SciDoc Publishers
Infer, Interpret & Inspire Science

International Journal of Finance, Economics and Trade (IJFET)
ISSN 2643-038X

# Exchange Rate Volatility and Portfolio Flows : A State Dependent and Heterogeneous Relationship, Evidence from Emerging Market Currencies

Research Article

Süleyman Hilmi KAL*

Central Bank of the Republic of Turkey, Ankara, Turkey.

**Abstract**

In this paper, we investigated whether the relationship between bond and equity portfolio ows and exchange rate volatility diers during times of high risk and low risk measured by VIX and existence of heterogeneity between among emerging market (Brazil, Chile, Turkey, Mexico, Indonesia, Russia, Poland, South Africa)currencies. To this end, using weekly data, we imple-mented two levels of analysis; rst, aggregate level, we employed impulse response functions of the PVAR method, and second, at the individual level, we employed impulses responses of the MSVAR model. Our results point a very diverse and state-dependent relationship between portfolio ows of both types and exchange rate volatilities.

JEL Codes: F31, F32,C32, C33

**Keywords:** Exchange Rate Volatility; Markov Switching VAR; Panel VAR.

## Introduction

Recent surge in the observed volatility of the exchange rates is linked to liberalization of capital markets and increasing magnitude and volatility of short term capital flows [3, 1, 8, 14, 2, 12, 6, 10, 4, 13]. Impact of cross-border short term capital flows (portfolio flows) on exchange rate volatility is documented to be far from being homogeneous among the different currencies with similar exchange rate regimes and economic fundamentals [9]. Furthermore, it is also reported that impact of portfolio flows are state dependent [5, 11].

Investigating the effects of equity and bond inflows for seven Asian countries, [4] document that net equity (bond) inflows drive the exchange rate to a high (low) volatility state. [9] Provide empirical evidence of the existence of different exchange rate volatility between floating ex- change rate countries with similar macroeconomic fundamentals as a result of 'noise trading' in the foreign exchange markets due to probable non-fundamental channel in the link between exchange rate regimes and exchange rate volatility. Arguing that investors react differently in different states of the market, [11] shows that the relationship between exchange rates and capital flows evolves over time and it is different under different exchange rate volatility condi- tions. [4] investigates the effects of bond and equity flows on the exchange rate volatility of seven emerging developing Asian economies. They provide evidence suggesting the association of high (low) exchange rate volatility with equity (bond) inflows with one exception. They conclude that capital controls could be an effective tool to stabilize the foreign exchange market in countries where flows affect exchange rate volatility. [12] find that high interest rate currencies are negatively related to innovations in global FX volatility, and thus deliver low returns in times of unexpected high volatility, when low interest rate currencies provide a hedge by yielding positive returns.[5], brings evidence on this issue from six emerging markets that raising nominal interest rate lead to higher probability of crises regime by utilizing a Markov regime switching specification.

In this paper, using a weekly data set of major emerging markets we will further investigate the issue of time-varying state dependent impact of portfolio flows on for the currencies of emerging markets (Brazil,Chile, Indonesia, Mexico,Philippines,Poland, Russia, S.Africa, Turkey) for the period between 2004-2019. We will proceed with two level of analysis for each type of portfolio flow (equity and debt); first at ag- gregate level employing im-

***Corresponding Author**:
Süleyman Hilmi KAL,
Central Bank of the Republic of Turkey, Ankara, Turkey.
E-mail: Suleyman.Kal@tcmb.gov.tr

**Received:** September 07, 2021
**Accepted:** November 11, 2021
**Published:** November 15, 2021

**Citation:** Süleyman Hilmi KAL. A Contemporary Approach to Customer Relationship Management. *Int J Financ Econ Trade.* 2021;4(2):100-107.
doi: http://dx.doi.org/10.19070/2643-038X-2100013

pulse response functions of Panel Data VAR method, we look into general tendencies for the whole sample for different sub-time periods divided depending on the global risk appetite measured by VIX. Second, using a two state Markov Switching Vector Auto Regression (MSVAR) method, we analyze state dependent effects of portfolio flows for each individual currency separately to investigate heterogeneous impact of both type portfolio flows among the countries and among the different type periods based on global risk appetite.

Our contribution to literature is multi-fold. First, in our best knowledge, this is the first study analyzing this relationship both at aggregate and country level. Second, we showed that at the aggregate level the relationship between bond flows, equity flows, and exchange rate returns differ depending on the state of the global risk appetite. Third, we provide further evidence at the individual country level that the impact of bond and equity flows on emerging country currencies show great heterogeneity.

The rest of the paper is as follows. In section next section Background and Data, we will explain the data and visually look in to the relationship between equity and bond flows and exchange volatility with graphs for full period and for sub-periods. In the third section, the econometric methods employed in this paper will explained.

We will discuss the results in Section 4 and Section 5 will be conclusion and policy implications.

## Data and Background

Sample countries are Brazil, Turkey, Mexico, Argentina, South Africa, Indone- sia,Poland, Philippines and Chile. Data used in the paper is obtained from IRRF and Bloomberg data bases. The periodicity of the portfolio flows, exchange rates and VIX are weekly. Realized monthly volatility is calculated from daily data for thirty days.

