Decomposing the Heterogeneity in Portfolio Flows to Emerging Markets: Using Structural VAR Techniques in Latin America, South East Asia and Sub Saharan Africa

by

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Abstract

This paper offers a perspective on the determinants in bond and equity portfolio flows to eight emerging market economies (EMEs). Using a structural vector autoregressive (SVAR) model, the impact of three global and two domestic shocks on net inflows are assessed in Latin America, South East Asia and South Africa. The results indicate that equity market volatility and monetary policy shocks in the US (measured by the VIX and Federal Reserve Balance Sheet) have been influential in driving flows to these regions. Furthermore, evidence on the heterogeneity in these responses (both inter and intra-regionally), as well as the case for VIX shocks explaining the volatility within these flows throughout the post-Lehman era, is presented. These findings are bound to have implications on investor and policymaking decisions throughout the emerging market context.

Keywords: Structural VAR, push and pull factors, emerging markets, portfolio investment, bond flows, equity flows, variance decomposition

JEL classification L250, L100

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1. Introduction

In the wake of the Global Financial Crisis in 2007-2008, capital flows to emerging market economies (EMEs) experienced a sharp deceleration with considerable outflows from their bond and equity markets. Since then, central banks in advanced economies (AEs) have undertaken a series of expansionary (and notably, unconventional) policy measures to improve liquidity conditions in their economies, and consequentially rejuvenating activity in these flows. Considering episodes in the past such as the Mexican and Asian crises in 1994 and 1997 respectively (both of these episodes were preceded by an influx in portfolio investment), EME policymakers have been on high alert in navigating their economies around the emergence of financial instability risks in recent years.

Seminal studies by Calvo, Leiderman, and Reinhart (1993) and Fernandez-Arias (1996) developed a framework by characterising the drivers of capital flows into two subsets, push (global) and pull (domestic) factors. The push-pull analytical framework has been of particular importance in studying why these flows have experienced episodes of volatility, and how investors can diversify their portfolios through investing in markets dominated by country-specific factors. The traditional view has been that contagion effects from AEs play a significant role in the determinants of capital flows, such as Milesi-Ferretti and Tille (2011) finding that global risk aversion led to the sharp deceleration in capital flows to EMEs as international investors unwound their investment positions in these regions. More specifically, the recent theme in this debate has evolved around how the range of unconventional monetary measures in AEs, collectively known as Quantitative Easing (QE), have shaped the trajectory in financial flows to the emerging world. These trends are discussed extensively in this paper.

Considering the above, this paper dissaggregates portfolio investment into debt and equity flows and uses a Structural Vector Autoregression (SVAR) model to investigate the extent in which global as well as domestic factors have been accountable in driving these flows to EMEs. Specifically, this research aims to uncover the differences in these determinants on an inter and intra-regional scope. To achieve these objectives, impulse response functions are used to analyse the dynamic behaviour within these respective flows, and variance decomposition to estimate the extent in which the factors identified in this study contribute to the shifts in portfolio flows within specific emerging markets.

This paper has four important findings. Firstly, the empirical results suggest that global factors (proxied by the reserve balances held by the Fed, the CBOE Volatility Index, and US productivity) have been influential in driving flows to these regions. Secondly, despite the evidence

presented on domestic productivity being an insignificant driver in EME financial flows, the interest rate differential between EMEs and AEs resulted in substantial financial movements. This underpins macroeconomic theory in highlighting how the US has acted as global banker to the rest of the world in arbitraging the spread between these interest rates. Thirdly, the model finds evidence with respect to the heterogeneity in these responses on both an inter-regional and intra-regional scope. This is exhibited through differences in the directional impact on investment flows within the Latin American region following movements in US monetary policy, as well as a greater significance in the interest rate differential throughout Latin America and South Africa when contrasted with South East Asia. Finally, the dynamic behaviour brought about by these identified factors offer explanations as to why emerging market financial flows have experienced episodes of volatility during the post-Lehman era. Specifically, the CBOE Volatility Index resulted a substantial amount of fluctuations in both bond and equity flows throughout these regions. This poses concerns with respect to the potential success EME policymakers will have in counteracting these destabilising effects through using macro-prudential tools.

The remainder of this paper is structured as follows. Section 2 explores the seminal research conducted in the capital flow context by offering possible explanations as to why capital flow volatility has increased throughout the past three decades, as well as the implications for financial stability in EMEs. Thereafter, section 3 will provide a detailed breakdown of the SVAR model, data and variables used in this paper. The empirical findings from the model are discussed in section 4, before concluding remarks are presented in section 5.

2. Literature Review

Investors, policymakers and researchers have become immensely consumed with understanding how asset returns and capital flow dynamics have evolved since the recent Global Financial Crisis. The deleveraging of cross-border banking in advanced economies following the crisis, led to the deterioration of capital flows to the majority of EMEs (Cerutti & Claessens, 2016). Capital flows experienced a moderate recovery in the post crisis era, though at levels below the peaks prior to its onset. McQuade and Schmitz (2017) studied the moderation in these flows through this recent retrenchment and highlighted the heterogeneity in responses across different regions and asset classes.

Emerging markets have experienced three waves of substantial financial inflows. The first wave was triggered in the early 1990s, following the international debt crisis that left majority of the

developing world under financial strain throughout the preceding decade. During this rebound, emerging markets enjoyed the benefits of improved macroeconomic fundamentals and re-access to international debt markets. This period also saw an increase in direct investment flows within the composition of capital flows, which was welcomed due to the stable perception and long term nature associated with these flows (Suchanek & Vasishtha, 2010)[1].

This surge came to a halt with the onset of the Asian financial crisis in 1997, as Baek (2006) indicated that average net private financial flows to emerging markets plummeted from $150 billion between 1990 and 1997, to an average of $57 billion over the next four years. From the early 2000s, financial market integration increased and flows to these regions accelerated once more. Notably, direct investment comprised an average of around 80% in total emerging market flows between 2003 and 2006, which served as an indication of the health in emerging market financial accounts at the time (Erduman & Kaya, 2016). This wave came to an end with the fall of the Lehman Brothers and the US subprime mortgage market in 2008, with global liquidity taking a nosedive as a consequence.

The third significant investment influx emerged in the aftermath of this crisis in 2008, due to an improvement in global liquidity conditions largely fuelled by aggressive phases of large scale asset purchases made by AE central banks. With interest rates in AEs hovering around the zero lower bound, magnified by uncertainty surrounding the recovery of assets in AEs, EME returns were viewed as an attractive proposition. This was fuelled even further by a gradual rise in the global risk appetite. Notably, this wave has been characterised as a rise in portfolio flows and financial account volatility, which motivates the focus on this subset of investment flows for this study. Figure 2.1 illustrates the Financial Account balance (measured as a % in GDP) in the eight EMEs investigated in this paper between 1980 and 2018.

Undoubtebly, the volatility in capital flows has put EME policymakers on alert, with concerns surrounding the emergence of asset price bubbles in their countries. Capital inflows have been focal in financing the growth of these regions, however uncontrolled flows may lead to fiscal imbalances and macroeconomic instability. For these reasons, these policymakers have been tasked with the responsibility of counteracting the volatility in capital flows with macro-prudential measures to curtail credit spirals, intervention in foreign exchange markets to boost export competitiveness, and interest rate tightening in response to an overheating economy.

[1]The IMF characterise the distinction in portfolio and direct investment by the size of an acqusition. Direct investment flows are defined as acquisions which exceed the 10% minimum threshold in a company. Portfolio investment refer to acquisitions below this threshold.

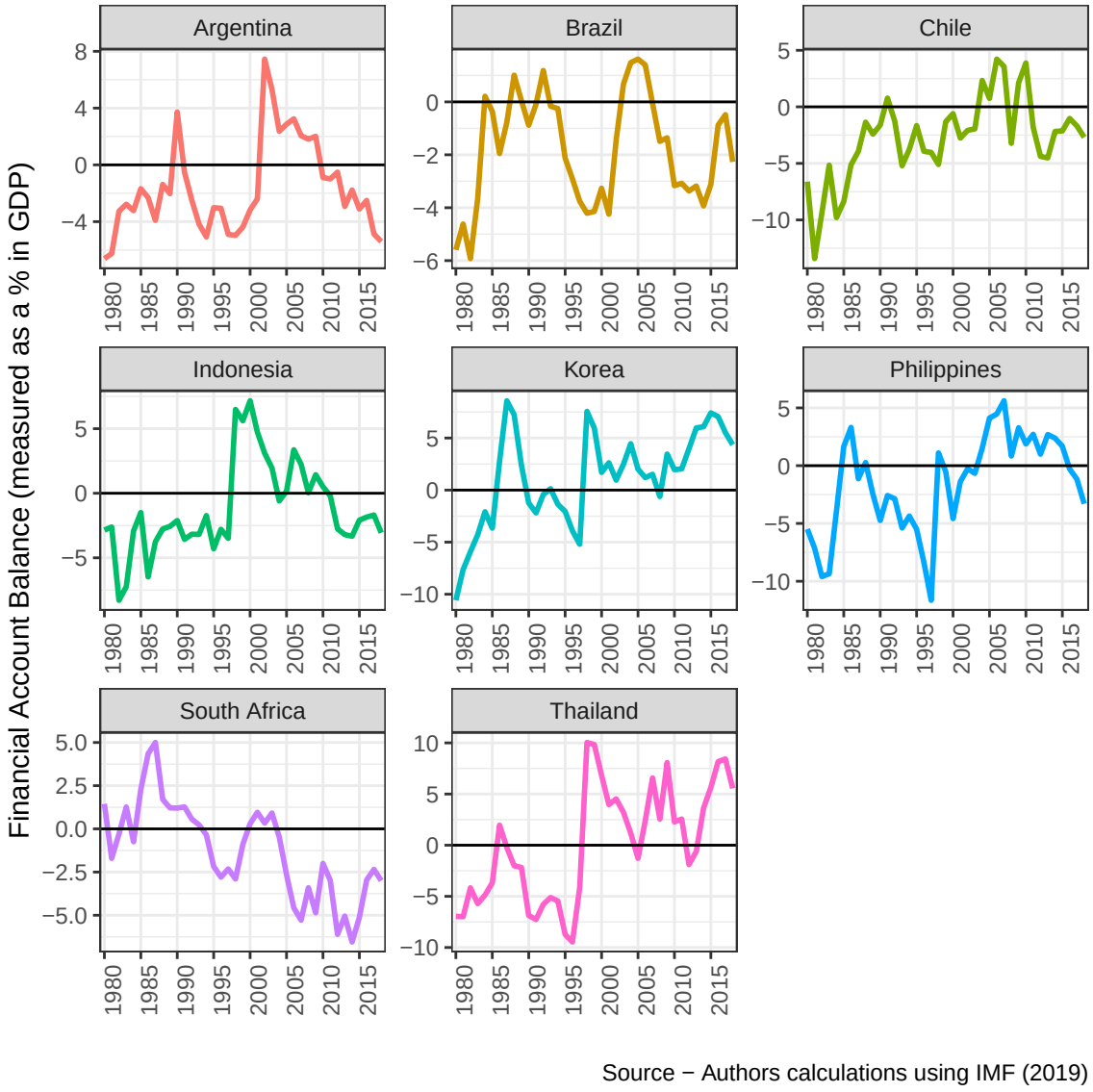

Figure 2.1: Financial Account Balance, measured as a % of GDP

With that being said, the implementation of these measures are not accompanied without challenges. A tighter interest rate stance can be counterproductive in this sense because this results in the appreciation of an exchange rate (and an even wider current account deficit due to a loss in export competitiveness). Furthermore, higher interest rates are bound to intice even more investment from abroad, as AE investors search for arbitrage opportunities. Policymakers in EMEs have occasionally turned to capital controls as a mechanism in offsetting these destabilising effects, however the rationale behind these tools have been subject to intense scrutiny from the IMF and macroeconomic scholars. Due to the mixed evidence surrounding its effectiveness,

