THE INFLUENCE OF INTERNATIONAL CAPITAL FLOWS ON ASSET PRICING AND DOMESTIC STOCK RETURNS

SUBMITTED FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Boubekeur Baba

Eskişehir, 2019

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ABSTRACT
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International capital flows have often been regarded as one of the drivers of the boom and bust episodes in asset prices especially in emerging markets. In this context, the thesis in hand aims to investigate the impact of international capital flows on asset prices, particularly stocks and house prices, in a number of emerging market economies. Firstly, we analyze the dynamic changes of stock prices throughout the cycles of foreign capital flows i.e. surge episodes, outflow episodes, and the episodes of moderate inflows. To this end, we employ a two-step analyses consist of identifying the episodes of capital inflows and the detection of stock index changepoints during these episodes. The changepoints of the stock price index are estimated using the Pruned Exact Linear Time (PELT) method, while the threshold and clustering approaches are used to identify the episodes of capital flows. The results suggest that stock prices have mostly appreciated during the episodes of moderate capital inflows. On the other hand, the stock price indexes of the selected emerging markets have not remarkably appreciated during the surge of foreign capital inflows. The empirical analysis, indeed, documents very few positive changepoints during the surge episodes of foreign capital inflows. Conversely, price depreciations are occasionally noticed during the episodes of capital outflows. In fact, the stock prices have seen many upward changes despite the reversals of foreign capital flows.

Secondly, the time-varying dynamics between US equity flows and stock returns are investigated using the time-varying parameter VAR (TVP-VAR) with stochastic volatility. The empirical estimations are based on monthly data of stock returns and US equity flows

from three Pacific Asian emerging economies, namely Indonesia, South Korea, and Thailand. The impulse response functions of the TVP-VAR model show a temporary impact of US equity flows on stock returns. The results also indicate that US equity investors have consistently followed feedback trading strategies throughout the sample periods. The US equity flows show a weak forecast ability to stock returns over most of the sample period.

Finally, the impact of foreign capital inflows on house prices during the housing boom episodes is studied using the time-varying parameter linear regression model. The empirical model was estimated using data from three emerging markets namely South Africa, South Korea, and Thailand. Consistent with the previous studies, the foreign capital inflows show a strong impact on house prices during the housing boom episodes in South Africa and South Korea. In contrast, house prices have not been significantly affected by foreign capital inflows in Thailand.

Keywords: International capital flows, asset pricing, change points detection, TVP-VAR, TVP linear regression.

ÖZET
Doktora Tezi

ULUSLARARASI SERMAYE AKIMLARININ

VARLIK FİYATLAMASI VE PAY SENEDİ GETİRİLERİ ÜZERİNDEKİ ETKİSİ

Boubekeur Baba

İşletme Anabilim Dalı

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Anadolu Universitesi, Sosyal Bilimler Enstitüsü, Kasım 2019

Danışman: Prof. Dr. Güven SEVİL

Uluslararası sermaye akımları, özellikle gelişmekte olan piyasalarda varlık fiyatlarındaki patlama ve yükseliş dönemlerinin itici güçlerinden biri olarak görülmektedir. Bu bağlamda, bu çalışma gelişmekte olan piyasa ekonomilerinde uluslararası sermaye akışlarının varlık fiyatları, özellikle hisse senetleri ve konut fiyatları üzerindeki etkisini araştırmayı amaçlamaktadır. Tezin birinci amacı, yabancı sermaye akışlarının döngüleri boyunca hisse senedi fiyatlarının dinamik değişikliklerini analiz etmektir. Bu amaçla, iki aşamalı bir analiz kullanılarak yabancı sermaye akışlarının döngüleri belirlenmiş ve hisse senedi endeksi değişim noktaları tespit edilmeye çalışılmıştır. Hisse senedi fiyat endeksinin değişim noktaları, "Pruned Exact Linear Time" (PELT) yöntemi kullanılarak tahmin edilmiştir. Sermaye akışlarının döngülerini tanımlamak için eşik ve kümeleme analizleri kullanılmıştır. Sonuçta, hisse senedi fiyatlarının orta sermaye akışları sırasında sık sık yükseldiğini göstermektedir. Öte yandan, hisse senedi endeksleri yabancı sermaye girişlerinin artması sırasında değer olarak yükselmemiştir. Yüksek yabancı sermaye akış dönemlerinde olumlu çok az hisse senedi endekslerinin değişim noktaları bulunmuştur. Tersine, yabancı sermaye çıkışı sırasında hisse senedi fiyatları çok sıklıkta değer kaybetmemiştir. Nitekim, yabancı sermaye akımları tersine çevrilmesine rağmen hisse senedi fiyatları yukarı yönlü değişiklik göstermiştir.

