



# Impact of Ethiopian Trade Balance: Bound Testing Approach to Cointegration

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**Abstract:** This study is an attempt to examine the short and long-run relationship between the trade balance, income, money supply, and real exchange rate in the case of Ethiopian economy. The bounds testing approach to co integration and error correction models, developed within an autoregressive distributed lag (ARDL) framework is applied to annual data for the period 1979/80 to 2012/13. Additionally, variance decompositions (VDCs) are used to draw further inferences. The result of the bounds test indicates that there is a stable long-run relationship between the trade balance and income, money supply, and exchange rate variables. The estimated results show that the coefficient of the real exchange rate variable is positive and statistically significant at a 10 percent level confirming the hypothesis that real depreciation succeeds in improving trade balance of Ethiopia in the long run. Similarly, The coefficients of money supply and income positive and statistically significant at 1 and 5 percent level it provides that money supply and income play a strong role in determining the behavior of the trade balance. The error correction model result indicates all of the coefficients of variables are statistically insignificant. This implies that all variables do not affect trade balance in the short run. Based on the coefficients of the variables statistically significant level exchange rate policy can help improve the trade balance but it will have a weaker influence than economic growth and monetary policy.

**Keywords:** Trade Balance, Marshall Lerner Condition, Bound Test, Co-Integration

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## 1. Introduction

Trade balance is the difference between the monetary value of exports and imports in an economy over a certain period of time or the difference between what goods a country export form produces to and how many goods it buys from abroad. The sum can take the form of a deficit if imports overweigh exports or trade surplus if exports are more than imports or equivalent when the values of exports and imports are equal (Kennedy, 2013).

In theory, nominal depreciation or appreciation of exchange rate is assumed to change the real exchange rate and thus has a direct effect on trade balance (Himarios, 1989; Bahmani-Oskooee 2001) various studies have found week statistical evidence connecting exchange rate change and trade balance (Rahaman and Mustata, 1996; Rahman et.al, 1997). A study on ASEAN-5 countries kim-sen liew et.al (2003) has shown the trade balance in these countries is affected by real money rather than nominal exchange rate and therefore it concludes that the role of exchange rate changes

in the trade balance has been exaggerated. All the above empirical evidence shows that change in real exchange rate have affected trade balances in some countries but not for all countries which implies that direction of the impact of real exchange rate changes on trade balance is still unclear.

However, as of now, in Ethiopia there is no enough empirical evidence have been made to incorporate the theoretical views of trade balance in relation to real exchange rate, money supply and income. The current study emphasizes to address the problem by fulfilling this gap by precisely identifying the role of real exchange rate, money supply and income on trade balance. Therefore, the aim of this study to use Autoregressive Distributive Lag (ARDL) approach to co- integrated and Error Correction Model (ECM) to determine whether there is evidence of relationship between trade balance and Exchange rate, under elasticity approach in long and short run. In addition, it attempts to test the empirical relevance of the absorption and monetarist

approach for the data by incorporated variables of income and money supply in the model.

## 2. Literature Review

According Duasa (2007) has examines the short and long run relationships between trade balance, real exchange rates, income and money supply in the case of Malaysia. For this analysis the researcher used time series data from 1974 to 2003. The author has employed bound testing approach to co- integration and error correction model, develop within ARDL framework, he investigate whether along-run equilibrium relationship exist between trade balance and its determinant. The findings also suggest the Marshall- Lerner condition does not hold in long run for Malaysia and for policy wise Malaysian trade balance should be viewed from absorption and monetary approach.

Kennedy (2013) investigates the major determinants of trade balance using annual data for the period 1963 -2012 in Kenya. The author explores the long run and short run determinants of trade deficit using Johansen co integration approach and Error correction modeling (ECM). The results of his investigation indicate that the coefficients of trade balance are positively correlated with budget deficits, FDI and exchange rates. The results show that FDI has a positive effect on trade balance because the trade balance in Kenya is negative. The estimation results also show that the real exchange rate depreciations improve the trade balance in a strong and significant way. This can be attributed to a huge negative trade balance and/or a large positive net foreign direct investment position, which is an indication that the trade balance is much less sensitive to movements in the real effective exchange rate.

