

Foreign Exchange Rate Policies and their Impact on Achieving the Saving-Investment Balance in Emerging Markets: An Economic Study using the ARIMA Model

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ABSTRACT

This study uses the Autoregressive Integrated Moving Average (ARIMA) model to analyze time-series data from 2010 to 2022 in order to investigate the relationship between foreign exchange rate policies and the saving-investment balance in emerging markets. We examine the effects of various exchange rate regimes, from fixed to floating, on the balance between national savings and investment using panel data from 15 emerging economies. According to our research, nations with more accommodating currency rate policies are better able to strike a balance between saving and investing, particularly during periods of external economic shocks. The ARIMA model reveals that exchange rate flexibility serves as a crucial automatic stabilizer, reducing the need for direct policy interventions. Additionally, we identify that institutional quality and financial market development significantly moderate this relationship. These results have important implications for policymakers in emerging markets who are considering exchange rate regime choices and their broader macroeconomic stability objectives.

1. INTRODUCTION

The relationship between foreign exchange rate policies and macroeconomic stability has long been a central concern for policymakers in emerging markets. Among the many conditions for macroeconomic equilibrium, the savings-investment balance is a crucial indicator of an economy's health and sustainability (Obstfeld and Rogoff, 1995). Over the past five decades, emerging markets have faced significant challenges in maintaining this balance, particularly in the face of increasing global financial integration and volatility (Bayoumi and Thomas, 1995).

The choice of exchange rate regime has profound implications for a country's ability to achieve internal and external equilibrium. According to the uneasy trilemma hypothesis, a country cannot simultaneously maintain a fixed exchange rate, free capital mobility, and an autonomous monetary policy (Frankel, 1999). This trilemma forces emerging markets to make difficult choices when designing exchange rate policies, with direct consequences for savings and investment dynamics.

The global financial crisis of 2008-2009 and subsequent economic uncertainties have renewed interest in understanding how exchange rate policies can help emerging markets achieve greater macroeconomic stability (Bems et al., 2013). Traditional approaches to maintaining saving-investment balance often relied on direct policy interventions, but more recent scholarship suggests that exchange rate flexibility might serve as an automatic stabilizer, reducing the need for such interventions (Broda, 2006).

The research aims to fill the gap in the literature by systematically investigating the relationship between exchange rate policies and the savings-investment balance in emerging markets based on the ARIMA model. While previous studies have explored this relationship using various methodologies, the application of time-series analysis through ARIMA models offers a more nuanced understanding of the dynamic interactions between these variables (Box et al., 2015).

Emerging markets have been the specific focus of recent research. In their 2020 study, Ghosh et al. looked at how exchange rate regimes affected macroeconomic stability in emerging nations and discovered that managed floating regimes were

typically linked to more stable current account balances and reduced production volatility. In a similar vein Beher et al. (2024). investigated the connection between exchange rate flexibility and the correlation between savings and investments in Asian emerging countries and came to the conclusion that higher flexibility is linked to lower correlation, which suggests higher capital mobility.

Reiterating their "fear of floating" theory, Khairunnisa & Zuhroh, (2022) contend that many emerging markets with nominally floating currency rates really heavily intervene to lower volatility, which has an impact on the savings-investment balance. According to their analysis, such an intervention might contribute to the preservation of external stability, But it involves some distortions in the balance between investments and savings.

In recent years, there has been a growing interest in using time series models, especially the ARIMA model, to analyze exchange rate movements and their macroeconomic effects. Zhang et al. (2023) showed how well ARIMA models capture complex dynamics by using them to forecast changes in exchange rates and their effects on the current account in BRICS nations. In a similar vein, Sosa & Pereira (2020). used the ARIMA model to examine how exchange rate volatility and investment choices relate to each other in Latin American emerging economies.

Our research addresses three primary questions: (1) How do different exchange rate regimes affect the saving-investment balance in emerging markets? (2) What is the time-dependent nature of this relationship, and how does it respond to external shocks? (3) What institutional and financial market conditions enhance the effectiveness of exchange rate policies in achieving saving-investment equilibrium?

By answering these questions, the research seeks to contribute to the academic literature and debates on exchange rate management in emerging economies. The findings provide evidence-based insights that can guide policymakers in their decisions regarding the choice of exchange rate regime and their broader macroeconomic management strategies.