Mai objective of this paper is to investigate the existence of state dependent relationship between portfolio flows and exchange rate volatility at aggregate and country levels and heterogeneity among the sample countries. Before quantifying this relationship with econometric techniques, as a natural first step, we divided sample period into sub-sample periods based on the state of the global economy and compare and contrast the statistical properties of the portfolio flows and the the exchange rates of each country for each sample period. We determined sub- sample periods based on the state of the global economy as flows: Pre-Financial Crises Period: 2004-2008, Financial Crises Period: 2008-2013, Post Financial Crises Period: 2013-2019.

**Full Sample: 2004-2019**

Figure 1 is intended to show comparative impact of the volatility of equity and bond flows to the volatility of exchange rates for the whole sample period:2004- 2019. Drawing these figures, we first calculated coefficient of variation (stdv/mean) for equity, bond flows for each country and ratio them to the coefficient of variations of the each currency. The first graph of Figure I is for equity flows and the second graph is for bond flows. For the first graph, Argentinian peso was eliminated as an out-lier. It is evident in the figure that other than Argentina, the volatility of both equity and bond flows are comparatively greater affect on the the volatility the currencies of Turkey, Chile and Poland.

**Sub-Sample I: 2004-2008**

This is the period which covers relatively calm period before the great financial crises during which portfolio flows reached all time high levels. Figure shows that affect of equity and bond portfolio flows are heterogeneous the countries in sample. Compared with Figure 1 it is evident that exchange rate volatility associated with bond and equity flow volatility is lower during this sub-period compared to the whole period and Chile,which has the most liberal capital markets for this period, seems to have highest impact.

**Sub-Sample II: 2008-2013**

This is the crises period marked first by the 2008 Lehman Brother crises and second with Euro era crises caused mainly by Greek, Spain and Portuguese economies. We choose June of 2013 as the end of liquidity abundance period with US FED president Ben Bernanke's famous tapering speech. Figure 7 shows the how volatility of equity and bond portfolio flows affect volatility of the currencies of the sample countries during this period. Compared with the previous period, impact of the volatility of portfolio flows on exchange rate volatility is smaller. During this 2008-2013 volatility of Chilean peso is more exposed to volatility of portfolio flows than the other currencies. Currencies of Brazil, Mexico, Russia are more resilient to the volatility of the equity and bond flows.

**Sub-Sample III: 2013-2019**

The last sub-period that we analyzed is post-tapering speech period, during which the global liquidity is reduced gradually. Figure 7 shows the how volatility of equity and bond portfolio flows affect volatility of the currencies of the sample countries during this period. Compared with the previous period (2008-2013), impact of the volatility of equity flows on exchange rate volatility is greater; again compared with pre-crises period, impact of the

**Figure 1. Full Sample: 2004-2016, Exchange Rate-Equity Flow Standard Deviation Ratio, Exchange Rate-Bond Flow Standard Deviation Ratio.**

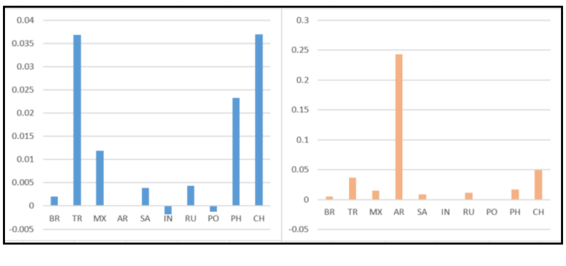


**Figure 2. Sub-Sample I: 2004-2008, Exchange Rate-Equity Flow Standard Deviation Ratio, Exchange Rate-Bond Flow Standard Deviation Ratio.**

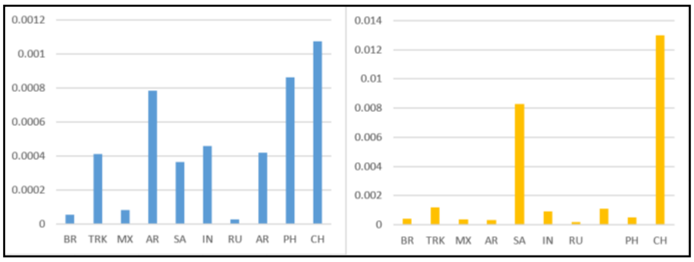



**Figure 3. Sub-Sample II: 2008-2013, Exchange Rate-Equity Flow Standard Deviation Ratio, Exchange Rate-Bond Flow Standard Deviation Ratio.**