İkinci olarak, ABD hisse senedi yatırımları ve hisse senedi getirileri arasındaki zaman değişen dinamikleri, "Time-varying Vector Autoregressive (TVP-VAR) yöntemi

kullanılarak araştırılmaktadır. Ampirik analizler, Endonezya, Güney Kore ve Tayland olmak üzere üç Asya Pasifik gelişmekte olan ekonomisinden aylık hisse senedi getirileri ve ABD hisse senedi akışları kullanılarak gerçekleştirilmiştir. Etki-tepki işlevi sonuçları ABD hisse senedi akışlarının hisse senedi getirileri üzerinde geçici bir etkisi olduğunu göstermektedir. Sonuçlar ayrıca, ABD hisse senedi yatırımcılarının sürekli olarak geri etki ticareti stratejilerini takip ettiklerini göstermektedir.

Son olarak, konut patlaması dönemlerinde yabancı sermaye akışlarının konut fiyatları üzerindeki etkisi değişen katsayılı regresyon modeli kullanılarak incelenmiştir. Ampirik model, Güney Afrika, Güney Kore ve Tayland olmak üzere üç gelişmekte olan piyasadan elde edilen veriler kullanılarak tahmin edilmiştir. Önceki çalışmalar ile tutarlı, konut fiyatları üzerinde yabancı sermaye akışlarının etkisi Güney Afrika ve Güney Kore'de konut balonun dönemler sırasında güçlü olduğu bulunmuştur. Tayland'da ise, sermaye akışlarının etkisinin konut balonu dönemleri sırasında nispeten zayıf olduğu görülmüştür.

Anahtar Kelimeler: Uluslararası sermaye akımları, Varlık fiyatlandırması, Değişim noktaları tespiti, TVP-VAR, TVP regresyon modeli.

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I dedicate this work to my family, relatives and friends in Algeria.

..../11/2019

STATEMENT OF COMPLIANCE WITH ETHICAL PRINCIPLES AND RULES

I hereby truthfully declare that this thesis is an original work prepared by me; that I have behaved in accordance with the scientific ethical principles and rules throughout the stages of preparation, data collection, analysis and presentation of my work; that I have cited the sources of all the data and information that could be obtained within the scope of this study, and included these sources in the references section; and that this study has been scanned for plagiarism with "scientific plagiarism detection program" used by Anadolu University, and that "it does not have any plagiarism" whatsoever. I also declare that, if a case contrary to my declaration is detected in my work at any time, I hereby express my consent to all the ethical and legal consequences that are involved.

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(Signature)
Boubekeur Baba

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ABBREVIATIONS

EME	Emerging Market Economies
CPI	Consumer Price Index
FCI	Foreign Gross Capital Inflows
FDI	Foreign Direct Inflows
FII	Foreign Institutional Investors
FPI	Foreign Portfolio Flows
FLS	Flexible Least Squares
HP	Hodrick-Prescott
HPI	House Price Index
HPG	House Price Growth
OFI	Other Foreign Investments
PELT	Pruned Exact Linear Time
TVP	Time Varying Parameter
TVP-VAR	Time Varying Parameter Vector Autoregressive
VAR	Vector Autoregressive