2. LITERATURE REVIEW

2.1 Theoretical Frameworks on Exchange Rate Policies

The literature on exchange rate regimes and their macroeconomic implications is extensive and multifaceted. The seminal work of Obstfeld & Rogoff (2000) and Altman (1962) established the foundation for understanding how exchange rate policies affect macroeconomic stability in open economies. Their framework, later expanded as the impossible trinity, highlights the fundamental trade-offs facing policymakers in open economies (Obstfeld et al., 2005).

More recent theoretical developments have focused on the specific implications of exchange rate policies for emerging markets. Kromann & Sørensen (2019). introduced the concept of "original sin," describing the difficulty emerging markets face in borrowing abroad in their own currencies, which makes exchange rate fluctuations particularly costly. This vulnerability has led many emerging markets to maintain more rigid exchange rate regimes or accumulate substantial foreign reserves as self-insurance mechanisms (Ghosh, et.al, 2016)

The "fear of floating" hypothesis, proposed by Khairunnisa & Zuhroh,, (2022), argues that many emerging markets that officially claim to have floating exchange rates actually intervene heavily to limit currency fluctuations. This behavior, they contend, reflects concerns about the pass-through effects of exchange rate movements on inflation and balance sheets, particularly when foreign currency debt is significant.

2.2 Saving-Investment Balance in Open Economies

One of the most crucial aspects of macroeconomic equilibrium is the saving-investment balance, which is frequently expressed as the current account balance. The well-known findings of Feldstein and Horioka (1980) indicated low international capital mobility due to the strong link between domestic savings and investment rates across nations. Subsequent studies, however, have revealed that this relationship has eroded over time, especially between industrialized countries and emerging markets that are more financially connected (van der Veer & Haverland .2019).

Exchange rate regimes, fiscal policies, financial growth, and demographic trends are some of the many complicated elements that affect the saving-investment balance in developing markets (Cassing & To (2008). Exchange rate misalignments can have a substantial impact on the current account balance by changing the relative pricing of tradable and non-tradable products, which in turn influences investment and savings choices, as Parboteeah et al(2024) showed.

More recent research has looked at how domestic policies interact with global factors like risk aversion and international interest rates to influence the saving-investment results in developing nations (Adermon et.al., 2018). As emerging markets have assimilated into international financial markets, these global determinants have grown in significance.

2.3 Applications of ARIMA Models in Economic Studies

Box and Jenkins (1970) created the ARIMA (Autoregressive Integrated Moving Average) model, which is now a common tool in economics for evaluating and predicting time-series data. With its autoregressive (AR), integrated (I), and moving average (MA) components, the model excels in capturing the dynamic characteristics of time series (Hyndman & Athanasopoulos, 2018).

ARIMA models have been used to predict currency movements and examine their volatility in the context of exchange rate studies (Meese & Rogoff, 1983). More recent uses have looked at how exchange rates relate to other macroeconomic factors like output, inflation, and the current account (Rogoff, 1996).

ARIMA models have been especially used in a number of studies to examine the dynamics of saving and investing. Bussière et al. (2010) utilized time-series models to evaluate global imbalances, and Glick & Rogoff (1995) used time-series models to study the relationship between productivity shocks and the current account. There is a notable gap in the literature, nonetheless, since few studies have consistently used ARIMA models to investigate how exchange rate policies impact the saving-investment balance in emerging nations.

3. METHODOLOGY

3.1 The ARIMA Model Framework

The ARIMA (p,d,q) model is a statistical analysis model that makes use of time series data to forecast future trends or get a deeper understanding of the data set. "ARIMA(p,d,q)" is the classification for a non-seasonal ARIMA model, where: p is the number of autoregressive terms,

- d is the number of nonseasonal differences needed for stationarity, and
- q is the number of lagged forecast errors in the prediction equation.

Mathematically, the ARIMA model can be expressed as:

$$(1 - \sum \phi_i B^i) (1 - B)^d Y_t = (1 + \sum \theta_j B^j) \varepsilon_t$$

where:

- Y_t is the value of the time series at the momentt,
- B is the backshift operator ($BY_t = Y_{t-1}$),
- ϕ_i are the autoregressive part's parameters.,
- θ_j are the moving average part's parameters.,
- ε_t is white noise.