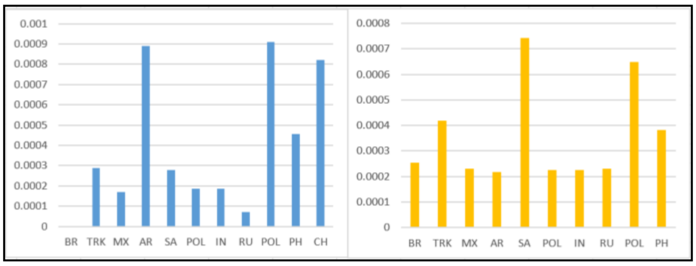
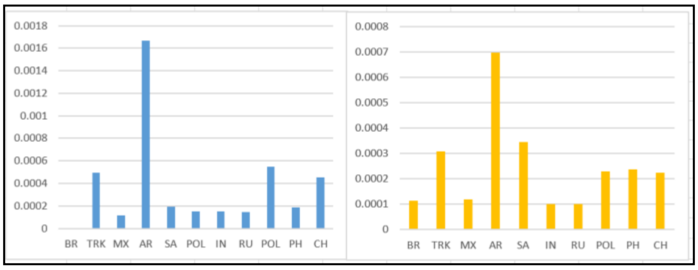



**Figure 4. Sub-Sample III: 2013-2019, Exchange Rate-Equity Flow Standard Deviation Ratio, Exchange Rate-Bond Flow Standard Deviation Ratio.**




equity flows is greater but that of bond flows is smaller. During this period countries like Argentina, Turkey are more vulnerable for both types of flows.

Global risk appetite according to which states in the MSVAR model is deter- mined by VIX value and CDS values for each country is used in MSVAR model to govern time-varying transi- tion probabilities.

## Methodology

### Panel VAR

As briefly explained above both exchange rates and portfolio flows affect each other,so the relationship between portfolio flows and exchange rate returns is en- dogenous. Thus, in aggregate level, we investigated this relationship by employing the panel data VAR method, which combines endogeneity of all the variables in the system of VAR method with unobserved individual heterogeneity of the panel data method.The model formulated as follows:

$$Z_{it} = \Gamma_0 + \Gamma_1 (Z)_{it} -1 + f_i + d_t + e_{it} \text{ ----- } (1)$$

where $Z_{it}$ is a vector of three variables: Exchange Rate Volatil- ity of Sample Coun- tries, Bond Flows to Sample Countries, Equity Flows to Sample Countries. We used Granger causality test to determine te order of the variables. The order selection criteria suggest all endogenous variables to enter the model with a lag. Unobservable time-invariant fixed effects such as different exchange rate regimes, country size, and financial regulation, at country level is included in the model with the term fi. For- ward mean-differencing is used to eliminate the correlated effects stem- ming from lagged regressors by preserving the orthogonality be- tween transformed variables and lagged regressors with system GMM12. Common time effects for all currencies such as to cap- ture any global macro economic shocks that may affect all coun- tries in the same way.For example, time effects capture common factors such as key in- terest rates, spreads or global risk factors are added to the model with $d_t$. This is equivalent of putting time dummies in the system.

### Markov Switching Exchange VAR Model

Fixed effect panel VAR estimation provides a general idea about relationship be- tween capital flows and exchange rates. Detect- ing the existence of heterogeneity with respect to countries and with respect to time periods requires analyzing each currency separately with a method which allows state dependent and non- linear analysis. Regime depended analysis provides a better frame work to investigate the relationship between exchange rate return and portfolio flows depending on global risk appetite than divid- ing sample period into sub-periods. Vector auto regres- sion will allow us to address the endogeneity of the relationship between exchange rate returns and portfolio flows. Thus, a two-state time varying transition probabil- ity Markov Regime Switching Vector Autoregressive Regression (MSVAR) model is employed in this paper.

[7] who use the Markov regime switching models in econometrics are pioneers in this litera- ture. Later on it is Hamilton(1990) who popularized Markov switching models. In Markov models, an observable variable yt depends on state variables which are not directly observed. Here st is used for state variable definition. States are defined as State 0, State 1.. State N. State variables, which are not observed, evolve follow- ing a Markovian regime change. st, state variable governs the distribution of each period. Thus, in our model there are two distributions each with different means and variance of yt which are based on the respected state. The purpose of using Markov regime changing model in this paper is to investigate whether relationship between exchange rate returns and portfolio flows depend on global risk apatite. We choose Chicago mercantile index VIX as the criteria to determine states of high risk appetite and low risk appetite.

Markov switching approach utilized in this paper is briefly summarized as follows:

$$y_t / s_t \sim N\left(\mu_{s_t}, \sigma^2_{s_t}\right) \text{ ----- (2)}$$

Thus, in case st = 0 the observed changes of yt is a random draw from distribution $y_t / s_t \sim N\left(\mu_{s_0}, \sigma^2_{s_0}\right)$ and in case $s_t$ = 1, the observed changes of $y_t$ is a random draw from distribution $y_t / s_t \sim N\left(\mu_{s_0}\right)$.