some researchers have held the belief that emerging markets should focus on improving their resilience to adverse global shocks with stronger macroeconomic fundamentals, instead of resorting to the use of capital controls. Sahay *et al.* (2014) support this view in highlighting that sudden stops caused by the Taper Tantrum in 2013 were quicker to recover in EMEs which had stronger initial current account positions higher growth prospects, stable inflation, sufficient international reserves to insulate the event of outflows, and a robust macroprudential policy design.[2]

Considering these arguments, much of the modern macroeconomic nexus has evolved around the drivers in international capital flows to emerging markets. A central theme within these debates relates to the extent in which global and domestic factors have influenced the movements in these flows. The nature of these determinants has crucial implications for receipient economies, who hold fears of their susceptibility to sudden stops and current account reversals in the event of a deterioration in global liquidity.

The relevance of global effects in the capital flow context have been researched extensively. Fernandez-Arias (1996) showed that the surge in investment flows to Latin America in the 1990s was largely driven by low interest rates and an economic slowdown in the US. The role of US interest rates has been highlighted further in studies such as Taylor and Sarno (1997), where credit spreads were shown to be the fundamental driver of short term bond flows to Latin America and Asia, as well as Kim (2000) who found that the resurgence in flows to the Asian region following the 1997 crisis were attributed to shifts in the global interest rate and AE-led economic growth. While there is a consensus on low US interest rates being an enabler of capital flows to EMEs, there are mixed interpretations on what impact productivity growth in AEs will have on investment flows to these regions. On one hand, higher growth in AEs would translate in an improvement in net wealth for these investors, meaning that they would have a higher capacity to invest in EMEs. The contrast of this is that higher growth in AEs presents investors with the incentive of choosing to invest in these favourable economic conditions as opposed to investing abroad in riskier EME assets. Other global factors which have featured prominently are the US equity market and global volatility, proxied by the S&P 500 index and CBOE VIX respectively.[3]

According to Chuhan, Claessens, and Mamingi (1998), US portfolio flows to the Latin American

[2]The Taper Tantrum refers to the phenomenon where capital flows to EMEs declined due to the Fed's unanticipated signal of plans to scale back on its large scale asset purchase program.

[3]Griffin, Nardari, and Stulz (2002) used the S&P 500 index to show its substantial impact on daily cross border flows to nine Asian emerging markets. Milesi-Ferretti and Tille (2011) found the VIX to be a primary explanation behind the recent capital retrenchment period.

region were equally as sensitive to domestic factors as global ones, with Asian countries being more sensitive to these country-specific determinants. Förster, Jorra, and Tillmann (2014) decomposed capital flows into global, regional and domestic factors using a Bayesian latent factor model, and found domestic factors to be the largest component in EME capital flow variance. Mody, Taylor, and Kim (2001) used a vector error correction model (VECM) to forecast the dominance of country-specific factors in flows to Latin America, South East Asia, the Middle East and emerging Europe. These sentiments support the case for domestic factors playing a role in capital flow dynamics as financial markets have become more integrated.

Due to the speculative nature in portfolio investment when compared to its direct investment counterpart, the distinctions between the two should come as no surprise. Goldstein (2010) explains that the institutional nature of an investor will determine whether the receipient economy will experience portfolio or direct flows. This study highlights the fact that multinational corporations traditionally opt for direct investment, while private equity, mutual funds and hedge funds tend to spread their portfolios with smaller acquisions (*i.e* portfolio investment). According to Pfeffer (2008), these decisions are based on an investor's preference between the trade-off in yields and liquidity. It is more likely for direct investment to flow to an EME when the investor prefers a higher yield but less liquidity, while portfolio flows are prevelant when there is a bias to having more ability in withdrawing their position. Evans and Hnatkovska (2014) used a domestic financial market integration factor to show how portfolio flows were more sensitive towards this factor compared to direct investment. Their model estimated portfolio flows to be large and volatile at low levels of financial integration with much investment being concentrated in bonds, and a decline in this volatility at higher levels of integration with greater access to global equity markets.

3. Data and Methodology

3.1. Variables and Data

This study samples data at a quarterly frequency from the first quarter of 1991 (1991:1) to the last quarter of 2018 (2018:4) across eight EMEs. Ideally, data extending further back would have been advantageous as this would have provided more observation points for the forecasts. However, limitations on quarterly frequenced data prior to 1991 in some of the sample countries meant that each series had to be restricted to this date to maintain uniformity across the study. Additionally, the inclusion of extreme events such as the Asian Crisis (1997), the Argentinean Debt Crisis (2001), and the Global Financial Crisis (2007-2008) would lead to spurious findings.

With this in mind, the SVAR estimations are preceded by detecting significant structural breaks endogenously with techniques developed by Zeileis *et al.* (2002), and controlling for them with dummy variables.

The geographical coverage for this research stretches across three Latin American economies (Argentina, Brazil, and Chile), four South East Asian countries (Indonesia, Korea, Philippines and Thailand), South Africa, and the United States as a global proxy. These economies are a natural choice considering their presence in their respective regions, as well as in the emerging market context. All of the data used in this paper was taken from the International Monetary Fund's Balance of Payments (BOP) and International Financial Statistics (IFS) databases, with the exception of the US data. The US data was extracted from the Federal Reserve Economic Database (FRED) due to its unavailability from the IMF.

The literature discusses a range of domestic and external factors, from monetary variables such as inflation, exchange rates and interest rates, to other macroeconomic variables such as productivity growth and risk aversion. As the primary aim of this research involves drawing comparisons on how these capital flow drivers differ on an inter-regional and intra-regional scope, including domestic variables which are easily compared between the respective EMEs is paramount. The domestic variables which are applied in the analysis are the short term interest rate differential (measured as the difference between the respective EME and US 3 month treasury yields), as well as domestic real economic growth. Including the interest rate differential is supported by the fact that it measures the primary rationale behind international investment; exploiting the arbitrage in returns between countries. This idea is particularly relevant in the current economic climate, with low AE yields (which have been even negative in Europe and Japan) forcing international investors to search for higher returns in EMEs. The domestic real economic growth variable provides international investors with an indication on expected returns as well as the institutional strength in these specific countries. This pull variable has featured prominently throughout emerging market capital flow research, such as Ying and Kim (2001) and Koepke (2018).

In recent years, capital flows have fluctuated considerably, magnified during episodes such as the subprime market crash, the Taper Tantrum and trade tensions between China and the US. Therefore, an objective of this paper is to understand the extent in which market volatility has influenced capital flows to these regions. The model uses the CBOE Volatility index (VIX) as an external factor, which has been used in various seminal studies as a measure for global

financial market volatility (see Rey, 2015; Friedrich & Guérin, 2016).[4] Including the VIX as measure of the global financial cycle is justified in that it offers insight into how uncertainty in market dynamics affects investment decisions, and ultimately flows to EMEs

An *a priori* expectation for this research is that the Fed's policy stance is likely to explain a substantial amount of the behaviour in these flows, given the US' (as the largest international investor) investment strategy of borrowing short (with selling low risk short term bonds) and lending long in riskier EME assets. The conventional approach to modelling the stance of monetary policy has involved the use of the federal funds rate, such as in Christiano, Eichenbaum, and Evans (1999) as well as Bernanke, Boivin, and Eliasz (2005). However, interest rates in AEs have hovered around the zero lower bound for majority of the post-Lehman era, which has diminished the influence of US interest rates on market liquidity. This phenomenon has seen the Fed resorting to liquidity injections (a form of QE) for much of this period. To successfully capture the effects of these interventions made by the Fed, the model uses the Fed's balance sheet as its measure of US monetary policy[5].

The final external factor used in the model is US Real GDP, calculated as a period-on-period growth rate. The inclusion of this variable is rationalised on building an understanding on the impacts which US business cycle fluctuations have on these flows. As highlighted previously, the particular motivation for selecting this variable is to investigate the contrasting interpretations surrounding how growth in AEs influences capital flows to EMEs. Including both a US productivity shock and monetary policy shock in one system makes intuitive sense, in that the expansion of the Fed balance sheet (a positive monetary policy shock) is likely to accelerate real GDP (*i.e* a positive domestic productivity shock).

This paper focuses on portfolio flows and dissaggregates these into the its two asset classes; debt (bond) and equity flows. These flows are calculated as a percentage of GDP to facilitate comparability between different economies. In focusing on portfolio flows, the analysis will investigate the speculative behaviour associated with investing in risky EMEs.[6] Direct investment flows fall beyond the scope of this research due to the non-speculative nature of these flows, and are therefore ignored.

[4]The VIX proxies the market's expectation on future volatility on S&P 500 futures. Although this variable is released at a daily frequency, this model uses quarterly end of period values of it.

[5]The Fed's balance sheet is measured as ratio of total reserve balances held by reserve banks to GDP in the US.

[6]Argentina is notable example of an economy which has experienced an influx of speculative portfolio activity in recent years due to high interest rates, a consequence of their history riddled with defaults and currency devaluations.

3.2. Methodology

Calvo, Leiderman, and Reinhart (1993), Chuhan, Claessens, and Mamingi (1998) and Fernandez-Arias (1996) all argued that US interest rate shocks accounted for a substantial portion of capital flow variance in Latin American economies in the early 1990s. Calvo, Leiderman, and Reinhart (1993) constructed a VAR model to account for these factors, while Fernandez-Arias (1996) considered international returns, and proxies for the domestic investment climate and creditworthiness to show that the international return factor explained over two thirds of the movement in capital flows to 13 developing economies in this period.