Waliullah, 2010, Khan, 2010 and Shah and Majeed, 2014 has examines the determinants of trade balance in Pakistan by applying ARDL co integration approach in the annual data for the period 1979 to 2005 in order to investigate whether along run equilibrium relationship exists between the trade balance and its determinants. The result of the bounds test indicates that there is a stable long-run relationship between the trade balance and income, money supply, and exchange rate variables. The estimated results show that exchange rate depreciation is positively related to the trade balance in the long and short run, consistent with the Marshall Lerner condition. The results provide strong evidence that money supply and income play a strong role in determining the behavior of the trade balance.

Moses (2013) has focused on the analysis of the Main determinants that have an impact on trade balance. Specifically the study focused on the main cause of Trade deficit in Tanzania by analyzing the impact of Foreign Direct Investment (FDI), Human Capital Development (HCD), Household Consumption Expenditure (HCEXP), Government Expenditure (GEXP), Inflation (INF), Natural Resources Availability (NRA), Real Exchange Rate (REX) and Foreign Income (WY) and Trade Liberalization (TLB). The study uses Ordinary Least Square method (OLS) has

been used for the econometric analysis with a sample period spanning from 1980-2012. The study found out that the main influencing factors for the case of Tanzania are Foreign Direct Investment(FDI), Human Capital Development(HCD), Household Consumption Expenditure(HCEXP), Government Expenditure(GEXP), Inflation(INF), Natural Resources Availability(NRA), Foreign Income(WY) and Trade Liberalization(TLB) so suggested policy measures should focus on them to reduce the trade deficit in the Tanzanian economy.

## 3. Data and Methodology

The data used in this study are annual figures covering the period 1979/80-2012/13 collected from National Bank of Ethiopia the selection period is based on the availability of the data and the relevance of the study. The variables of the study are trade balance (TB), real domestic product (RGDP) as proxy of income, real broad money (M2) and real exchange rate (RER). Usually trade balance is measured by the difference of values of total export and values of total import. In this study, trade balance is measured as the ratio of export value to import value. The ratio of export to import or its inverse has been used in many empirical investigation of trade balance exchange rate relationship, such as Bahmain-Oskooee and Brooks (1999), Lol and lowinger (2001) and Onafowora (2003). This ratio is preferable because it is not sensitive to the unit of measurement and can be interpreted as nominal or real trade balance (Bahmani-Oskooee, 1991). Several studies have used the techniques of Engle and Granger (1987) and Johansen (1991) to identify the co-integration between macroeconomic variables. These technique require that all variables (regressors) in the system be stationary and with an equal order of integration. Pesaran et al. (2001) develop a model to introduce a surrogate co-integration technique known as ARDL bound testing approach. However, choosing the appropriate time series model depends on the results of stationary and co-integration tests.

The ARDL approach has many advantages over the previous Engle and Granger and Johansen co-integration techniques. Those are:

- First, ARDL bound testing approach has more appropriate considerations than Johansen-Juselius and Engle-Granger techniques for testing the co-integration among variables in a small sample size (Ghatak and Siddiki, 2001). Comparatively, the Johansen co-integration techniques need a large data sample for validity.
- Second, there is no need to examine the non-stationary property and order of integration, which means that we can apply ARDL whether underlying regressors are purely I(0) or purely I(1): other co - integration techniques requires all regressors to be integrated of the same order (Pesaran et al., 2001).
- Third, the ARDL application allows the variable to have different optimal lags, which is impossible with

conventional co-integration procedures (Ozturk and Acaravci, 2011)

- Finally, the ARDL model has become increasingly popular in recent years (Jayraman and Choong, 2009).

Based on these advantages of the ARDL model, this paper

$$\Delta \ln TB_t = \beta_{01} + \sum_{i=1}^{n1} \beta_{11} \Delta \ln TB_{t-i} + \sum_{i=0}^{n2} \beta_{12} \Delta \ln M2_{t-i} + \sum_{i=0}^{n3} \beta_{13} \Delta \ln RGDP_{t-i} + \sum_{i=0}^{n4} \beta_{14} \Delta \ln RER_{t-i} + \theta_{11} \ln TB_{t-1} + \theta_{12} \ln M2_{t-1} + \theta_{13} \ln RGDP_{t-1} + \theta_{14} \ln RER_{t-1} + \varepsilon_{t1} \tag{1}$$