The probability density of yt conditional on state variable is formulated as follows:

$$f\left(y_t / s_t\right) = \frac{1}{\sqrt{2\Pi\sigma_{s_t}}} e^{\frac{-\left(y_t - \mu_{s_t}\right)^2}{2\sigma^2_{s_t}}} \text{ ------ (3)}$$

Transition between the states is only based on the previous state. Transition probability is defined as the probability of switching from one state to another state. Transition probabilities can be constant, as Hamilton suggested in his very well cited work (Hamilton, 1989), or it can be time varying, as developed by Diebold, Wein- bach and Lee (1994). In the Hamiltonian framework, the probabilities of switching between the states are fixed, exogenous and do not vary over time. For example, the transition from State (t - 1) to State (t) is shown as: $P(s_t = i \mid s_{(t-1)} = j) = P_{ij}$

These features of the model limit the explanatory power of the Markov process. Allowing transition probabilities to change over time, depending on a vector of variables, enriches the Markov process by enabling it to model the underlying process of transitional dynamics explicitly. Hamilton's constant transition model is later evolved by Diebold, Weinbach and Lee (1994) by addition of time-varying transition probabilities which are estimated with logistic functions of vector of (x(t - 1)) as follows:

$$p_t^{11} = P(s_t = 1 \mid s_t - 1 = 1, x_{t-1}, \delta) = \frac{e^{\delta_0^1 + x_{t-1}\delta_1^1}}{1 + e^{\delta_0^1 + x_{t-1}\delta_1^1}} \text{ ----(4)}$$

$$p_t^{01} = P(s_t = 1 \mid s_t - 1 = 1, x_t, \delta) = 1 - \frac{e^{\delta_0^1 + x_t\delta_1^1}}{1 + e^{\delta_0^1 + x_t\delta_1^1}} \text{ ---- (5)}$$

$$p_t^{00} = P(s_t = 1 \mid s_t - 1 = 1, x_t, \delta) = \frac{e^{\delta_0^0 + x_t\delta_1^0}}{1 + e^{\delta_0^0 + x_t\delta_1^0}} \text{ -----(6)}$$

$$p_t^{10} = P(s_t = 1 \mid s_t - 1 = 1, x_t, \delta) = 1 - \frac{e^{\delta_0^0 + x_t\delta_1^0}}{1 + e^{\delta_0^0 + x_t\delta_1^0}} \text{ ----- (7)}$$

Transition probabilities matrix is a (2 X 2) and it is called transition matrix Γ. It is written Γ as follow: Here we used 5 year sovereign debt CDS premium for each currency as $x_t$.

*p*00 *p*10
*p*01 *p*11

and $\sum_{j=0}^{1} P_i j = 1, 0 \leq p_{ij} \leq 1$

Since Sims (1980) study, Vector Autoregressive model has become one of the major tools of empirical studies. Krolzig (1997) introduces the regime changes to vector autoregressive model. An MSVAR model provides framework of modeling multivariate representation of related variables non-linearly. Following bond and equity portfolio ows and exchange rate model is designed with Markov specication, for each currency VAR of bond ows, equity ows and exchange rate returns is model as follows:

$$V_t = \Phi_0^{s_t} + \Phi_1^{s_t,k} V_{t-k} + \Omega_t^{s_t} \text{ ----- (8)}$$

where Φ is state dependent constant term, Yst state vector is ranked as bond flows,equity flows and exchange rate return (against USD) for each currency, Ωst error term.

According to this model, we will have a time varying transition probability two state Markov switching autoregressive model. State O is defined as the periods during which VIX index is less than 25 and State 1 is the periods during which VIX index is higher than that threshold level. We assume risk appetite is low in State I and high in State 0. Thus, the model used is in this paper is to see whether the relationship between both of the portfolio capital flows and exchange rate volatility demonstrate any difference between the states.

The impulse response functions uses Cholesky decomposition and impulses are defined as one standard deviation positive shocks the variables.

## Empirical Results

### Aggregate Model: PVAR Exchange Rate Volatility

In section impulse response graphs of PVAR model are presented and discussed. As indicated in the previously sample period in divided into four sub-periods to ana- lyze whether volatility of exchange rate react differently to equity and bond flows depending on the global risk appetite measured by VIX index: Precrises Period: 2005-2008; Crises Period:2008-2013 and Post-crises Period:2013-2019. The response of exchange rate volatility to a one-standard-deviation shock to bond flows and eq- uity flows are plotted. All graphs show responses for the first 10 quarters. Upper and lower limits of are 90th percentile bounds constructed using Monte Carlo simulations with 500 repetitions.Each of the graphs also plots the zero line.

Figure 5 shows aggregate volatility response of sample countries to the impulses of equity and bond flows for the full-period, 2005-2019. The first graph of Figure 1 indicate that bond flows reduce exchange rate volatility, second graph of Figure 1 on the other hand portrays a different outcome for equity flows, equity flows initially increase the volatility of exchange rates for four periods before it is reduced. Results shown in Figure 6 are for pre-crises period, 2005-2008 are different from the whole sample period; bond flows during this period increase exchange rate volatility permanently, while equity flows decrease it permanently. During the great financial crises period (2008-2013) bond flows do not have significant impact on exchange rate volatility, while equity flows reduce it permanently. Post-crises period relationship is similar to hat of the whole sample period.

