>
<td>.038116</td>
<td>-1.3097</td>
<td>.207</td>
</tr>
<tr>
<td>ecm(-1)</td>
<td>-.46029</td>
<td>.079853</td>
<td>-5.7642</td>
<td>.000***</td>
</tr>
</tbody>
</table>

*** (**) denotes the rejection of the null hypothesis of unit root at 1% (5%) 10%

Table 1.4 shows the Error correction model which shows the short run dynamics of the real exchange rate determinants in Ghana.

From the results, all the two inflation variables had negative coefficients which are different from the long run inflation coefficient which was positive. What this means is that in the short run inflation depreciates the real exchange rate, whiles in the long run it appreciates the real exchange rate. Openness however in the short run had a negative significant coefficient which does not differ from its long run negative coefficient. Thus openness (trade) had a depreciating impact on the real exchange rate in the short run and this is consistent with the findings of Mkenda (2001). POL maintained its negative sign in the short run as it was in the
long run but still was not significant at 5% level. Thus election year does not have any
significant impact on the real exchange rate both in the short run and in the long run.

Finally, the error correction model (ECM) measures the speed of adjustment to restore
equilibrium in the dynamic model. It had a negative sign as expected and also it was
significant at 1% level. The ECM had a coefficient of -.46029. This coefficient measures the
speed at which the real exchange rate adjusts to changes in the independent variables in the
model. Thus it implies, about 46% percent of disequilibrium from the previous year’s shock
converges back to the long-run equilibrium in the current year. What it means is that after a
shock it takes some time for the real exchange rate to come back to equilibrium.

CONCLUSION AND RECOMMENDATION

From the results it can be concluded that, openness or trade depreciates the real exchange rate
in both the long run and the short run. Also Inflation can be concluded to depreciate the real
exchange rate in the short run and appreciate the real exchange rate in the long run. Election
year was however found to have no impact on the real exchange rate both in long run and in
the short run.

Based on the findings, this paper would recommend that measures must be taken to ensure
some level of Inflation in Ghana since inflation rate tends to appreciate the real exchange rate
in the long run. Thus monetary authorities in Ghana should not always over concentrate on
reducing inflation in their attempt to reduce the depreciation nature of the exchange rates as
has been the case in Ghana but rather, they should give room for some modest level of
inflation which will be needed in the Ghanaian economy to serve as a signal to producers and
investors to invest and therefore in the long run leading to an appreciation of the real
exchange rate. Finally the study would recommend that since trade (openness) depreciates the
real exchange rate in the long run, export enhancing policies such as export subsidies and other export incentives must be given to Ghanaian businesses who export in order to make them more competitive abroad.

REFERENCE


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