This section builds on these seminal papers by developing a structural VAR (SVAR) framework to model the contemporaneous effects of domestic and external shocks on capital flows. In order to develop a structural VAR, all of the explanatory variables should be stationary in levels or first differences, and the structural shocks should have no mutual correlation with unit variance (Sims, 1980). Additionally, it would be ideal for the respective capital flows to be stationary in levels in order to retain all the information in these series. In order to test whether the data meets these specifications, the SVAR estimations are preceded by the seminal Dickey and Fuller (1979) and Phillips and Perron (1988) tests to detect possible unit roots which would need to be addressed.

Assuming that each variable meets the stationarity conditions from these tests, a system of variables can be defined as follows

$$Y_t = fed_t, y_t, vix_t, int_t, dy_t, pfdebt_t, pfequity_t \tag{3.1}$$

where the system's global (push) factors are denoted by fed_t, y_t, and vix_t, which refer to Fed balance sheet, US quarterly real GDP growth and the CBOE VIX. The domestic (pull) factors are represented by int_t and dy_t, which refer to the interest rate differential and domestic quarterly real GDP growth in the model's EMEs.[7]. Debt and equity portfolio flows are denoted by $pfdebt_t$ and $pfequity_t$.

The SVAR for each portfolio flow is specified as a function of shocks to each variable identified in the push-pull framework, as well as lagged effects of the dependant variable in question (which are debt or equity flows in this case). This can be expressed as

[7]Real economic growth is calculated as a period-on-period rate of change in both the domestic and US case.

$$pfdebt_t = f_1(\varepsilon_t^{fed}, \varepsilon_t^{y}, \varepsilon_t^{int}, \varepsilon_t^{dy}, \varepsilon_t^{vix}, \varepsilon_t^{pfdebt}) \tag{3.2}$$

$$pfequity_t = f_2(\varepsilon_t^{fed}, \varepsilon_t^{y}, \varepsilon_t^{int}, \varepsilon_t^{dy}, \varepsilon_t^{vix}, \varepsilon_t^{pfequity}) \tag{3.3}$$

It is important to note that the structural shocks in 3.2 and 3.3 cannot be observed directly. As a result, restrictions will be imposed on the model to isolate the impacts of specific shocks. The remaining part of this subsection aims to fulfil this purpose. In order to achieve this, a VAR(p) model can be specified and expressed in its lag polynomial form as

$$Y_t = \Sigma_{i=0}^{\infty} A_i \varepsilon_{t-i} = A(L)\varepsilon_i \tag{3.4}$$

where A_i is a matrix of impulse responses of endogenous variables to the structural errors represented by ε_i (Ying & Kim, 2001).

Thereafter, the moving average representation can be specified by estimating the reduced form VAR in 3.5 and expressing it in its structural moving average form, 3.6. The rationale for specifying the structural moving average representation is to capture the initial impacts of the structural errors in ε_i and determine the contemporaneous correlation between the endogenous variables in Y_t. Essentially, this representation gives dynamic multipliers of Y_t to changes in ε_i. U_t represent these dynamic structural errors.

$$B(L)Y_t = U_t \tag{3.5}$$

$$Y_t = B(L)^{-1}U_t = C(L)U_t \tag{3.6}$$

The coefficient matrix that shows the contemporaneous effects of the shocks in the reduced form takes on an identity matrix, $C(0) = I$. By using equations 3.5 and 3.6, the following can be expressed

$$\varepsilon_t = A_0^{-1}V_t \tag{3.7}$$

and

$$A_i = A_0^{-1} C_i \tag{3.8}$$

where $A_0 = A(0)$ is the leading coefficient matrix in $A(L)$, A_i is the coefficient matrix of $A(L)$ and C_i is the coefficient matrix of $C(L)$. As C_i is derived as the moving average representation of the reduced form VAR, A_i and its structural representation can be derived using the A_0 matrix. In order to derive A_0, consider the following

$$A_0 S A_0^{'} = A_0 A_0^{'} = \Omega \tag{3.9}$$

where $\Omega = Var(U_t)$ and $S = Var(\varepsilon_t)$. S is normalised into an identity matrix in order to achieve global (uniform) identification of the structural shocks in ε_i, simplified further to

$$A(1)A(1)^{'} = C(1)\Omega C(1)^{'} \tag{3.10}$$

$C(1)$ takes on the same characteristics as $A(1)$ and Ω is the covariance matrix of the reduced form VAR. Thereafter, $A(1)$ can be transfigured through imposing long run restrictions, represented in 3.11. As highlighted previously, these restrictions are imposed with the aim of decomposing isolated effects in the system using economic theory. Similar to Blanchard and Quah (1989), the restrictions are characterised as follows

1) All of the emerging markets in question are assumed to be small open economies. This implies that domestic shocks in emerging markets will have no impact on global factors.[8]

2) In the long run, economic growth can only be affected by supply shocks. This assumption is supported by von Hayek's (1932) relatively uncontroversial theory on the long run neutrality of monetary policy.[9]

[8] The interest rate differential and domestic real economic growth have no impact on the Fed balance sheet, US economic growth or the VIX.

[9] The neutrality of monetary policy theory infers that the Fed balance sheet and the interest rate differential will have no long run effect both domestic and foreign real economic growth variables.

$$\begin{bmatrix} fed_t \\ y_t \\ int_t \\ dy_t \\ vix_t \\ pfdebt/equity_t \end{bmatrix} = \begin{bmatrix} * & * & 0 & 0 & * & 0 \\ 0 & * & 0 & 0 & * & 0 \\ * & * & * & * & * & * \\ 0 & * & * & * & * & * \\ * & * & 0 & 0 & * & 0 \\ * & * & * & * & * & * \end{bmatrix} \begin{bmatrix} \varepsilon_t^{fed} \\ \varepsilon_t^{y} \\ \varepsilon_t^{int} \\ \varepsilon_t^{dy} \\ \varepsilon_t^{vix} \\ \varepsilon_t^{pfdebt/equity} \end{bmatrix} \tag{3.11}$$

Following these long run restrictions, the SVAR representation can be derived by Cholesky decomposition of the $C(1)\Omega C(1)^{'}$ matrix. After the $A(1)$ is obtained, the $A(0)$ matrix can finally be expressed as the following

$$A(1)A(1)^{'} = C(1)\Omega C(1)' \tag{3.12}$$

The VAR model in question is estimated by employing Ordinary Least Squares techniques with optimal lags specified by the Schwarz (1978) Bayesian information criterion. This criterion minimised the optimal lag length throughout each estimation in this study, which motivates this choice from a parsimony perspective.

The discussion of the findings from the structural VAR model is presented in Section 4, with the aid of impulse response function analysis to visualise the magnitude and persistence which these respective shocks have had on portfolio flows to each EME. Thereafter, the paper uses variance decomposition to break down the variation in bond and equity flow forecast errors which can be attributed to variations within the SVAR's factors.

4. Results

Following the confirmation of each variable's stationarity as well as controlling for structural breaks, the SVAR model can be estimated. Thereafter, this research uses impulse response function analysis and variance decomposition to unpack the behaviour in flows to each EME. The findings from the model are discussed extensively in this section.

4.1. Impulse Response Analysis

The impulse response functions for the Latin American region are presented in figures 4.1 - 4.6, South Africa in 4.7 & 4.8, and South East Asia in 4.9 - 4.16. These figures model the dynamic behaviour of these flows in response to endogenous variable shocks within the push-pull framework. The y-axis on these figures measures the percentage change in each flow (which is expressed as a percentage of GDP) in response to the shocks identified. As the primary rationale for this research entails unpacking the inter and intra-regional differences which emerge within the push-pull context, this section does not focus on the debt-on-debt and equity-on-equity responses within the system.

In analysing the impact of a positive one standard deviation shock to the VIX (which implies higher US stock market volatility), debt inflows occured in Brazil and Chile over the 10 period horizon. The magnitude in this shock differed considerably between the two countries, which can be interpreted as a 5 percentage point increase in debt flows to Brazil after 5 periods, while Chile experienced a 0.4 percentage point rise. Unanticipated increases in the VIX resulted in immediate (and sometimes persistent) outflows across both asset classes throughout the remaining economies. The fact that equity outflows were experienced in the aftermath of this shock supports an *a priori* theory for this research. In unpacking this theory, higher global volatility is expected to nudge investors in decreasing their exposure in equities and opt for safer asset holdings such as bonds and cash. While South African equity flows exhibited a slightly positive response to spikes in the VIX, it is important to note that this finding is statistically insignificant. Friedrich and Guérin (2016) drew similar conclusions on the negative impact which the higher global uncertainty has on equity flows, where they measured a 10 point increase in the VIX to trigger a 15% equity outflow episode on the Emerging Portfolio Fund Research (EPFR) index.

A positive shock to the Fed balance sheet (which can be intepreted as a looser policy stance in the US) resulted in immediate debt inflows to Brazil and Thailand persisting over 10 periods. The initial effects of this shock on South African and Korean debt flows were negative, before considerable inflows were experienced in these countries. In Chile, the response to both asset flows in the wake of this shock were volatile in nature, before normalising after 10 periods. The confidence bands on equity flows in Thailand indicate that this shock had insignificant impacts on their equity market. This evidence for portfolio inflows following an expansion of the Fed balance sheet supports economic theory, in that improved liquidity conditions fuelled by interventions made by the Fed result in investors having a greater scope to purchase assets in EMEs. Similar sentiments are echoed in Ramirez and Gonzalez (2017), who found US treasury

purchases conducted by the Fed to have significant impacts on EME flows. With that being said, the response in both debt and equity flows to Indonesia and the Philippines were negative in the aftermath of an expansion in the Fed balance sheet.

Within the Latin American region alone, the model finds considerable evidence on the heterogeneity in US productivity shocks to portfolio flows. Both asset flows were estimated to experience a positive spike in Chile and Brazil immediately after an increase in US real GDP growth, while the opposite trend emerged in the Argentinean case. In Brazil, the significance of this shock is emphasised through an estimated 10 percentage point response in the equity flow ratio after two quarters. This shock had relatively insignificant effects in South East Asia, with the exception of debt flows to Thailand and Indonesian equity flows. In South Africa, the impulse responses to US productivity shocks exhibit contrasting effects between the debt and equity flows, interpreted as a positive and negative effect respectively. As a result, it is difficult to draw conclusions on whether policymakers in EMEs can expect US productivity spikes to trigger investment inflows or outflows to these regions. Clearly, the inflow episodes highlighted in the Chile and Brazil case indicate that a higher capacity to invest in AEs (caused by shifts in investor net wealth) outweigh the incentive they face to reinvest their capital in these favourable AEs conditions. The opposite of this trend can be interpreted when a net portfolio outflow is estimated in response to this shock.