Impulse response figures of PVAR method provides evidence that heterogeneous response of exchange rate among different period between 2004-2019 provide ev- idence that exchange rate volatility portfolio flows relationship is not linear and depending on the investors' risk appetite both types of portfolio flows sometimes reduce sometimes elevate exchange rate volatility. After detecting this important pattern from aggregate analysis, as a natural next step we will discuss the results of same VAR ranking analysis for implemented to individual currencies separately by employing MSVAR frame work in the next session.

Impulse response figures of PVAR model indicate that aggregate the relationship between bond and equity portfolio flows is heterogeneous across the different periods.

**Exchange Rate Volatility Model Markov Regime Switching VAR Models**

MSVAR framework allows to model state dependent variables. In the previous sec- tion, results imply that at aggregate level both types of portfolio flows and exchange rate volatility are not linear and vary depending on the global risk appetite mea- sured by VIX. As explained above we employed MSVAR method for each currency separately to investigate state dependent impact of portfolio flows on exchange rate volatilities. In this context, States of MSVAR model is determined based on VIX value. A VIX value of higher than 25 is determined as high risk low risk appetite state and a VIX value of lower than 25 is determined as periods of low risk state.

Figure 9 shows he smoothed transition probability of being at State 1 of MSVAR model. This figure compared to sub-periods of PVAR analysis shows a more nu- anced state depended analysis.

Figures 10 to Figure 16 show the response of the return of the each currency in both states. First two graphs of each figure show the volatility response of each currency to bond and equity positive one standard deviation shock in State 0 and last to those of in State 1. When one looks at the figures together, diversity of the volatility responses of the exchange rates to the bond and equity flows are notice- able. Bond flows permanently reduce volatility of Brazilian real and Russian ruble in State 0, also in State I bond