INTRODUCTION

The international capital flows are of particular importance to policymakers and international investors. Therefore, a large segment of literature has explored this topic with special focus on the determinants and the impacts of the foreign capital inflows on the recipient countries. Theoretically, the international capital flows are supposed to stimulate economic growth through its impact on capital stock, and also spurring sectoral development by bringing new technology, skills, and competition to the local markets. However, the effects of international capital inflows were debated by the scholars since the mid of the last century, the early studies on FDI and spillovers on the host economies which mostly belong to dependency theorists such as Singer (1950), Prebisch (1968), and Bos et al. (1974) claimed that FDI from developed to developing countries is harmful to the economic growth in the long term. Even the UNCTAD paper of 1999 supported this argument revealing that multinational corporations were involved in exploitation of local natural resources. On the other hand, studies such as Hein (1992) and Firebaugh (1998) found that FDI promotes economic growth in short and long term.

The international capital inflows consist of three major components: foreign direct investment (FDI), foreign portfolio investment (FPI), and debt. The FDI was the dominating topic in international finance until the 1990s. However, with the rise of globalization and financial integration in the emerging markets in the last two decades, the share of FPI in the international capital flows rapidly increased and became another key concern in the international financial policy. The FPI share has also increased due to the financial liberalization and the openness of emerging markets to foreign investors. The developments of emerging financial markets have also been one of the pulling factors of short-term foreign capital flows. Another factor contributed to the rise of share of FPI is the growing role of institutional investors especially after the global financial crisis. The emerging markets of all other regions have been constantly linked to the international capital flows in many studies. The historical link between the emerging markets and international capital inflows goes back to the Brady Plan that involved converting the Latin American countries' debt to dollar-denominated bonds in the late 1980s. Since then, the international capital investments have been increasingly flowing into emerging market economies primarily in form of FDI, merely

because it is considered as a safe source of external financing and a stabilizing factor to the financial system in the host economies.

Recently, there has been a resurgence in the literature of international capital flows following the surge of capital inflows to emerging markets after the global financial crisis. As a result, the literature on this topic progressed significantly bringing attention to new aspects of the implications of international capital inflows. Some recent studies have explored the response of asset prices relative to the components of the international capital flows. Other studies, inspired by the seminal works of Calvo (1998), Reinhart (2009) and Forbes and Warnock (2012), have focused on the cycles of international capital flows and its determinants. Within this framework, the thesis in hand examines the impact of international capital flows on asset prices, particularly stocks and house prices, in a number of emerging market economies.

The international capital flows to emerging markets have gone through several boom-bust cycles over the last decades. Throughout these cycles, asset prices in emerging markets have been driven away from the fundamentals as the international capital flows were booming. However, asset prices would also experience severe depreciation during the periods of capital reversal. In the light of these ramifications, the first chapter investigates the behaviors of stock prices throughout the cycles of capital flows using data of daily stock prices and quarterly foreign capital flows in 15 emerging market economies. The empirical investigations of the first chapter are carried out as follows: First, stock index changepoints are detected using the Pruned Exact Linear Time (PELT) method. Next, episodes of capital flows are identified using the threshold and k-means clustering approaches. Finally, the results from the previous steps are combined by distributing the detected changepoints over the identified capital flows.

The second chapter investigates the time-varying dynamics between foreign equity flows and the stock returns. The international capital flows are typically known to be procyclical as suggested in many studies. Therefore, the impact on asset prices is likely to be time-varying and differ in accordance with the experienced cycle. In regard to stock markets, the behaviors of foreign investors can be dictated by the cyclical changes of capital flows,

which might, in turn, affect the stock returns. Theoretically, several competing hypotheses have been put forth to explain the impact of foreign investors on stock returns such as the feedback trading hypothesis, the base-broadening hypothesis of Merton (1987) and the price pressure hypothesis. These hypotheses have been subjected to rigorous empirical testing using different identification schemes through structural VAR models. However, the extant literature, in this context, analyses the relationship between foreign equity flows and stock returns using time-invariant versions of structural VAR models. Assuming time-invariant dynamics between international equity flows and equity returns might be unrealistic and empirically too restrictive to the parameters of the VAR model. Therefore, the second chapter employs the time-varying parameter VAR model with stochastic volatility developed by Nakajima (2011) to uncover the time-varying dynamics between foreign equity flows and stock returns.