Figure 4.1: Argentina Debt Flows - Impulse Response Functions

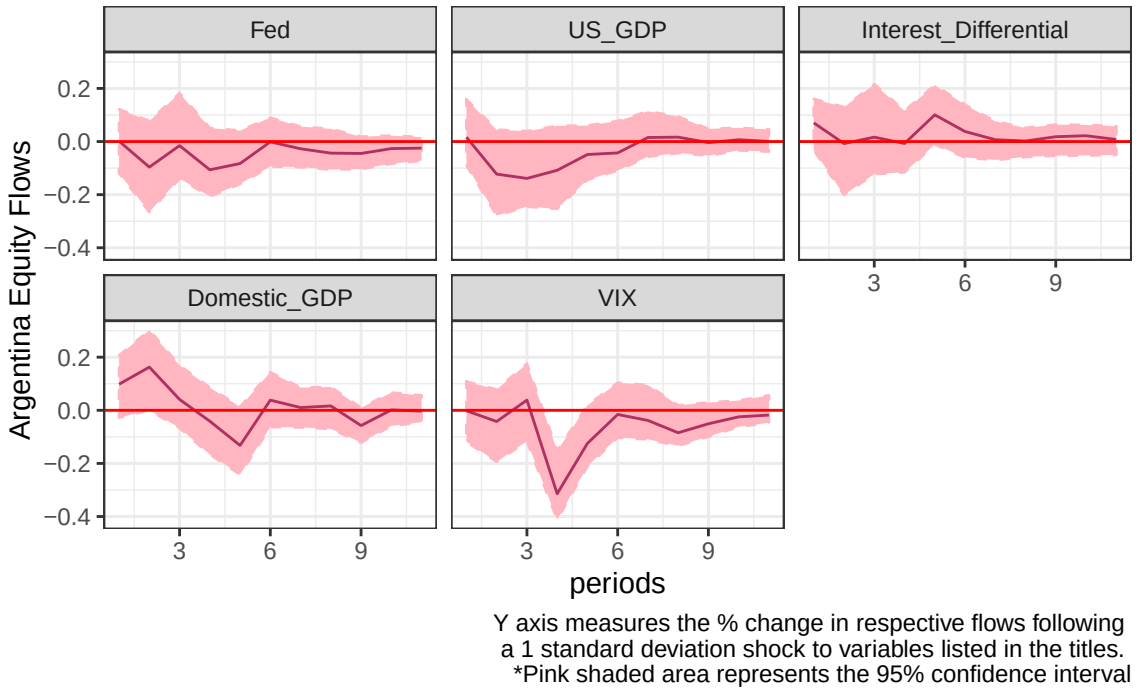

Figure 4.2: Argentina Equity Flows - Impulse Response Functions

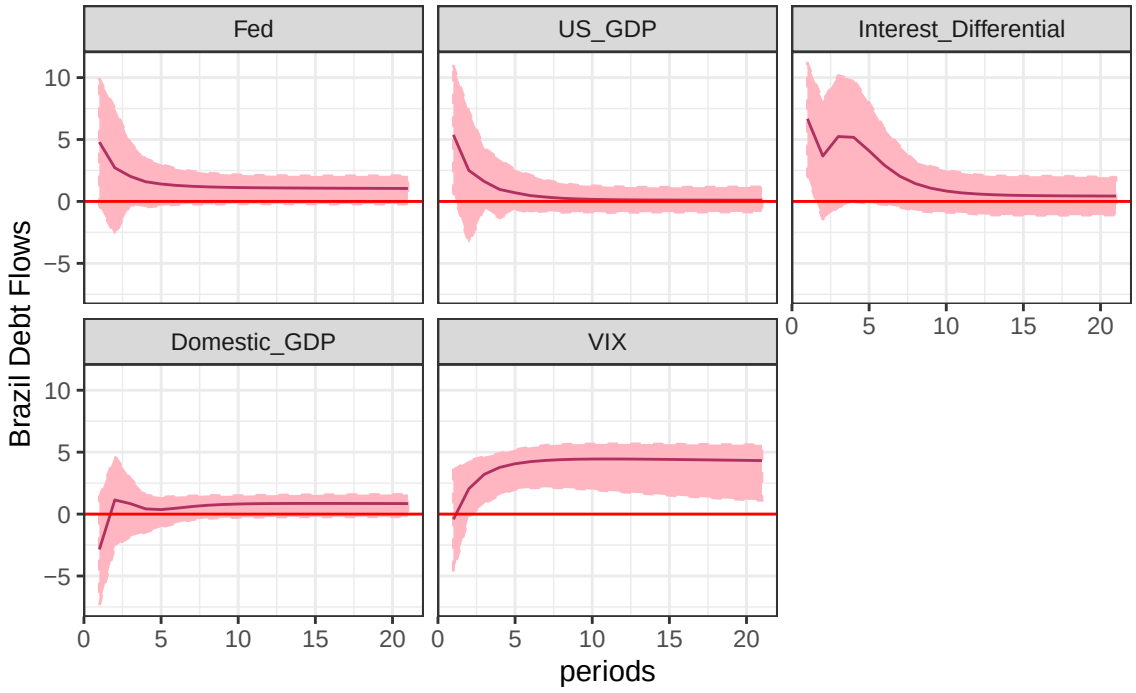

Figure 4.3: Brazil Debt Flows - Impulse Response Functions

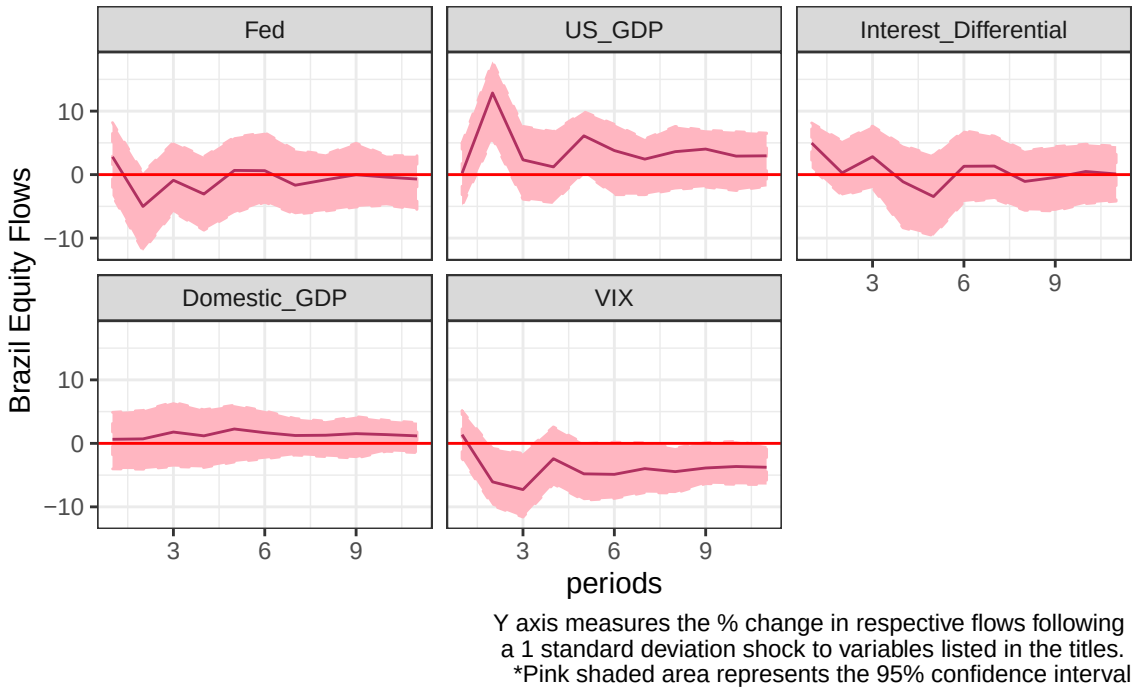

Figure 4.4: Brazil Equity Flows - Impulse Response Functions

Figure 4.5: Chile Debt Flows - Impulse Response Functions

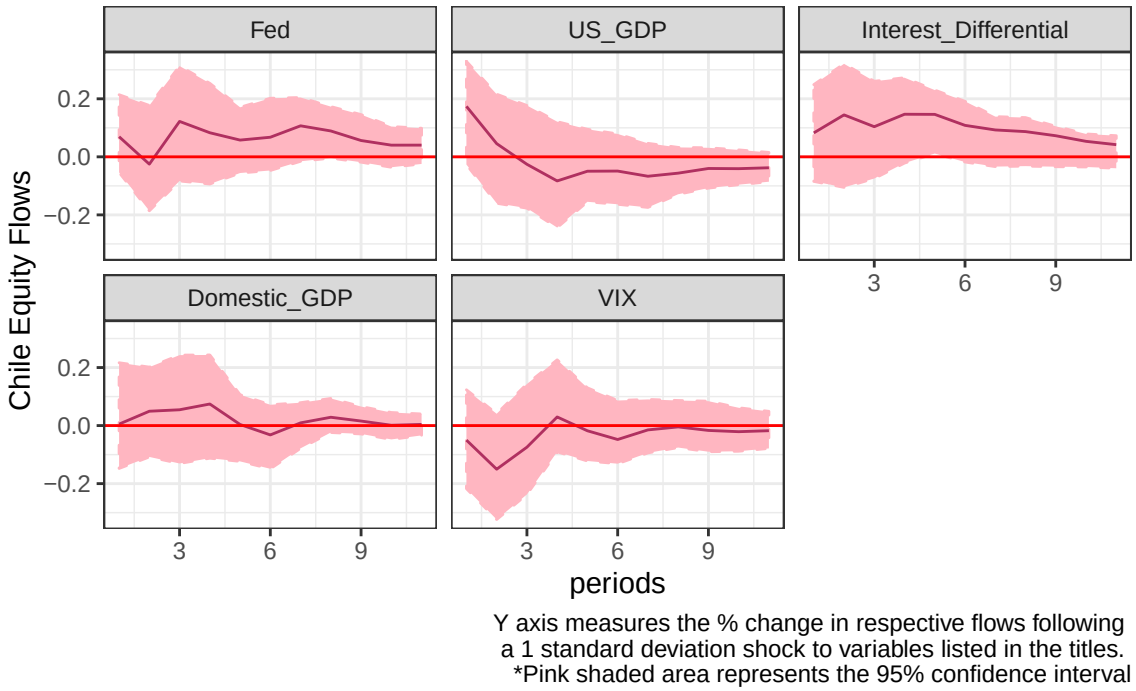

Figure 4.6: Chile Equity Flows - Impulse Response Functions

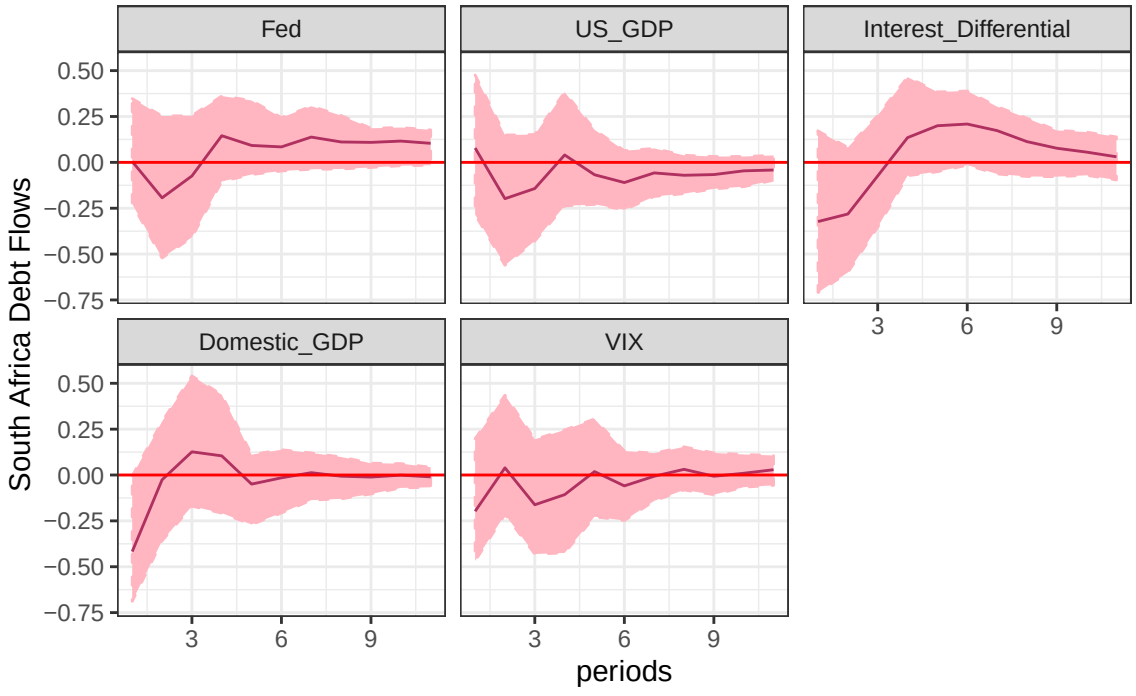

Figure 4.7: South Africa Debt Flows - Impulse Response Functions

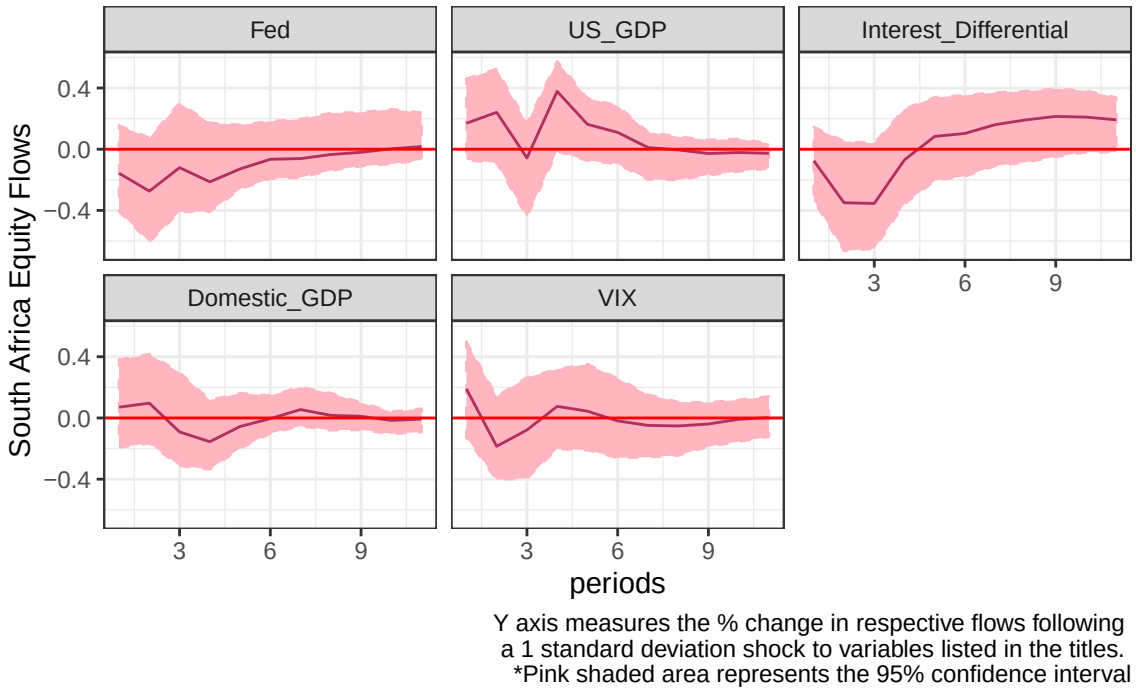

Figure 4.8: South Africa Equity Flows - Impulse Response Functions

As expected, the interest rate differential proved to account for significant shifts in EME capital flows. The expectation of an increase in portfolio flows when a positive shock to this variable occurs can be rationalised on the premise that AE investors view this as an attractive opportunitity to profit off the spread between the two interest rates through arbitrage. The figures depict net inflows occuring Brazil over 10 periods, while debt flows in Argentina fluctuated between positive and negative impacts. In theory, this evidence on Argentina is supported by the fact that interest rates set by their central bank have been volatile in themselves in combating the hyperinflationary episodes they've faced while attemping to improve economic growth, which has fuelled speculative portfolio in their economy (Gibbs, 2018). Furthermore, the findings in South East Asia indicate that this shock has had greater impacts on debt flows relative to its equity counterpart in Indonesia and the Philippines. Considering the South African case, an initial net outflow was experienced from both their debt and equity markets before inflows were recorded after one year. As a collective, these responses were less significant in the Asian economies compared to Latin America and South Africa. An explanation for this finding is that interest rates have typically been lower in South East Asian economies in recent years, therefore leaving AE investors with less of a interest rate spread to exploit.[10]