**Figure 5. PVAR Exchange Rate Volatility Response, 2005-2019, Bond Flows, Equity Flows.**

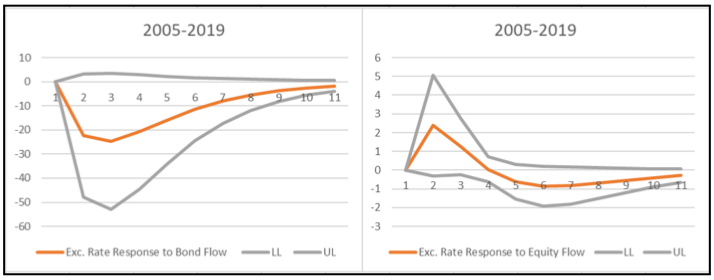



**Figure 6. PVAR Exchange Rate Volatility Response, 2005-2008, Bond Flows, Equity Flows.**

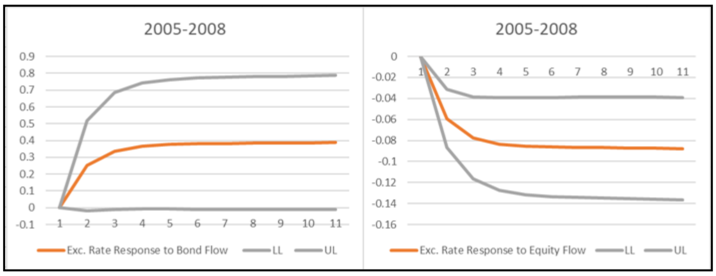



**Figure 7. PVAR Exchange Rate Volatility Response, 2008-2013, Bond Flows, Equity Flows.**

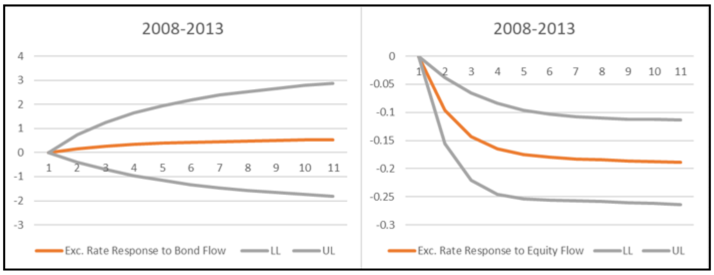


**Figure 8. PVAR Exchange Rate Volatility Response, 2013-2019, Bond Flows, Equity Flows.**

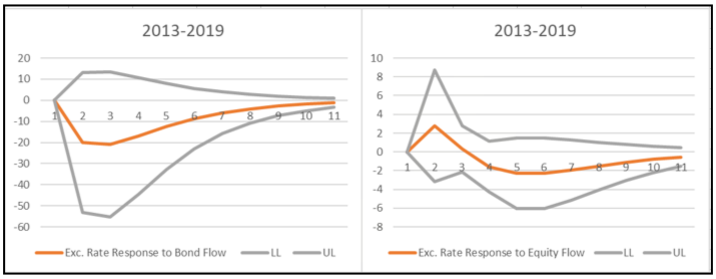



**Figure 9. Exchange Rate Returns: Smoothed Transition Probabilities of Markov Regime Switching Model.**

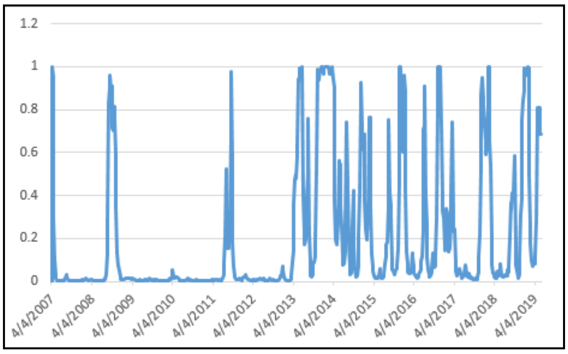


**Figure 10. Brazilian Real Volatility Response to Bond Equity Flows:State 0 and State 1.**

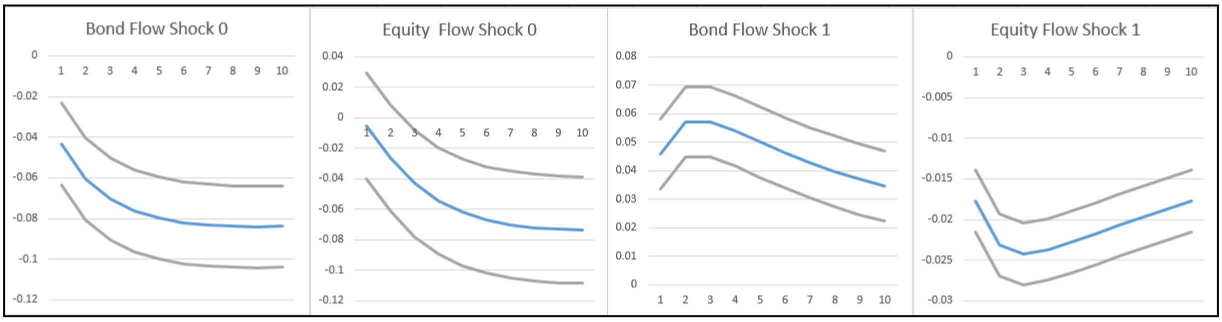



**Figure 11. Chilean Peso Response to Bond Equity Flows:State 0 and State 1.**

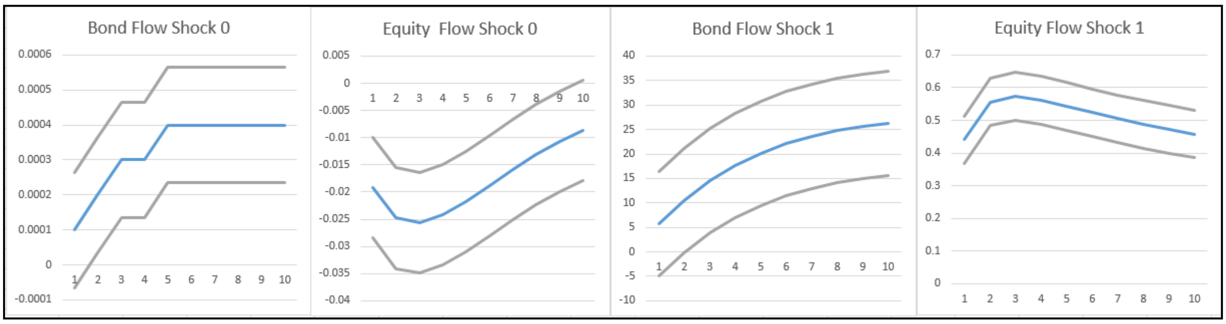