The third chapter of the thesis follows the same specifications as chapter two but with the focus on house prices. Similar to the case of stock prices, many studies have questioned the role of international capital flows in the boom of the house prices in the emerging market economies. Particularly, after the last global recession which followed the collapse of the housing market in US, many researchers have begun to study the impact of international capital flows on house prices with special focus on the housing boom periods. Some studies such as Olaberría (2014) and Jara and Olaberría (2013) have used data-censoring technique to single out the periods of asset and housing booms. In the third chapter, the impact of foreign capital flows during the housing boom episodes is investigated by applying the time-varying parameter linear regression model.

1. THE BEHAVIOR OF STOCK MARKET PRICES THROUGHOUT THE EPISODES OF CAPITAL INFLOWS

1.1. Introduction

Over the past two decades, international capital inflows to emerging market economies (EMEs henceforth) have been characterized by remarkable fluctuations. The first wave of capital flows to EMEs observed after the oil crisis of 1973 and ended after nearly a decade with the breakout of debt crisis in 1982. The surge of capital flows in this period was primarily driven by syndicated international loans extended to borrowers in EMEs. Most of these loans were unhedged leaving the borrowers with large exposures to interest rate and exchange rate movements. In the period of 1990-96, EMEs had another turn-up of net private capital flows[1]. This turn-up, however, was interrupted by a succession of crises started with Mexican currency crisis in 1995, then hit East Asian countries in 1997-1998, Russia in 1998, Brazil 1999, Argentina and Turkey in 2001. Before the crises, the capital flows to Emerging Asia had historical peak at about 6.75 percent of aggregate regional GDP. The determinants of the surge in net private capital flows were similar to the previous episode. The lending to EMEs rebounded after Latin America showed signs of recovery from the lost decade of 1980s, this development was coincided with the booming growth rates of East Asian countries. Perrault (2002) and King (2001) argue that excessive capital flows were instrumental in sowing the seeds of the economy's vulnerability to the Asian financial crisis[2]. Milesi-Ferretti and Tille (2011) show that international capital inflows during the period 1988-1998 have been dominated by hot money and therefore were prone to reversals. The following boom of capital flows to EMEs occurred at the beginning of the 2000s, but in relatively smaller sums compared to the previous period, the gross and net capital flows have been on a strong upward trend growing almost six folds in the first five years since 2000. In 2006, net capital inflows to Emerging Asia were about 2 percent of GDP and the gross capital

[1] Net private capital flows are defined as the sum of net foreign direct investment, net portfolio, net derivative, and net other investment flows, excluding other investment flows to the general government and monetary authorities.

[2] According to Perrault (2002) the capital flows to EME's in the 1990s led to real estate bubbles in some countries, overvalued real exchange rates, and inflated financial-asset prices in most of the region, thereby sowing the seeds for the Asian crisis in 1997. King (2001) argues that the lending by Japanese banks to Asian debtors created asset-price bubbles in Thailand, and possibly in other countries, that eventually burst and sparked the Asian crisis.

inflows have grown to levels close to their historical highs since the dramatic fall during 1997-1998. On the other hand, gross capital outflows have increased rapidly exceeding historical levels, thus resulting in lower net capital inflows. China and India, however, continued to receive net capital inflows. For the same period, net capital flows to Latin America were down four percent from previous highs in the pre-Mexican crisis period, gross capital inflows have been fairly stable and remained unchanged because the purchases of the new claims by the non-residents were offset by the repayment of public external debt. Gross capital outflows in Latin America have been also on the rise as in Asia, but shortly after that, the trend shifted downward in few countries of the region, particularly Brazil has experienced large capital inflows in the first half of 2007.