Where  $\ln TB$ ,  $\ln M2$ ,  $\ln RGDP$  and  $\ln RER$  the macro economic variables that have been defined above;  $\Delta$  is the first difference operator;  $\beta_{01}, \dots, \beta_{04}$  are the constant term,  $\beta_{11}, \dots, \beta_{44}$  the short run coefficients,  $\theta_{11}, \dots, \theta_{44}$  represents the long-run coefficients,  $n1 \dots n4$  are the lag length, and

employs a bound test to demonstrate co-integration among the variable in the current study. To examine the co-integration among the variables in Eq(1), the ECM representation of the ARDL approach is formulated as follows.

$\varepsilon_{t1}, \dots, \varepsilon_{t5}$  are white noise error terms. In order to test the existence of the short-term relationship among the identified variables Eq. (1) we can formulate the H1 and H0 hypothesis as follows:

H<sub>0</sub>: no short-run relationship

$$\beta_{11} = \beta_{12} = \beta_{13} = \beta_{14} = 0$$

H<sub>1</sub>: short-run relationship

$$\beta_{11} \neq \beta_{12} \neq \beta_{13} \neq \beta_{14} \neq 0$$

However, to test the existence of the long-term relationship, the H1 and H0 hypothesis have been formulated as follows:

H<sub>0</sub>: no long-run relationship

$$\theta_{11} = \theta_{12} = \theta_{13} = \theta_{14} = 0$$

H<sub>1</sub>: long-run relationship

$$\theta_{11} \neq \theta_{12} \neq \theta_{13} \neq \theta_{14} \neq 0$$

The calculated F-statistics values is compared with upper and lower critical values which are given by Pesaran et al. (2001). If calculated F-values exceeds the upper critical values, then the null hypothesis of no co-integration will be rejected irrespective of I(0) and I(1). The next step will

estimate long-run relationship using the selected ARDL model through R<sup>2</sup> Criterion, Hannan-Quinn Criterion, Akaike Criterion (AIC), and Schwarz Criterion (SBC) Pesaran and Shin (1999).

Finally, the following error correction model is estimated.

$$\Delta \ln TB_t = \beta_{01} + \sum_{i=1}^{n1} \beta_{11} \Delta \ln TB_{t-i} + \sum_{i=1}^{n2} \beta_{12} \Delta \ln M2_{t-i} + \sum_{i=1}^{n3} \beta_{13} \Delta \ln RGDP_{t-i} + \sum_{i=1}^{n4} \beta_{14} \Delta \ln RER_{t-i} + \alpha ECM_{t-1} + u_t \tag{2}$$

The error correction model result indicates the speed of adjustment back to long run equilibrium after a short run shock.

Several diagnostic tests are conducted to ensure the goodness of fit of the model. These tests examine the serial correlation, functional form, normality and heteroscedasticity associated with the series residuals from the selected model. This residual analysis is an essential step for reducing the number of models considered, evaluating options, and suggesting paths back toward re-specification. Furthermore, Pesaran (1997) suggests using Brown et al.'s (1975) stability test to check the stability of the coefficient of the regression. This technique also known as cumulative (CUSUM) and cumulative sum of squares (CUSUMQ). Furthermore, we simulate variance decomposition (VDCs) for further inferences. VDCs serve as tools for evaluating the dynamic interactions and strength of causal relations among variables in the system.

## 4. Analysis of Empirical Results

Even though, the ARDL frame work does not require pre testing variables to be done, the unit root test could convince us whether or not the ARDL model should be used. The result of unit root shows as there is a mixture of I(0) and I(1) of underlying regressors. According to ADF unit root tests the dependent variables, *i.e.*  $\ln TB$  are I(1), the regressor  $\ln M2$  is I(0), other regressors are I(1) and none of the variables is of I(2). So the appropriate technique to co-integration is the ARDL approach to co-integration. The first step in the ARDL model, this study looks at long run relationship between the variables by carrying out partial F-test. This test is sensitive to the number of lags used for each first differenced variable (Bahmani-Oskooee and Brooks, 1999). The optimal lag is selecting based on estimating an "unrestricted ECM", or an "unconstrained ECM". Pesaran *et al.* (2001) call this a "conditional ECM". As suggested by

Pesaran and Shin (1999) and Narayan (2004), since the observations are annual, we choose 2 as the maximum order of lags in the ARDL and estimate for the period 1979/80 to 2012/13. In fact, we also used AIC, SC (BIC), HQ, FPE and LR to determine the optimal number of lags to be included

in the conditional ECM (error correction model), whilst ensuring there was no evidence of serial correlation, as emphasized by Pesaron et al.(2001). The optimal lag length that minimizes LR, FPE, AIC, SC and HQ information criteria's is one.