**Figure 12. Mexican Peso Response to Bond Equity Flows:State 0 and State 1.**

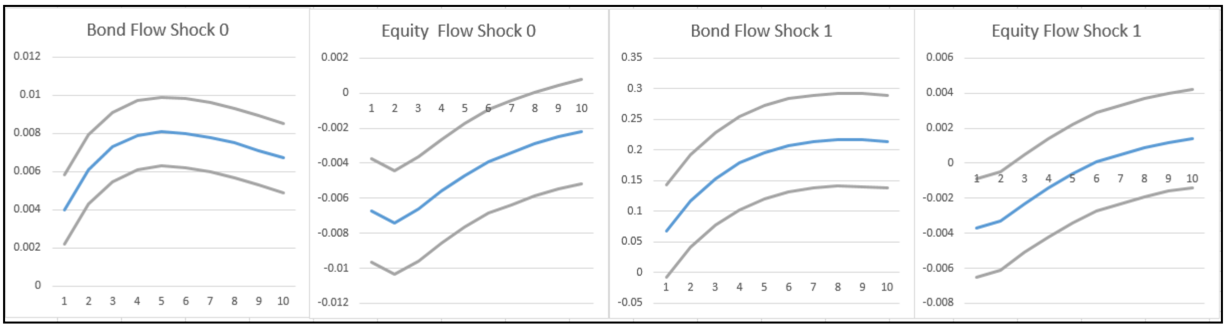


**Figure 13. Polish Zloty Response to Bond Equity Flows:State 0 and State 1.**

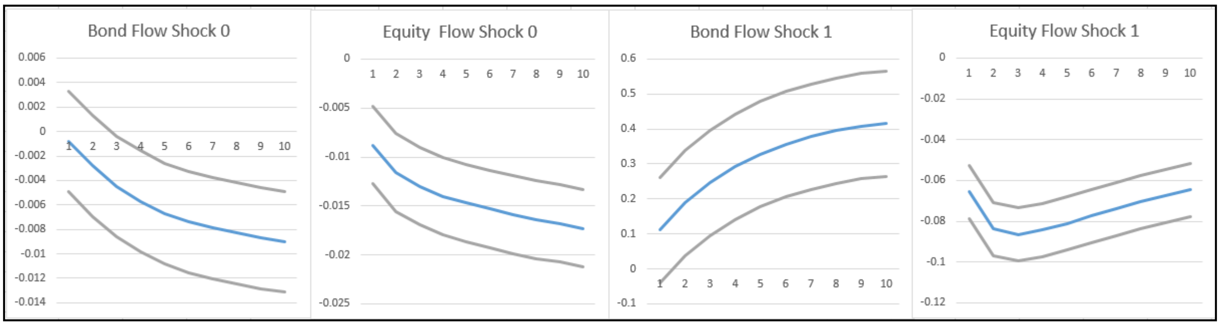



**Figure 14. Russian Ruble Response to Bond Equity Flows:State 0 and State 1.**

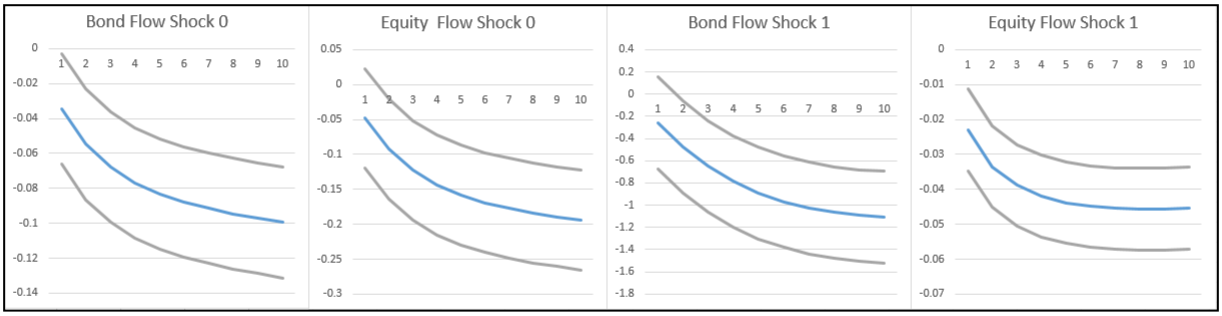



**Figure 15. S. African Zar Response to Bond Equity Flows:State 0 and State 1.**

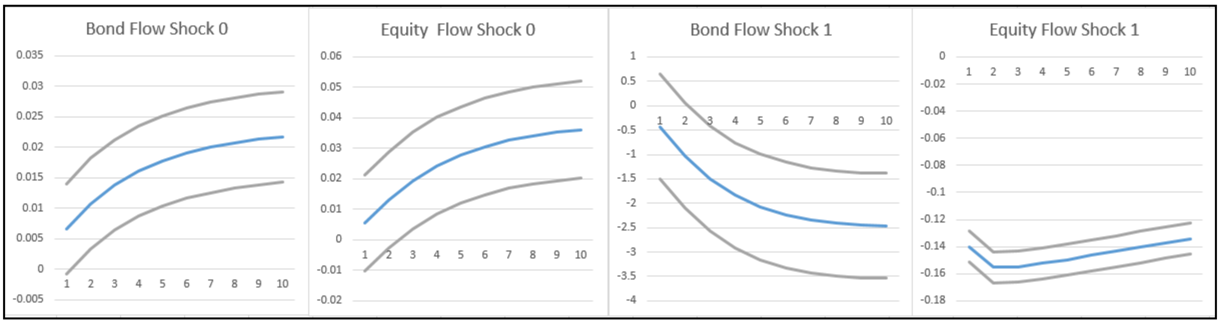
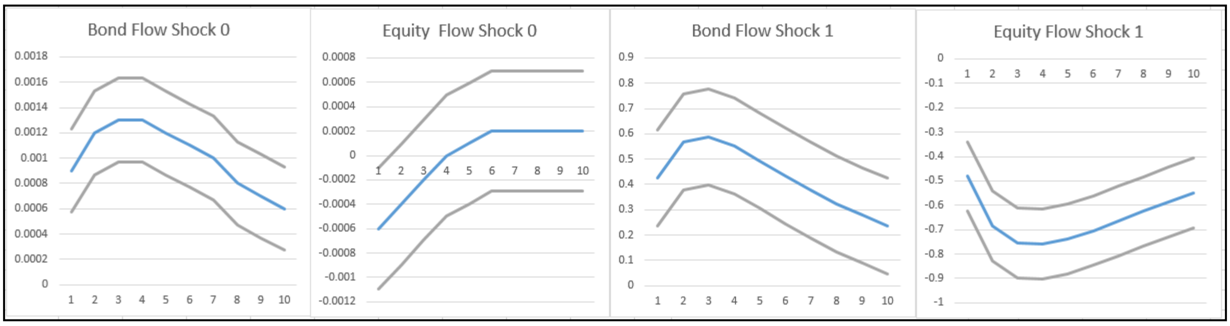



**Figure 16. Turkish Lira Response to Bond Equity Flows:State 0 and State 1.**




flows reduce volatility of Chilean peso, Russian ruble and South African zar permanently. On the other hand, bond flows in State 0 increase volatilties of Chilean peso, Mexican peso, South African zar, permanently and Polish zlot,Turkish lira and Mexican peso temporarily; In State it increases volatilities of Brazilian real, Turkish lira temporarily and Mexican peso, Polish zlot permanently.