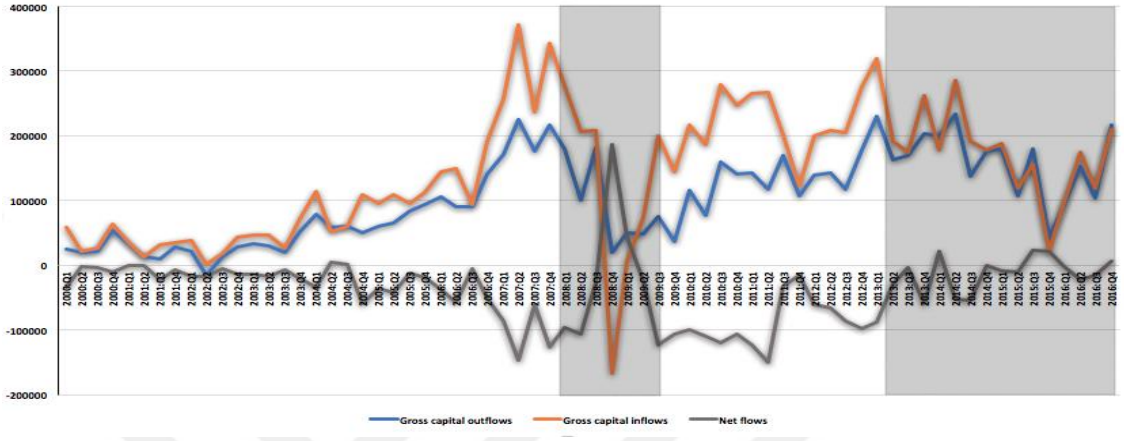
The remarkable surge in gross capital flows that started in the early 2000s again ended abruptly with the global financial crisis (GFC) in 2008. The GFC induced heavy selling of foreign assets worldwide. The global capital flows which had been steadily increasing over the previous decade by growing from 7 percent of global GDP in 1998 to over 20 percent in 2007, turned sharply negative later in 2008. The gross inflows to EMEs dropped precipitously and the net inflows experienced sharp fluctuations during the GFC. Meanwhile, the United States Federal Reserve (Fed) embarked on a monetary easing by reducing interest rates to near-zero level, against this backdrop, the gross inflows picked up substantially in mid-2009. The turn-up of capital inflows shortly after the GFC was driven by the widening of interest rates and the growth prospect differentials between the Advanced Economies (AEs) and the EMEs during that period. The ratcheting capital inflows reduced significantly in following five years affected by the slowdown of growth rates in EMEs, coupled with sharp decline in commodity prices and high political turbulence in some countries. Bems and Catao (2016) document that the slowdown of capital inflows to EMEs during 2010-2015 was as large as in 1995-2000. The last turnaround of capital flows in EMEs was triggered by the US Fed's announcement on tapering its monetary easing policy in May 2013. This event which has come to be known as "the Taper Tantrum" caused large waves of gross outflows in EMEs amounted at 150$ billion of equity investments. Although the US long rates rose only by almost one basis point between May and August 2013, it already had a significant effect on countries such as Brazil, India, Indonesia, South Africa, and Turkey.

Overall, the development of international capital flows since 2000, which is the focus of this research, can be divided into four periods. Fig. 1 highlights the gross inflows and outflows as well as the net flows for EMEs from 2000 through 2016. The first is the period leading up to the GFC between 2000-2007. The second is the period of emergence of sub-prime crisis in the US and the following turbulent period (2007-2009). Then comes the period of US monetary easing and slow growth rates in Advanced Economies (2009-2013) and finally the period since 2013 when the US Fed was rumored to end its quantitative easing policies.