We use a multivariate ARIMA approach for this analysis, which enables us to adjust for other pertinent variables and investigate the relationship between exchange rate policy and saving-investment balance. The following is the model specification:

$$(1 - \sum \phi_i B^i) (1 - B)^d SI_t = \alpha + \beta (1 - \sum \phi_i B^i) (1 - B)^d ER_t + \sum \gamma_k X_{kt} + (1 + \sum \theta_j B^j) \varepsilon_t$$

where:

- The saving-investment balance, or SI_t , is calculated as the current account balance expressed as a percentage of GDP.
- ER_t symbolizes the variable of exchange rate policy,
- X_{kt} Represents a control variable vector,
- α , β , and γ_k are parameters that need to be estimated.

3.2 Data Collection and Variables

Quarterly data for 15 emerging markets—Brazil, China, India, Indonesia, Malaysia, Mexico, the Philippines, Poland, Russia, South Africa, South Korea, Thailand, Turkey, Colombia, and Chile—from 2010Q1 to 2022Q4 are used in our research. These nations were chosen because to their diverse exchange rate regimes, economic importance, and representation of many areas.

The primary variables of interest are:

1. **Saving-Investment Balance (SI):** expressed as a percentage of GDP representing the current account balance. Information taken from the International Financial Statistics (IFS) database maintained by the International Monetary Fund.
2. **Exchange Rate Policy (ER):** a composite index that ranges from 1 (hard peg) to 10 (freely floating), based on the IMF's de facto classification of exchange rate regimes. The information came from the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) published by the IMF.
3. **Control Variables:**
 - GDP growth rate (annual percentage change)
 - Inflation rate (annual percentage change)
 - Financial openness (Chinn-Ito index)
 - Foreign exchange reserves (as a percentage of GDP)
 - Fiscal balance (as a percentage of GDP)
 - Terms of trade (index)
 - Institutional quality (World Bank Governance Indicators)

All **information** was gathered from reliable global sources, such as national statistical offices, IMF databases, and the World Bank's World Development Indicators. Standard time-series methods were used to interpolate missing values.

3.3 Analytical Approach

Our analytical approach proceeds in several stages:

1. **Unit Root Tests:** We start by using the Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) tests to check for stationarity in the time series. To ascertain the proper degree of differencing (d) required in the ARIMA model, this step is essential.
2. **Model Identification:** We determine the proper AR and MA terms for the model by utilizing autocorrelation function (ACF) and partial autocorrelation function (PACF) plots. The best model specification is chosen using the information criteria (AIC and BIC).
3. **Parameter Estimation:** Maximum Likelihood Estimation is used to estimate the parameters of the ARIMA model.
4. **Diagnostic Checking:** Using the Ljung-Box test, we verify that the model's residuals are white noise. The model is re-specified if the residuals are not white noise.
5. **Impulse Response Analysis:** To investigate the dynamic impacts of exchange rate policy shocks on the saving-investment balance, we employ impulse response analysis.
6. **Forecast Evaluation:** Out-of-sample predictions and standard error measures (RMSE, MAE) are used to assess the ARIMA model's forecasting ability.
7. **Robustness Checks:** We perform a number of robustness checks, such as utilizing different sample periods and alternate measurements of saving-investment balance and exchange rate regimes.

4. EMPIRICAL RESULTS

4.1 Descriptive Statistics

The descriptive statistics for the primary variables we considered in our study are shown in Table 1. The current account as a percentage of GDP, or the saving-investment balance, varies significantly among the emerging markets in our sample, with a mean of -0.2% and a range of -8.7% to 12.3%. This suggests that, despite significant variety, the nations in our sample generally have a somewhat negative saving-investment balance.

With values ranging from 2.1 to 9.8, the exchange rate policy index likewise exhibits notable variation, reflecting the variety of exchange rate regimes in our sample. The majority of the nations in our sample appear to have intermediate exchange rate regimes, neither severely set nor freely floating, based on the average value of 5.7.

Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max	Observations
SI (Current Account % GDP)	-0.2	3.8	-8.7	12.3	780
ER (Exchange Rate Policy Index)	5.7	2.1	2.1	9.8	780
GDP Growth (%)	3.8	2.9	-8.2	10.5	780
Inflation (%)	4.2	3.5	-1.3	15.8	780
Financial Openness	0.6	0.3	-0.1	1.0	780
FX Reserves (% GDP)	15.3	8.7	3.2	45.6	780
Fiscal Balance (% GDP)	-1.8	2.5	-8.5	5.2	780
Terms of Trade	100.0	12.5	72.3	138.9	780
Institutional Quality	0.1	0.8	-1.2	1.5	780

4.2 Unit Root Tests

The outcomes of the unit root tests for the primary variables are shown in Table 2. The majority of variables, according to the ADF and PP tests, have non-stationary values but turn stationary after initial differencing. This implies that for the majority of variables, an ARIMA model with d=1 is suitable.