Responses to equity flows also plot a a very heterogeneous picture in their impact on exchange rate volatilities of emerging market currencies.In State 0, equity flows permanently reduce the volatilities of Brazilian real, Polish zlot and Russian ru- ble; volatilities of Chilean and Mexican peso are temporarily reduced.On the other hand, volatilities of Turkish lira, South African zar are permanently increased by equity flows. In State 1, Polish zlot, Russian ruble, Turkish lira, South African zar are permanently reduced by equity flows;volatilities of Brazilian real and Mexican peso temporarily reduced and Chilean peso permanently elevated. Impulse response analysis of bond equity flows on exchange rate volatilities of emerging market cur- rencies provide additional evidence of heterogenous and state dependent impact of portfolio flows on exchange rate volatilities.

According to the graphs (Figure 7), response of return of Chilean Peso to bond flow shocks at State 0 and State 1 is different,appreciate at State 0 and depreciate at State 1, response of the currency to equity flows on the other hand is similar in states appreciation.

## Conclusion

In this paper, we investigated heterogeneous effect of bond and equity portfolio flows on volatility of emerging market currencies. Following a two stage analysis method, we found at aggregate level, for different periods, bond and equity flows have varying impact on emerging market currencies together. And at individual level, our results point a very diverse and heterogeneous impact of portfolio flows on the volatilties of emerging markets currencies. As a conclusion, it is hard to generalize a pattern of impact of portfolio flows on emerging market currencies. Thus, central bank policies on attracting foreign capital for currency stabilization may lead to unexpected results.

Compliance with Ethical Standards: This article does not contain any studies with human participants performed by the author. This article does not contain any studies with animals performed by the author. This article does not contain any studies with human participants or animals performed by the author.

Conflict of Interest Statement: On behalf of the author, the corresponding author states that there is no conflict of interest.

Data Availability Statement : The data that support the findings of this study are available from the corresponding author upon reasonable request.

Financial Support Statement: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

## References

[1]. Brooks R, Edison H, Kumar MS, Sløk T. Exchange rates and capital flows. European Financial Management. 2004 Sep;10(3):511-33.
[2]. Brunnermeier MK, Nagel S, Pedersen LH. Carry trades and currency crashes. NBER macroeconomics annual. 2008 Jan 1;23(1):313-48.
[3]. Caporale GM, Hunter J, Ali FM. On the linkages between stock prices and exchange rates: Evidence from the banking crisis of 2007–2010. International Review of Financial Analysis. 2014 May 1;33:87-103.
[4]. Caporale GM, Ali FM, Spagnolo F, Spagnolo N. International portfolio flows and exchange rate volatility in emerging Asian markets. Journal of International Money and Finance. 2017 Sep 1;76:1-5.
[5]. Chen SS. Revisiting the interest rate–exchange rate nexus: a Markov-switching approach. Journal of Development Economics. 2006 Feb 1;79(1):208-24.
[6]. Fratzscher M. Capital flows, push versus pull factors and the global financial crisis. Journal of International Economics. 2012 Nov 1;88(2):341-56.
[7]. Goldfeld SM, Quandt RE. A Markov model for switching regressions. Journal of econometrics. 1973 Mar 1;1(1):3-15.
[8]. Hau H, Rey H. Exchange rates, equity prices, and capital flows. The Review of Financial Studies. 2006 Mar 1;19(1):273-317.
[9]. Jeanne O, Rose AK. Noise trading and exchange rate regimes. The Quarterly Journal of Economics. 2002 May 1;117(2):537-69.
[10]. Kal SH. Global Capital Flows, Time-Varying Fundamentals and Transitional Exchange Rate Dynamics. Journal of Forecasting. 2013 Apr;32(3):247-55.
[11]. Lovcha Y, Perez-Laborda A. Is exchange rate–customer order flow relationship linear? Evidence from the Hungarian FX market. Journal of International Money and Finance. 2013 Jun 1;35:20-35.
[12]. Menkhoff L, Sarno L, Schmeling M, Schrimpf A. Carry trades and global foreign exchange volatility. The Journal of Finance. 2012 Apr;67(2):681-718.
[13]. Pasricha GK, Falagiarda M, Bijsterbosch M, Aizenman J. Domestic and multilateral effects of capital controls in emerging markets. Journal of International Economics. 2018 Nov 1;115:48-58.
[14]. Siourounis G. Capital flows and exchange rates: An empirical analysis. Working Paper, London Business School; 2004 Aug.