Throughout these cycles of capital flows, EMEs have experienced various implications. During the boom of international capital inflows, the economic growth in EMEs was significantly stimulated and the stock market capitalization substantially increased. However, there have been also serious concerns that the foreign capital inflows might have increased the fluctuations of stock prices in EMEs. Even though this has not been consistently found to be the case in the literature, the fact remains that capital flows into EME have coincided with a wide appreciation of stock prices in EMEs. Kim and Yang (2011) observe a 50% increase in the stock indexes of most emerging Asian economies during the boom of foreign capital inflows from 2000 to 2007. The Bank of International Settlements (BIS) in a report from 2009 stated that the international equity prices were correlated with all three types of capital flows. Equity prices of EMEs particularly have sharply increased during the global economic upswing since 2004. On the other hand, as seen during the GFC and the taper tantrum periods, this upward trend quickly turns down in the event of foreign capital outflows. Many empirical studies on this subject have been primarily concerned with the change of stock returns volatility before and after the market liberalization events in EMEs. For instance, Levine and Zervos (1998) estimate the structural breaks in stock returns around the dates of financial liberalizations in 16 EMEs. Similar to Levine and Zervos (1998), this study adopts an indirect approach in which the episodes of foreign capital flows are identified for a number of EMEs. Then, the changepoints of the stock indices are estimated and designated to the corresponding episode of capital inflows.

The rest of the chapter is structured as follows, section two briefly discusses the literature of capital flow episodes, section three reviews the literature on the impact foreign capital

flows on emerging stock markets, section four specifies the empirical methodology. Finally, section five analyses the empirical results.



Notes: The selected EMEs are: Argentina, Brazil, Chile, Colombia. Czech Republic, Hungary, India, Indonesia, Malaysia, Mexico, North Korea, Philippine, Poland, Romania, Russia, Singapore, South Africa, Thailand, Turkey.

Figure 1.1. *Net and gross capital flows for selected EMEs.*

1.2. Measuring extreme capital flows

Extreme movements of capital flows such as surges also known as "bonanzas", sudden stops and capital flight have been extensively studied in the literature. The origin of this literature can be traced to the first study on sudden stops by Calvo (1998)[3]. Prior to Calvo (1998) researchers, particularly in the 1980s, were interested in capital flights (see e.g., Cuddington, 1986; Lessard & Williamson 1987; Dooley 1988). Reinhart and Reinhart (2009) reversed Calvo's sudden stop measure by analyzing capital flow "bonanza" or "surge" defined as sharp increase in net capital inflows. The studies of capital flow volatility were often concerned with either the slowdown or the surge of capital flows, but recent studies have shown growing interests in analyzing both upward and downward trend of capital flows[4]. Another interesting comparison is the approach and the criteria used to identify the surges and the sudden stops of capital flows, especially regarding surge episodes in which a

[3] Calvo (1998) defined sudden stops as sharp slowdown in net capital inflows, later Calvo et al. (2004) and Calvo et al. (2008) broadened the definition by establishing stylized facts such as the concurrence of sudden stop with output contraction and sharp rise in interest rate spreads.

[4] Forbes and Warnock (2012) identify episodes of "surge", "sudden stop", "flight" and "retrenchment" in the gross inflows and outflows of 58 countries, Forbes (2012) follows Forbes & Warnock's methodology focusing on Asia, Yeşin (2015) also applies Forbes and Warnock's terminology to analyse waves of capital flows to and from Switzerland, Schmidt & Zwick (2015) analyse the link between uncertainty and episodes of extreme capital flows, Agosin and Ituaita (2012) use the surges in capital flows to predict future sudden stop episodes.