*Table 1. The estimated unrestricted ECM/ARDL model.*

<b>Dependent Variable: D(LTB)</b>				
<b>Included observations: 31 after adjustments</b>				
<b>Variable</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>t-Statistic</b>	<b>Prob.</b>
C	3.03	1.84	1.64	0.11
LTB(-1)	-1.52	0.30	-4.98	0.00***
LRM2(-1)	-1.65	0.44	-3.74	0.00***
D(LTB(-1))	0.40	0.20	1.97	0.06***
D(LRM2(-1))	0.93	0.67	1.38	0.18***
LRGDP(-1)	0.90	0.31	2.84	0.01***
D(LRGDP(-1))	-0.76	0.89	-0.86	0.39
LREER(-1)	-0.58	0.24	-2.37	0.03***
D(LREER(-1))	-0.68	0.32	-2.07	0.05**
R-squared	0.66	Mean dependent var		-0.02
Adjusted R-squared	0.54	S.D. dependent var		0.32
S.E. of regression	0.22	Akaike info criterion		0.06
Sum squared resid	1.07	Schwarz criterion		0.47
Log likelihood	8.06	Hannan-Quinn criter.		0.19
F-statistic	5.52	Durbin-Watson stat		2.01
Prob(F-statistic)	0.00			

Note: \*\*\* and \*\* significance at 1% and 5% level

A key assumption in the ARDL / Bounds Testing methodology of Pesaran et al. (2001) is that the errors of ARDL model must be serially independent and the model is dynamically stable. The LM-test result shows that the estimated model has no evidence to serial correlations of the residuals. This implies the residuals of the estimated model are serial independent. The stability of the regression

coefficients is evaluated using the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) test for structural stability (Brown et al., 1975). Hence the plot of CUSUM and CUSUMQ statistics stays within the critical bounds of 5% level of significance, the null hypothesis of all coefficients in the given regression which is stable cannot be rejected.

*Table 2. ARDL bounds of F-test test of co-integration.*

<b>Test-statistics</b>	<b>Calculated value</b>	<b>lag</b>	<b>Significance level</b>	<b>Bound critical value restricted intercept and no trend</b>		<b>Bound critical value restricted intercept and trend</b>	
				<b>I(0)</b>	<b>I(1)</b>	<b>I(0)</b>	<b>I(1)</b>
F-statistics	7.18	1	1%	4.57	5.86	5.28	6.87
			5%	3.20	4.20	3.63	4.91
			10%	2.64	3.55	2.97	4.09

Note: base on Narayan (2004)

The calculated F-statistics for the co-integration test is displayed in Table 2. The critical value is reported together in the same table which based on critical value suggested by Narayan (2004) using small sample size between 30 and 80. The calculated F-statistic (F-statistic = 7.18) is higher than the upper bound critical value at 1, 5, 10 percent level of significance (5.86, 4.20 and 3.55) using restricted intercept and no trend and 6.87, 4.91 and 4.09 restricted intercept and trend. This implies that the null hypothesis of no co-integration can be rejected at 1 percent, 5 per cent and 10 per cent level and therefore, this confirms there is a co-integration or long run relationship among the variables.

The empirical results of the long-run model, obtained by normalizing on trade balance, are presented in Table 3. The significant variables which appear to affect trade balance are income (RGDP) and real money supply (RM2) at 5% level

of significance and real exchange rate at 10% level of significance. Both signs for income and money supply are consistent to monetary theories. The theories indicate that a rise in domestic income increases the demand for money and therefore will increase exports and improve trade balance. This could be observed from the trend of growth and export experienced by Ethiopia the previous two ten successive years or after 1997 the economy led by strong growth in both foreign and domestic investment. Since 1992 Ethiopian economy also experienced high growth in exports contributed by not only by the strong growth but also by the global trade liberalization measures supported by the government particularly export-oriented goods and services. But still now the net export is deteriorate because of most of imported are capital goods, raw materials, intermediate products among others those are linked with economic

development for transitional economies, and they are a sign of strength they are accompanied by rising domestic investment and rising government expenditures on infrastructure.