[10]The average 3 month interest rate in Korea and Thailand between 2010 and 2018 was estimated to be 2.28%

In general, shocks to domestic productivity collectively had the least significant impact on portfolio flows from the variables identified in this push-pull framework. The insignificance in the responses to flows in Brazil, Chile and the Philippines come as a surprise when considering the belief that productivity growth represents a benchmark for expected asset returns in a particular economy, as highlighted in Koepke (2018). Debt flows in Indonesia experienced a substantial amount of volatility in the aftermath of this shock. This is consistent with Jayasuriya and Leu (2017), who also estimated a domestic productivity shock to have volatile effects on Indonesian portfolio flows. Notably, the negative effects of a productivity shock on South African debt flows should be concerning to policymakers in the country. In recent years, South African sovereign bond yields have performed poorly against emerging market benchmarks, which culminated to a $1.8 billion selloff in South African bonds in the first two weeks of 2019 (Goko, 2019). However, the wave of negative bond yields throughout Europe and Japan in recent years presents South Africa with a window of opportunity to attract debt investment from these regions if the country can avoid a credit downgrade in early 2020.[11]

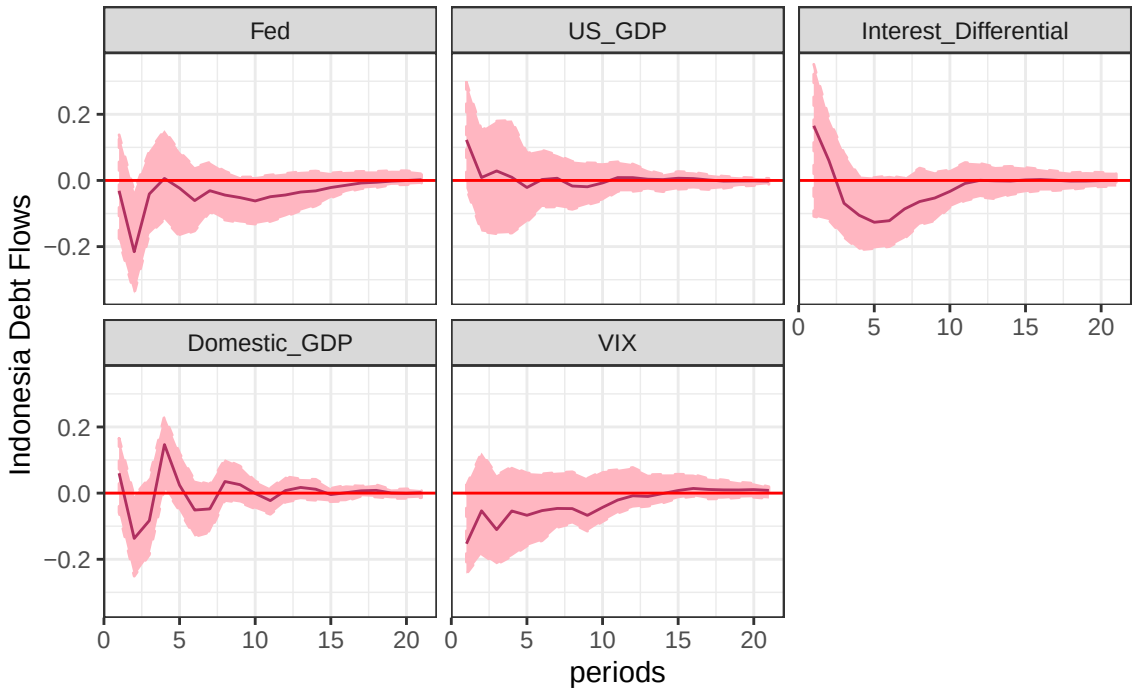

Figure 4.9: Indonesia Debt Flows - Impulse Response Functions

and 1.59% respectively. The corresponding figures in South Africa, Argentina, Brazil and Chile are 6.78%, 23.45%, 10.57% and 6.2% (IMF, 2019).

[11] As of December 2019, Moody's was the only major credit rating agency which had South African sovereign bonds rated as investment grade.