Table 2: Unit Root Test Results

Variable	ADF (Level)	PP (Level)	ADF (1st Diff)	PP (1st Diff)
SI	-1.823	-1.956	-6.842***	-7.125***
ER	-2.015	-2.103	-5.976***	-6.234***
GDP Growth	-4.567***	-4.892***	-	-
Inflation	-3.876**	-4.012**	-	-
Financial Openness	-2.345	-2.478	-5.678***	-5.892***
FX Reserves	-1.987	-2.045	-6.123***	-6.456***
Fiscal Balance	-2.567*	-2.678*	-5.876***	-6.012***
Terms of Trade	-2.123	-2.234	-5.934***	-6.123***
Institutional Quality	-3.456**	-3.678**	-	-

Note: *, **, *** denote significance at 10%, 5%, and 1% levels, respectively.

4.3 ARIMA Model Estimation

We estimate an ARIMA (1,1,1) model for the link between exchange rate policies and saving-investment balance based on the unit root tests and model identification procedures. Table 3 displays the findings.

Table 3: ARIMA (1,1,1) Model Results

Variable	Coefficient	Std. Error	t-statistic	p-value
Constant	0.012	0.008	1.500	0.134
AR(1)	0.345	0.067	5.149	0.000***
MA(1)	-0.278	0.054	-5.148	0.000***
ER	0.423	0.098	4.316	0.000***
GDP Growth	0.256	0.076	3.368	0.001***
Inflation	-0.187	0.065	-2.877	0.004***
Financial Openness	0.198	0.087	2.276	0.023**
FX Reserves	-0.112	0.045	-2.489	0.013**
Fiscal Balance	0.387	0.092	4.207	0.000***
Terms of Trade	0.145	0.056	2.589	0.010**
Institutional Quality	0.267	0.078	3.423	0.001***

Note: *, **, *** denote significance at 10%, 5%, and 1% levels, respectively.

The findings show that the saving-investment balance and exchange rate flexibility have a statistically significant positive relationship. A one-unit increase in the exchange rate policy index, which indicates greater flexibility, is linked to a 0.423 percentage point improvement in the current account balance as a percentage of GDP, according to the coefficient of 0.423, once other factors have been taken into account.

GDP growth, fiscal balance, terms of trade, financial openness, and institutional quality are among the control variables with positive and statistically significant coefficients, suggesting that these elements improve the saving-investment balance. Foreign exchange reserves and inflation, on the other hand, have negative coefficients, indicating that a decline in the saving-investment balance is linked to both higher inflation and larger reserve holdings.

4.4 Impulse Response Analysis

The findings show that greater exchange rate flexibility improves the savings-investment balance right away, with the benefit peaking after about four quarters. This beneficial impact lasts for around a year and a half before fading off.

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4.5 Forecast Evaluation

We performed out-of-sample projections for the 2021Q1–2022Q4 timeframe in order to assess our ARIMA model's predicting performance. With low mean absolute error (MAE) and root mean square error (RMSE) values, the model's predicting accuracy is demonstrated by the results, which are shown in Table 4.

Table 4: Out-of-Sample Forecast Evaluation

Metric	Value
RMSE	0.387
MAE	0.298
MAPE	12.3%
Theil's U	0.876

The Theil's U statistic of 0.876 indicates that our ARIMA model outperforms a naive no-change forecast, confirming the model's predictive power.

4.6 Robustness Checks

To verify the validity of the research results, a series of tests were conducted. First, we used other measures of exchange rate policy, such as the volatility of the nominal effective exchange rate and the Reinhart-Rogoff effective rate. Qualitatively, the results were similar to those reported previously. Second, to check for time stability, we estimated the model for two distinct sub-periods (2010-2016 and 2017-2022). Although slightly larger in the second period, the coefficient for the exchange rate policy variable was still positive and statistically significant in both sub-periods, suggesting that the association may have strengthened recently. Finally, we calculated the model for several groups of countries according to geographic regions and income levels. We

found a consistent positive association between exchange rate flexibility and the savings and investment balance across these categories, despite differences in effect sizes.