number of empirical studies use substantially varying methods[5]. Besides the varying criteria and approaches, the literature dealing with extreme capital flows use different inputs, some studies focus on analyzing net capital flows. For instance, Calvo (1998) and Calvo et al. (2004) use net capital flows to gauge sudden stop episodes, Fecuri et al. (2011), Carderelli et al. (2010) and Mendoza and Terroness (2008) also determine the episodes of large capital inflows and sudden stops based on the deviations of net capital flows. In contrast with these studies, Broner et al. (2013); Forbes and Warnock (2012); Rothenberg and Warnock (2011) focus on the behavior of the gross capital flows[6]. According to Forbes and Warnock (2012) the net capital flows, which is the sum of gross inflows and outflows, cannot distinguish the capital movements initiated by foreigners and domestic investors. The differentiation between gross inflows and gross outflows is important because foreign and domestic investors can be motivated by different factors and respond differently to various policies and shocks. Moreover, policy responses to capital flows differ based on whether the extreme capital flow movements are driven by domestic or foreign investors. As a result, net-flows based analysis would miss the dramatic changes that have occurred over the past decade. Forbes and Warnock (2014) further emphasize on using the gross flows stating that the net-flows based analyses, which often ignore the outflows of domestic investors, could misdiagnose the changes in capital flows as being driven by changes in foreign flows. Another reason to use gross flows instead of net flows according to Forbes and Warnock (2014) is that gross flows have been more volatile and grew larger while net flows remained stable over the past years[7]. On the other hand, although Ghosh et al. (2014) did not dismiss the importance of distinguishing between the gross flows of assets and liabilities, they argue that the net capital flows in the case of EMEs still largely reflect the changes in external

[5] Crystallin (2015) finds substantial differences in the number of surge episodes identified by seven different methods.

[6] In the literature, the term of gross inflows refers to net foreign purchases of domestic assets, whereas the term of gross outflows refers to the net purchases of foreign assets by domestic investors.

[7] Other studies that have stressed on the importance of distinguishing the association that global and domestic factors have with gross capital flows, from the association they have with net capital flows (see e.g; Rey, 2013; Calderon and Kubota, 2013; Broner et al., 2013).

liabilities[8]. Therefore, they relied on net-flows based analysis to identify surges in capital flows and found that over two-thirds of surges in capital flows to EMEs are driven by increase in residents' liabilities rather than by a decline in their foreign assets.

1.3. Foreign capital flows and the stock market

The relaxation of capital controls to attract foreign capital flows has been an integral part of the development strategy of many EMEs. In this respect, substantial studies have discussed the developments attained by EMEs in terms of economic growth, industrial sector and firms' profitability in the post-liberalization period (e.g. Errunza, 2001; Chari & Henry, 2004; Bekaert et al., 2005; Mitton, 2006; Gupta & Yuan, 2009; O'Connor, 2013). However, since the tumultuous events in EMEs such as the Mexican, the Russian and the Asian crises, the short-term capital inflows have become frequently linked to destabilization effects. Errunza (2001) states that the resulting large portfolio equity flows after stock market liberalization have been held as the primary culprit in precipitating the Asian crisis. Of particular relevance to the destabilization effects is the potentials of capital inflows to increase the stock market volatility. Predominantly, the large foreign purchases of local equities are highly likely to drive the stock prices up and away from the fundamentals, while a sell-off by foreign investors can cause the stock prices to plunge sharply.

In the literature, the empirical analysis of the impact of capital flows on the stock market volatility is carried out in several ways. Some of the early studies such as Bekaert and Harvey (1997), DeSantis and Imrohoroglu (1997) and Levine and Servos (1998) examine the effects of capital inflows on stock volatility by considering the event of equity market liberalization. Other studies do not include the events of stock market openness, but rather directly deal with the actual involvement of foreign investors in the stock markets (e.g. Umutlu et al., 2013). In addition, the empirical evidence presented by these studies appears to be inconclusive. With different empirical models and data samples being employed, these studies show that the emerging market volatility can either increase, decrease or remain unchanged over the post-liberalization period.

[8] A study by Pagliari and Hannan (2017) on the volatility of capital flows to AEs and EMEs confirms this assumption. The study finds that the gross outflows tend to dampen the effect of gross inflows on net flows in AEs but not in EMEs, meaning that net flows of EMEs are more related to gross inflows than gross outflows.