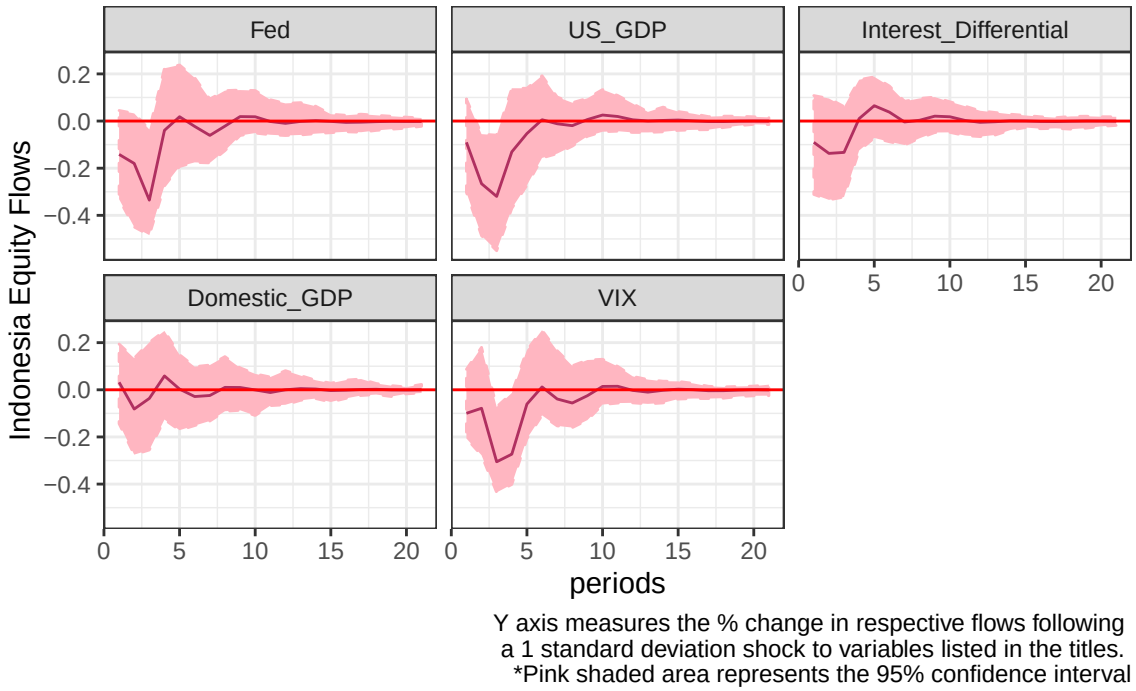

Figure 4.10: Indonesia Equity Flows - Impulse Response Functions

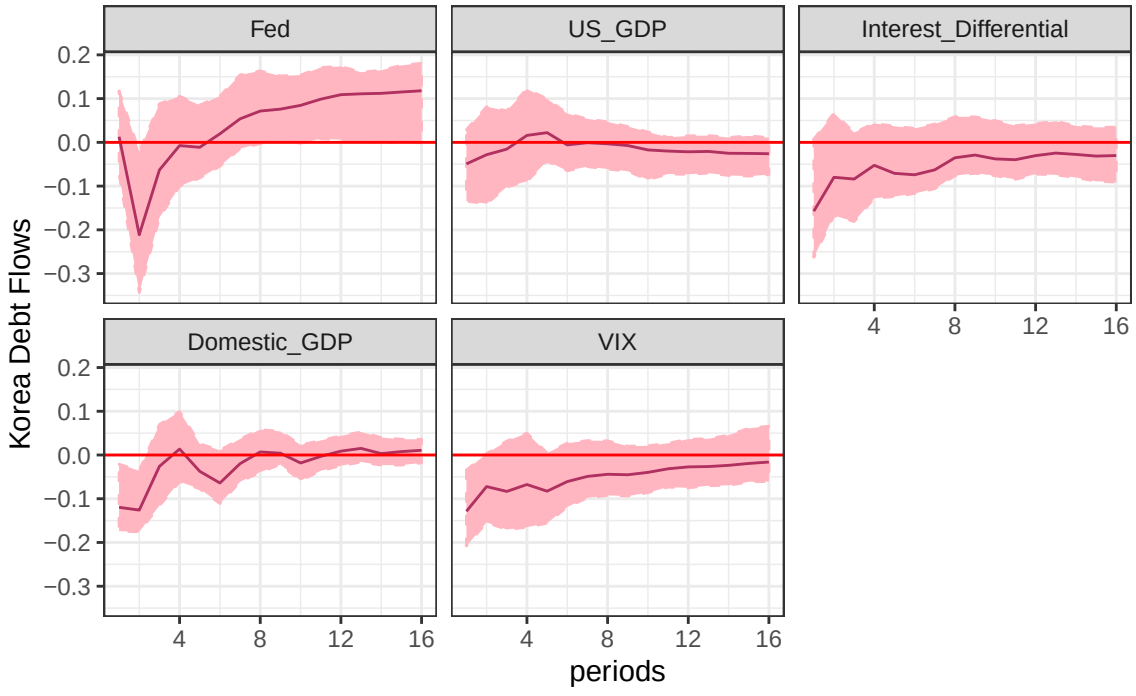

Figure 4.11: South Korea Debt Flows - Impulse Response Functions

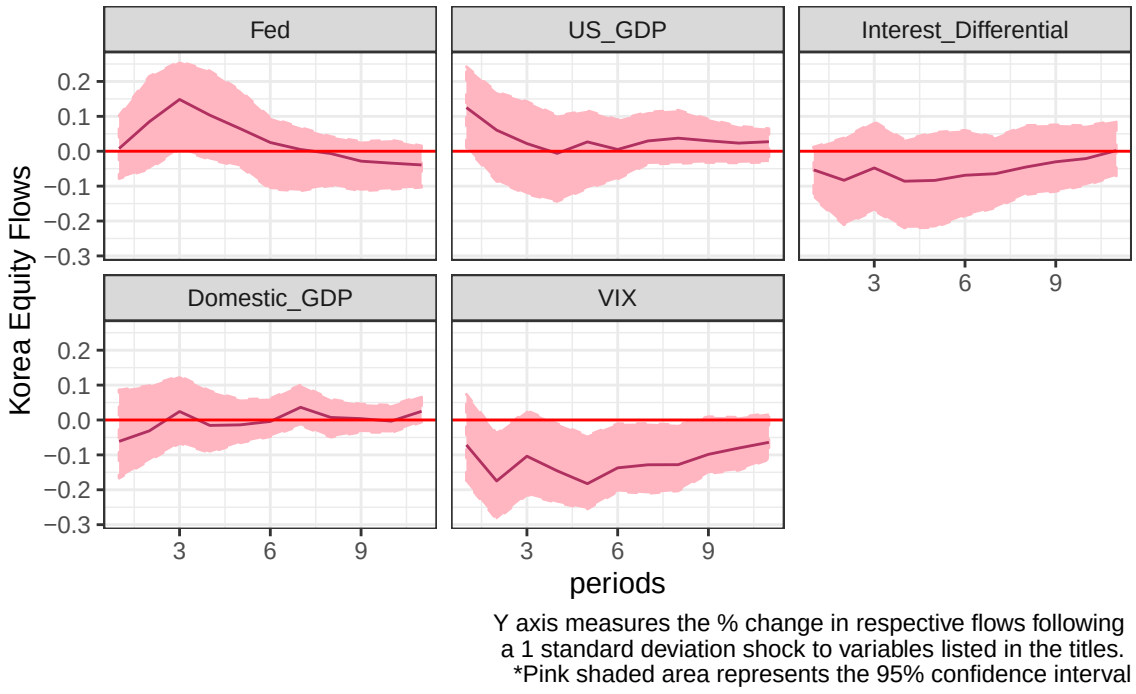

Figure 4.12: South Korea Equity Flows - Impulse Response Functions

Figure 4.13: Philippines Debt Flows - Impulse Response Functions

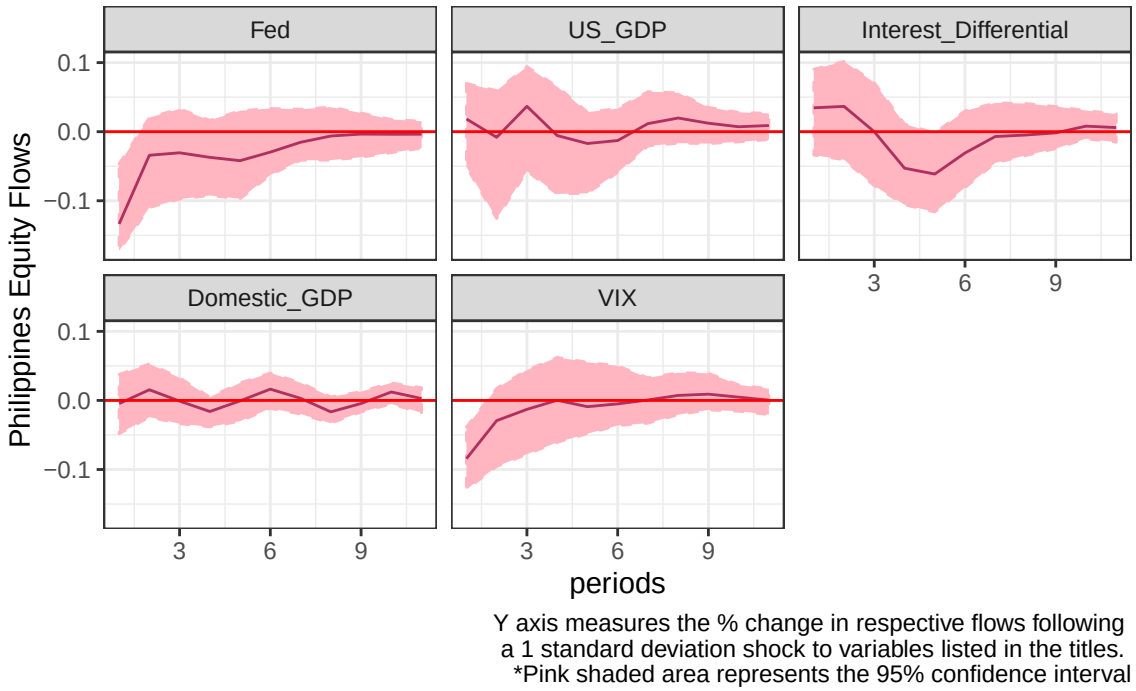

Figure 4.14: Philippines Equity Flows - Impulse Response Functions

Figure 4.15: Thailand Debt Flows - Impulse Response Functions

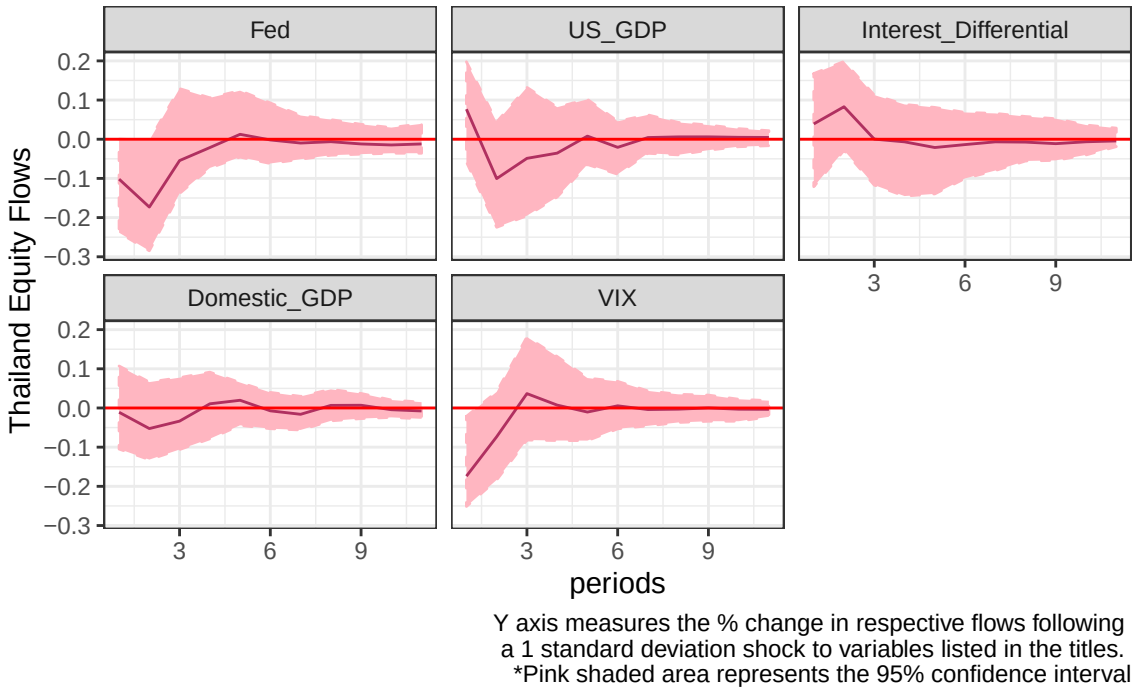

Figure 4.16: Thailand Equity Flows - Impulse Response Functions

Four important points emerge from the model's impulse response function analysis. Firstly, it is evident that global shocks have had contrasting impacts across EMEs. This is particularly emphasised where the shock to the Fed balance sheet resulted in debt inflows in countries such as Brazil and Thailand, while Indonesia and the Philippines experienced outflows from this. Similarly, the VIX shock caused outflows in most cases, apart from debt flows to Brazil and Chile. Secondly, the fluctuations in most of these responses serves as evidence of these shocks contributing to the emerging market capital flow volatility which has been observed throughout the post-Lehman era. Crucially, these volatile effects have not been unique to a specific region or asset class. Thirdly, the shocks to the interest rate differential were more significant in both Latin America and South Africa relative to the South East Asian region, which could indicate the greater scope for arbitrage opportunities in these economies. Finally, the outflow episodes arising from shocks to the Fed balance sheet and US productivity normalised relatively quickly. This should offer a sense of encouragement to international investors who are aiming to hedge the downside of their portfolios with increasing their exposure in these economies. With that being said, the persistence in outflows arising from shocks to the VIX presents EME policymakers with the challenge to insulate their current account balances from spillovers in the global volatility measure.

4.2. Variance Decomposition Analysis

With the aid of forecast error variance decompositions, conclusions can be drawn on the importance in which global and domestic contributions have on movements in EME capital flows. The model estimates these decompositions at 2, 10 and 20 period forecasts to capture both short and longer run dynamics in these flows. Debt flow decompositions are presented in tables 4.1 and 4.2, with equity flow decompositions being represented in 4.3 and 4.4. Overall, the combined effect of global shocks explains a substantial part of portfolio flow variance in Brazil and Korea, therefore highlighting the role of the external sector in these economies. Shocks to the interest rate differential explained a considerable amount of variance in portfolio flow movements to Argentina, Chile and South Africa. However, the domestic productivity factor proved to have relatively insignificant effects in most countries. These findings have implications for international investors, who have concerns surrounding ways in which they can hedge their portfolios with exposure in economies driven by country-specific factors.

The impacts caused by US monetary policy shocks are estimated to be a substantial component in the variance of debt flows to Brazil and Korea at a 20 period forecast (9.11% and 25.98% respectively), as well as equity flows to Chile, Korea and the Philippines (approximated to be 10.87%, 15.25% and 11.5%) over the same horizon. The results suggest that the variance arising from Fed shocks has been more significant in the South East Asian region compared to Latin America and South Africa. The significance of shocks to the Fed balance sheet support the findings echoed in the impulse response analysis, which underpin this paper's *a priori* theory surrounding the dominance of US liquidity injections in the push-pull context over the past decade. These shocks were estimated to have lagged effects for Korean debt flows and Chillean equity flows respectively.

In addition to these lagged effects highlighted above, the dynamics in forecast error variance explained by the VIX offer further insight into the nature of global shocks. The variance contributed by the VIX rose substantially in equity flows to Argentina and debt flows to Brazil between the 2nd and 20th period. Over this horizon, the excess variance between the two periods was measured as roughly 20% in Brazil, with 10% arising in Argentina. It is expected that the effects of global factor variance are likely to be lagged before having an impact on EME portfolio flows, especially given the time taken to unwind an investment position in the event of a negative shock when a specific EME has capital controls in place. Generally, the dynamics in domestic factor variance remained relatively constant throughout this analysis, with the exception of the interest rate differential impact on Korean equity flows. This factor is estimated to rise by 13% between the 2nd and 20th period.