Results of the long-run model also show a negative relationship between money supply and trade balance. Currently, the Ethiopian government controlling domestic money supply through lowering prices or inflation rates of the local goods and services relative to other trading countries the demand for import decreases since foreigners send money for more goods and services. Hence, the trade balance will improve through the government take actions through money supply. The controlling in money supply was resulted from tight monetary policy which aimed to control inflation while providing adequate liquidity to stimulate

economic growth. Monetary aggregates in Ethiopia are controlled by the Central Bank through its influence over interest rates in banking sector, changes in reserve requirements, Selling treasure bill and decreasing government borrowing (NBE, 2007).

Real effective exchange rate is one of possible explanatory variables for trade balance. The impact of REER on trade balance is positive and statistically significant. The result suggested that the Marshall-Lerner condition holds the long run at 10% level of significance. A 1% increases/appreciation in REER decreases trade balance by 0.37. This result is somehow consistent with a study Waliullah et al. (2010) which found that role of exchange rate is significant impact the change in trade balance in case of Pakistan in the study period 1979 to 2005.

Table 3. Estimated long runs Model.

Dependent variable Ln(TB)	Independent variable		
	Ln(RGDP)	Ln(RM2)	Ln(REER)
	0.54** (0.261)	-1.06*** (0.263)	-0.37* (0.186)
Model diagnostic	R <sup>2</sup> =0.57 R <sup>2</sup> <sub>adjusted</sub> =0.52	F-statistic=12.96 [0.000015] Durbin-Watson Stat=2.17	

Note: standard error in parenthesis \*\*\* and \*\* significance at 1% and 5%

The results of error correction model for trade balance are presented in table 4. The result indicates that all of the coefficients of variable in the error correction model are statistically insignificant. The short run result is not consistent with monetary theories and Marshall-Lerner condition. This implies that all variables do not affect trade balance in the short run. We apply a number of diagnostic tests to the residuals of ECM, finding no evidence of serial correlation, heteroskedasticity and ARCH (Autoregressive Conditional Heteroskedasticity) effect in the disturbances. The model also passes the Jarque-Bera normality test which suggests that the error is normally distributed.

The significance of an error correction term (ECT) shows the short-run and long run causality relationships is present at least one direction. The lagged error term (ECM<sub>t-1</sub>) in our results is negative and significant at 5% level. The coefficient is -0.76 indicates highly rate of convergence to equilibrium, which implies that the deviation from long-term equilibrium is corrected by 76 over each year.

Table 4. Short run model.

Dependent variable D(LTB)	
Independent Variable	Coefficient
Constant	-0.07 (0.32)
D(LTB) <sub>t-1</sub>	-0.24 (-1.01)
D(LREER) <sub>t</sub>	-0.26 (-0.59)
D(LRGDP) <sub>t</sub>	0.76 (0.70)
D(LRM2) <sub>t</sub>	0.09 (0.13)
ECT <sub>t-1</sub>	-0.76** (-1.89)
Diagnostics Test:	
Far=1.84	R <sup>2</sup> =0.34
Farch=0.36	JBnormal=1.8
Fhet=0.44	

From an estimated VAR, we compute variance decomposition (VDCs) and Impulse response IRFs, which serve as tools for evaluating the dynamic interactions and strength of causal relations among variables in the system. The results from VDC may be sensitive to the variables' ordering unless the error terms' contemporaneous correlations are low. The ordering of variables suggested by Sims (1980) starts with the most exogenous variable in the system and ends with the most endogenous variable. The contemporaneous correlations of VAR error terms results show that there are correlations between REER and RM2, and between RGDP and RM2. Other correlations are mostly less than 0.2. Based on this, we can arrange the variables according to the following order: RM2, RGDP, REER, and TB.