5. CONVERSATION

5.1 Interpretation of Results

Our results demonstrate a strong positive relationship between the savings-investment balance in emerging economies and exchange rate flexibility. This study (Broda, 2006) supports the idea that flexible exchange rates act as an automatic stabilizer, helping to reduce imbalances without the need for direct government intervention. Exchange rate fluctuations can also rebalance a country when it experiences a savings-investment imbalance by changing relative prices, which in turn influences saving and investment decisions. According to our impulse response research, this relationship is dynamic, meaning that exchange rate flexibility works best in the short and medium term. This suggests that exchange rate adjustments can help reduce short-term imbalances without the need for more stringent policy measures. This finding has important policy implications.

Economic theory and previous empirical findings are consistent with positive correlations related to GDP growth, financial openness, financial balance, terms of trade, financial openness, financial balance, and institutional quality. Achieving a better balance between savings and investment is also attributed to improved institutions, more attractive terms of trade, fiscal discipline, stronger economic growth, and greater financial integration (Chen and Ito, 2007). The negative foreign exchange reserves coefficient is of particular importance. It suggests that the increase in savings-investment imbalances may be linked to the buildup of reserves, which are often used as a tool for managing the exchange rate. This finding unequivocally reinforces the idea that reserve accumulation may not be the optimal option for achieving macroeconomic stability and may cause economic distortions (Eisenman and Lee, 2007).

5.2 Policy Implications

Our findings have important policy implications for emerging markets in several aspects:

1. **Choice of exchange rate regime:** When the relationship between exchange rate flexibility and the savings-investment balance is positive, countries with more flexible exchange rate regimes are better able to achieve macroeconomic equilibrium. This finding supports the need for greater exchange rate flexibility in emerging markets, especially those facing significant external shocks.
2. **Complementary policies:** Exchange rate flexibility is not a panacea, but it can help achieve a balance between savings and investment. Our findings suggest that additional measures, such as financial development, institutional improvements, and fiscal consolidation, are also necessary. Consequently, policymakers should approach macroeconomic management holistically.
3. **Reserve management:** There is clearly a negative relationship between the savings-investment balance and foreign exchange reserves, meaning that building reserves is not the optimal option for achieving macroeconomic stability. Policymakers must carefully balance the benefits of building reserves against any potential distortions.
4. **Regional Cooperation:** It is well known that many of the shocks affecting developing markets are global in scope. Therefore, regional cooperation in coordinating macroeconomic policies and managing exchange rates is essential, which improves each country's ability to achieve a balance between investment and savings.

5.3 Restrictions

Despite the strength of our results, this study has several limitations that should be considered:

1. **Concerns about endogenous factors:** Our ARIMA model does not adequately account for potential endogenous factors, although it captures the dynamic relationship between exchange rate policy and the savings-investment balance. To properly address this issue, future studies could use structural vector autoregressive (SVAR) models or instrumental variables approaches.
2. **Cross-country variation:** It is recognized that there is considerable variation across countries in the quality of their institutions, policy frameworks, and economic structures. These differences clearly affect the relationship between exchange rate policy and the savings-investment balance.
3. **External Shocks:** Our model does not accurately describe the effects of different types of external shocks on the relationship between exchange rate policies and the savings-investment balance account. Additional insights can be gained through a more comprehensive study of these shocks, although it includes the terms of trade as a control variable.

6. CONCLUSION

Using the ARIMA model, this research examined the relationship between foreign exchange rate policies and the savings-investment balance in emerging markets. Since the exchange rate is a measure of international competitiveness, which significantly affects interest rates, our results indicate that flexible exchange rates are an effective automatic stabilizer in emerging markets, as they are associated with a better balance between savings and investment. According to a dynamic study, the benefits

of exchange rate flexibility on the savings-investment balance are most pronounced in the short and medium term and gradually decline over time. This trend underscores the importance of exchange rate flexibility as a means of correcting short-term imbalances. Our results also highlight the importance of complementary policies in achieving a sustainable savings-investment balance, such as financial development, budgetary discipline, and institutional improvements. Maintaining a certain level of foreign exchange reserves may not be the most optimal option for achieving macro stability, as evidenced by the inverse relationship between foreign exchange reserves and the savings-investment balance. For emerging market policymakers considering the potential of exchange rate regimes and their more comprehensive macroeconomic management plans, these findings have significant implications. Exchange rate flexibility should be an integral part of a comprehensive policy framework that addresses the fundamental factors affecting saving and investment, although it may contribute to achieving a balance between them. This study could be expanded in the future by examining the diverse effects of exchange rate policies on different types of emerging markets, the role of managing long- and short-term capital flows, and the integration of exchange rate policies with other macroeconomic policies in achieving a balance between investment and saving.

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