Interpreting the domestic variables, it is evident that the impacts triggered by movements in the interest rate differential outweigh shocks to domestic productivity throughout all of these cases. As highlighted in the impulse response analysis, the interest rate differential has greater impacts in Latin America and South Africa when compared to Asian portfolio flows. Lagged effects are exhibited by this variable in Chillean, South African and Korean equity flow forecast errors.

The findings unpacked throughout this section are bound to have considerable implications for policymaking and investor decisions. To explain this, the rationale for international investment is predicated on being able to maximise asset returns while contemporaneously minimising the risk that is accompanied by this exposure. For investors to meet this objective, developing an understanding on the underlying drivers in these returns as well as portfolio flow movements to specific EMEs is crucial. Markowitz (1952) pioneered this idea of asset diversification in modern portfolio theory by emphasizing that the components within a portfolio should be driven by heterogenous shocks. In this sense, any rational international investor should prioritise their search for investment opportunities in EMEs where country-specific drivers have substantial impacts.

This model finds limited evidence to support the case for domestic productivity being a focal of emerging market portfolio flows. However, the impact of the interest rate differential in Latin America and South Africa should offer a sense of enouragement to investors from an arbitrage perspective, particularly in the current economic landscape where yields in AEs have approached the zero lower bound. This paper concludes that effects arising from shocks to the VIX and the Fed balance sheet have had substantial spillover impacts in these EMEs throughout the past three decades. Furthermore, shocks to US productivity were magnified in cases such as Brazil. The substantial effects caused by global spillovers on capital flows throughout this model underpin the sentiments echoed in Calvo, Leiderman, and Reinhart (1993), Fernandez-Arias (1996) and Milesi-Ferretti and Tille (2011). Critically, the spike in recent global market uncertainty (fuelled by trade tensions between China and the US) mean that EME-focused investors and policymakers in these countries should expect these contagion effects to continue in the near future.

Table 4.1: Variance Decomposition for Debt Flows - Latin America and South Africa

Periods	Fed Balance Sheet	US GDP	Interest Rate Differential	Domestic GDP	VIX	Debt Flows
Argentina						
2	0.851	1.7999	7.5878	0.5342	9.7108	88.2558
10	3.144	2.7839	9.1244	1.4152	3.1412	81.6326
20	5.7872	3.316	8.9558	1.6099	1.9072	78.4594
Brazil						
2	1.4266	3.3935	3.9355	1.1466	1.1968	88.9842
10	7.2439	8.3086	4.8637	0.618	13.5700	65.4016
20	9.1187	9.4231	3.7980	0.4835	21.0202	56.1562
Chile						
2	1.2933	3.4807	1.5797	0.3554	0.5893	92.7013
10	6.6356	3.298	1.4555	0.5165	4.4366	83.2619
20	6.5134	3.9616	1.5751	0.5312	8.1374	79.2809
South Africa						
2	1.1884	0.8763	4.7444	5.1368	2.2237	85.8353
10	3.2113	2.067	7.4694	5.4136	3.585	78.5770
20	4.2005	2.2101	7.4172	5.3547	3.5491	77.2681

Note:
This table presents the percentage of variation in the forecast errors of Debt Flows due to variations in each factor within the Structural VAR system after 2, 10 and 20 quarters

Table 4.2: Variance Decomposition for Debt Flows - South East Asia

Periods	Fed Balance Sheet	US GDP	Interest Rate Differential	Domestic GDP	VIX	Debt Flows
Indonesia						
2	6.1777	1.9707	4.0308	2.9113	3.4253	81.4839
10	6.4079	1.7697	9.4848	5.9777	6.0649	70.351
20	7.0733	1.7668	9.3865	5.9581	6.1253	69.67
Korea						
2	11.1129	0.9129	7.9098	7.4165	5.1423	67.5052
10	11.9092	0.918	10.102	6.4198	6.5502	65.7915
20	25.9801	1.4392	9.7114	5.2512	6.1138	51.504
Philippines						
2	1.316	0.1323	5.4797	0.0908	2.1518	90.8290
10	3.9179	0.7973	7.9581	0.6409	6.047	81.5
20	4.1771	0.8201	7.8343	0.8889	6.497	79.7824
Thailand						
2	1.2967	1.742	1.3481	3.0798	1.4973	91.0358
10	3.0213	2.3267	2.752	4.0702	1.9175	85.8293
20	6.8214	2.7919	2.7334	3.9054	1.9074	81.8184

Note:
This table presents the percentage of variation in the forecast errors of Debt Flows due to variations in each factor within the Structural VAR system after 2, 10 and 20 periods.