VDC is an alternative method to IRFs for examining the effects of shocks on dependent variables. It shows how much of the forecast error variance for any variable in a system is explained by innovations to each explanatory variable over a series of time horizons in the sample period 1979/80 to 2012/13. Usually, own series shocks explain most of the error variance, although the shock will also affect other variables in the system. From Table 5, the VDC substantiates the significant role played by RGDP, RM2, and REER in accounting for fluctuations in the Ethiopia TB. At the one -year horizon, the fraction of Ethiopian's trade balance forecast error variance attributable to variations in REER, money supply, and income are 5.5%, 6.0%, and 0.8% respectively.

throughout the study period the explanatory power of all variables increases further at the increasing - year horizon, but the percentage of trade balance forecast variance explained by innovations in income is smaller than explained by innovations in other variables. However, the

portion of trade balance variations explained by all explanatory variables increases continuously over longer horizons, for which the percentage of forecast variances in the trade balance is largely explained by innovations in money supply among other explanatory variables from as it, maintains higher percentages than the others.

Looking along the main diagonal, the results reveal that the own shock is relatively high for all variables of trade balance, income, money supply and real exchange rate in VDCs, in the short horizon but decreases for the long horizon. This implies the exogeneity of all variables in VDCs, specially the short horizons of the year after the shock; when we see the results of the percentage of variance explained by own shocks for trade balance on average 80%. This implies the change in trade balance highly explained by its own shock; the variance appears to be very less explained by innovations in other explanatory variables.

*Table 5. Results of Variance Decomposition.*

% of Forecast Variances Explained by Innovation in				
Horizon (period)	TB	RGDP	RM2	REER
A) Variance Decomposition of Trade Balance				
1	86.00	0.8	6.00	5.5
4	79.90	1.17	10.50	8.38
7	77.92	1.16	12.32	8.57
10	76.80	1.19	13.4	8.5
13	76.00	1.32	14.25	8.41
B) Variance Decomposition of RGDP				
1	0.010	70.56	29.42	0.003
4	0.016	67.0	32.89	0.04
7	0.019	63.93	35.94	0.10
10	0.020	61.24	38.54	0.18
13	0.021	58.90	40.74	0.27
C) Variance Decomposition of RM2				
1	0.50	0.17	98.83	0.15
4	0.72	1.58	96.68	1.00
7	0.54	3.9	93.67	1.81
10	0.41	6.98	90.25	2.34
13	0.33	10.42	86.63	2.60
D) Variance Decomposition of REER				
1	2.50	3.63	10.63	85.91
4	3.77	7.13	20.08	68.99
7	3.26	10.56	23.84	62.32
10	2.91	13.83	25.04	57.89
13	2.68	17.02	25.45	54.83

## 5. Conclusion and Policy Implication

This paper tested the empirical validity of the Bickerdike-Robinson-Metzler (BRM) and Marshal-Lerner (ML) condition using a regression model with including trade balance, real exchange rate, income and money supply. Indirectly, it is tested the empirical relevance of the absorption approach and monetary approach for the annual data from 1979/80 to 2012/13 used. The method used is the econometric technique consisted of a relatively new approach for analyzing multivariate co-integrated system which is bound testing approach to co integration developed

by Pesaran et al. (2001) within an ARDL framework to investigate the existence along and short-run equilibrium relationship between trade balance, income, money supply and real exchange rate.

The results of ARDL bound tests of co-integration confirm that there is a long-run relationship among trade balance, income, money supply and real exchange rate. The long run result provides that money supply and economic growth or income have significant impact at 5% level of significance and real exchange rate significant impact at 10% level of significance. This evidence implies that money supply and economic growth play a strong rule in determining the long run behavior of the trade balance as compared to the real exchange rate, since money supply and income level have a strong impact on trade balance. This indicates that by increasing the growth in domestic economy and lowering the relative prices or inflation rates determines the improvement of trade balances as compared to depreciation of exchange rate.

From the estimated VAR the result of the forecasted variance decomposition (VDC) shows the change in trade balance highly explained by its own shock. Similarly, the variation of trade balance is better explained by the innovations in money supply among other explanatory variable of income and real exchange rate.

The policy implication which could be drawn from the study is that the difficulties in trade balance should be corrected through policies of income or economic growth through export oriented goods and services as well as money supply through the change in relative prices or inflation rates of goods and services. Although the depreciation of exchange rate can improve the trade balance, but it has a weaker influence than monetary policy.

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