Table 4.3: Variance Decomposition for Equity Flows - Latin America and South Africa

Periods	Fed Balance Sheet	US GDP	Interest Rate Differential	Domestic GDP	VIX	Equity Flows
Argentina						
2	0.6211	2.402	1.191	7.0271	0.2724	88.4855
10	1.9222	6.522	2.3133	8.2811	10.9789	69.907
20	3.3503	6.6783	2.6351	8.3073	10.9061	68.127
Brazil						
2	4.7107	16.4636	4.3008	0.1064	3.6626	70.7556
10	6.9626	14.0175	5.6293	0.6825	3.5735	69.1343
20	6.1369	12.564	4.8329	1.2743	6.432	68.7594
Chile						
2	0.951	2.3432	3.4837	0.3117	0.3296	92.5805
10	10.6203	2.7287	12.0287	0.4917	2.631	71.4993
20	10.8792	2.783	13.585	0.4721	3.4277	68.8527
South Africa						
2	3.0724	2.2877	3.0041	0.9736	1.3677	88.7042
10	6.2118	6.7615	8.8444	1.4884	1.4603	74.9905
20	6.0738	6.7453	11.1363	1.4603	1.6602	72.92385

Note:

This table presents the percentage of variation in the forecast errors of Equity Flows due to variations in each factor within the Structural VAR system after 2, 10 and 20 quarters

Table 4.4: Variance Decomposition for Equity Flows - South East Asia

Periods	Fed Balance Sheet	US GDP	Interest Rate Differential	Domestic GDP	VIX	Equity Flows
Indonesia						
2	2.8731	4.3214	1.4789	0.4206	0.8824	90.0233
10	7.3369	8.5892	2.1818	0.5995	8.2329	73.0337
20	7.3389	8.6235	2.1825	0.6072	8.2459	73.0017
Korea						
2	13.8856	0.4529	1.4359	3.268	4.2675	76.6898
10	13.975	1.1321	12.8693	2.5378	11.849	57.6364
20	15.2622	1.3658	14.348	2.4744	11.3553	55.1939
Philippines						
2	10.8935	0.0232	0.1451	0.1487	4.5667	82.7075
10	11.6476	1.4035	4.8875	0.5952	4.032	77.4124
20	11.5844	1.5038	4.9931	0.972	4.0208	76.9256
Thailand						
2	1.1997	1.14	1.069	2.8301	2.0304	91.7304
10	6.2324	3.3389	0.9964	3.801	2.6681	82.9128
20	9.3052	4.0905	0.9722	3.6513	2.2539	79.4413

Note:
This table presents the percentage of variation in the forecast errors of Equity Flows due to variations in each factor within the Structural VAR system after 2, 10 and 20 quarters.

5. Conclusion

This paper investigates the global and domestic determinants of portfolio flows to EMEs over the past three decades. Using a SVAR model, the paper identifies global effects proxied by the VIX and the Fed balance sheet to explain a substantial amount in the dynamics of these flows. Furthermore, there is contrasting evidence related to the impacts which these global shocks have had across the three regions investigated in this study. Even though limited evidence is shown to support the case for the domestic productivity factor in driving flows throughout these EMEs, investors should take some encouragement from the impact which shocks to the interest rate differential have had within the system. The main implications of these findings are that investors face limited opportunities to diversify contagion effects away (through increased exposure in domestic-driven EMEs), as well as an uncertain path ahead for policymakers in stabilising these flows.

The future trajectory of monetary policy carried out by the Fed, in conjunction to the implications thereof on financial market uncertainty, have been subject to intense scrutiny in recent years. At the beginning of 2019, the Fed emphasized their plans for the policy rate to remain unchanged, despite initial signs of an economic slowdown largely fuelled by the Trump Administration's protectionist strategies. However, the brief inversion in the US yield curve as these trade tensions escalated throughout the year forced the Fed to cut its policy rate for the first time since 2008, as well as re-kickstarting the expansion of their balance sheet (Lane, 2019). Despite the sentiments echoed by the Fed in highlighting this latest asset purchase program to be a mere mid-cycle adjustment as opposed to a response in the growing signs of a US recession, policymakers in EMEs will undoubtebly be paying close attention to developments in reserve balances held by the Fed as a forecast measure for investment flows.

In responding to emerging market investment volatility, EME policymakers face an enormous challenge to addressing these instabilities through the use of macro-prudential tools. These challenges are magnified by the current economic landscape characterised by the significance in the VIX and unconventional monetary policy measures, which are beyond their control. These spillover effects have not only contributed to the volatility in these flows, but also a shift in sentiment related to capital controls. Historically, the IMF have debated the use of capital controls by emerging market policymakers. In recent years, they have voiced their support for the use of these macro-prudential measures in major emerging markets such as Brazil and India (Erduman & Kaya, 2016). The implications of capital controls fall beyond the scope of this paper, though it presents an interesting prospect for future research.

Even though this paper focused extensively on contagion effects from AEs, this framework did not account for intra-regional spillover effects which possibly exist. In rationalising this, shocks to the equity market in Brazil are bound to have an impact in Argentina given the strong ties between the two economies. Therefore, it is plausible that some of the underlying mechanisms created by intra-regional spillovers have been ignored here. This presents a further opportunity to extend this research in the future.

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7. Appendix

Table 7.1: List of Countries

Variable	Code
Latin America	
Argentina	ARG
Brazil	BRA
Chile	CHI
South East Asia	
Indonesia	IDO
South Korea	KOR
Philippines	PHP
Thailand	THA
Sub Saharan Africa	
South Africa	SA
Global	
United States	US

Table 7.2: List of Variables

Variable	Code	Shock
Global Factors		
Federal Reserve Balance Sheet	Fed	Shock 1
US Real GDP Growth	US_GDP	Shock 2
CBOE VIX	VIX	Shock 3
Domestic Factors		
Interest Rate Differential	Interest_Differential	Shock 4
Domestic Real GDP Growth	Domestic_GDP	Shock 5
Capital Flows		
Bond Portfolio Flows	Debt_Flows	Shock 6*
Equity Portfolio Flows	Equity_Flows	Shock 6*

The variables within the SVAR are required to be stationary in levels or first differences. The results for the unit root tests are presented in table 7.3 for Latin America and South Africa, with South East Asia and Global region tests appearing in table 7.4. Augmented Dickey Fuller and Phillips-Perron tests are used in identifying whether a series contains a unit root. The Phillips-Perron test results hold merit on the premise that this test is non-parametric and robust against particular forms of structural breaks (Phillips and Perron 1988).

To undertand the structure of these tests, the null hypothesis of both tests implies the presence of a unit root. Therefore, the null hypotheses in both tests are required to be rejected for a series to be considered stationary.[12] The Fed Balance sheet, US Real GDP growth, the VIX, Brazil debt and equity flows and the South African interest rate differential were all I(1) at a 5% significance level for the ADF test, and needed to be differenced to be stationary. The remaining debt and equity flows were I(0) across the sample period, therefore enabling the model to retain all the variation in these series through avoiding differencing them.

Table 7.3: Unit Root Test Results - Latin America and Sub Saharan Africa

	ADF		**PP**	
Variables	**Level**	**1st Diff**	**Level**	**1st Diff**
Argentina				
Argentina Debt Flows	-5.1971	-	-8.9746	-
Argentina Equity Flows	-6.4197	-	-9.3232	-
Argentina Interest Rate Differential	-2.1273	-	-12.1862	-
Argentina Real GDP Growth	-7.1276	-	-15.786	-
Brazil				
Brazil Debt Flows	-1.8775	-12.7989	-5.9782	-
Brazil Equity Flows	-2.1253	-13.1002	-6.6983	-
Brazil Interest Rate Differential	-4.7509	-	-4.5561	-
Brazil Real GDP Growth	-9.1358	-	-10.3081	-
Chile				
Chile Debt Flows	-4.2499	-	-8.6435	-
Chile Equity Flows	-3.9552	-	-6.127	-
Chile Interest Rate Differential	-2.628	-	-2.9643	-
Chile Real GDP Growth	-7.6052	-	-10.817	-
South Africa				

[12] A null hypothesis is rejected when a calculated test statistic is greater than the critical value at a significance level in absolute value.

South Africa Debt Flows	-5.544	-	-7.97	-
South Africa Equity Flows	-3.6455	-	-5.8889	-
South Africa Interest Rate Differential	-1.4311	-6.9302	-2.8836	-
South Africa Real GDP Growth	-4.6255	-	-11.188	-

Note:
This table presents the results from the Augmented Dickey Fuller (ADF) and Phillips Perron (PP) unit root tests. The critical values for the ADF test -2.58, -1.95 and -1.62 at the 1, 5 and 10% significance levels. The critical values for the PP test at these abovementioned significance levels are -3.49, -2.89 and -2.58

Table 7.4: Unit Root Test Results - South East Asia and Global

	ADF		**PP**	
Variables	**Level**	**1st Diff**	**Level**	**1st Diff**
Indonesia				
Indonesia Debt Flows	-4.1619	-	-7.2617	-
Indonesia Equity Flows	-5.6615	-	-6.035	-
Indonesia Interest Rate Differential	-2.6547	-	-3.6571	-
Indonesia Real GDP Growth	-6.4181	-	-11.3325	-
Korea				
Korea Debt Flows	-2.2502	-	-4.5986	-
Korea Equity Flows	-3.0145	-	-4.5149	-
Korea Interest Rate Differential	-2.5774	-	-1.9228	-7.7227
Korea Real GDP Growth	-8.3612	-	-19.4535	-
Philippines				
Philippines Debt Flows	-4.3754	-	-7.6455	-
Philippines Equity Flows	-5.7745	-	-5.8662	-
Philippines Interest Rate Differential	-2.0605	-	-3.5056	-
Philippines Real GDP Growth	-9.4274	-	-43.9147	-
Thailand				
Thailand Debt Flows	-3.6402	-	-8.8113	-
Thailand Equity Flows	-4.7827	-	-7.7444	-
Thailand Interest Rate Differential	-3.5142	-	-3.6121	-
Thailand Real GDP Growth	-11.9959	-	-11.7015	-
Global				
Fed Balance Sheet	-1.7662	-9.7281	-4.7228	-
US Real GDP Growth	-1.5869	-11.9063	-8.9552	-
VIX	-1.1317	-11.2402	-5.3335	-

Note:
This table presents the results from the Augmented Dickey Fuller (ADF) and Phillips Perron (PP) unit root tests. The critical values for the ADF test -2.58, -1.95 and -1.62 at the 1, 5 and 10% significance levels. The critical values for the PP test at these abovementioned significance levels are -3.49, -2.89 and -2.58