Levine and Zervos (1998) study the developments of market size, liquidity, and volatility following capital control liberalization in 16 emerging market economies. To this end, Levine and Zervos select the adjusted 12-month rolling standard deviation of return as volatility measure. Then, the Perron test is applied to identify the structural breaks in stock returns around the event dates of major policy changes involving portfolio flows. Their empirical evidence suggests that the stock markets tend to be larger, more liquid, and more volatile after the relaxation of restrictions on international portfolio flows. Similarly, Nguyen and Bellalah (2008) examine the dynamic changes in the volatility of seven emerging markets around stock market liberalization dates. Unlike previous studies, Nguyen and Bellalah employ bivariate GARCH-M model to measure the stock market volatility. The authors then apply the Bai and Perron stability test on their estimates of conditional volatilities to associate the breaks in stock market volatility with stock market liberalization dates. The empirical results indicate that structural breaks detected in emerging markets volatility rather coincide with alternative events of liberalization instead of the official liberalization dates.

Umutlu and Shackleton (2015) examine the short-run relationship between stock-return volatility and daily equity trading by domestic individual, domestic institutional and foreign investors in the Korean stock exchange. They find that net foreign trading has an increasing impact on volatility though it is not always significant.

Umutlu et al. (2013) investigate the role of foreign equity trading in explaining the total average volatility and its components in the Istanbul stock exchange. Based on the assumption of Piotroski and Roulstone (2004) that the influence of the investors on the market is to a great extent subjected to the information sets that each type of the investors hold, Umutlu et al. decompose the total average volatility into global, local and idiosyncratic components. In doing so, they are able to identify whether the information sets held by foreign investors are at a country-specific or firm-specific level. Their findings suggest that the net equity flow of foreign investors has a positive impact on the total average volatility. This impact also appears to be significant in the case of local and idiosyncratic volatilities.

Bae et al. (2004) use the stock investibility, which indicates the degree to which a stock is accessible to foreigners, to investigate whether volatility changes have ensued stock

market liberalization events in 33 emerging markets. The results show that stocks with higher investibility have higher return volatility.

French and Vishwarkarma (2013) use a parsimonious SVARX-GARCH model and daily equity flows to estimate the relationship between net equity flows and volatility of equity returns in Philippine. They find that the unexpected increases in foreign equity flow significantly increase the conditional volatility of the Filipino stock market.

Tseng and Lai (2014) evaluate the impact of the trading behavior of institutional investors on the realized volatility of the Taiwan Stock Exchange during the subprime mortgage crisis. The findings indicate that the net equity selling by foreign institutional investors, mutual funds and securities dealers caused more volatility in the Taiwan Stock Exchange during the crisis period.

Using both static and dynamic models based on daily data, Dhingra et al. (2016) investigate the interactions of foreign institutional investments with market returns and market volatility in India. To analyze the trading-volatility interactions, Dhingra et al. estimate the volatility of the Indian stock returns using the ARMA-TARCH model. The results of both static and dynamic models suggest that the foreign institutional investors, particularly their selling activities, influence the market volatility. The results also provide evidence that the shock to foreign institutional investments increases the volatility of the Indian capital market.

Applying vector autoregressive (VAR) model, Wang (2007a) explores the impact of foreign ownership and participation on the volatility dynamics of individual stocks in Indonesia. The results show that stock with high foreign holdings have greater volatility and lead other stocks in daily volatility variations.

French and Li (2012) simultaneously examine the long-run dynamics between US equity flows, equity returns, and the volatility of equity returns and commodity prices in Brazil. The results show that unexpected shock to US equity flows increases the volatility of the Brazilian equity market.

Guo and Hwang (2010) utilize a multivariate vector autoregressive (VAR) with Markov regime-switching (MS) feature to investigate the impact of speculative capital inflows on the fluctuations of China's real estate market and the stock market. The results indicate that the speculative capital flows have largely contributed to the price fluctuations in both markets.

Contrary to the above literature, many studies support the proposition that emerging stock markets become less volatile after liberalization. In particular, an early study by Bekaert and Harvey (1997) investigate the stock market volatility of 20 emerging markets using a semi-parametric ARCH (SP-ARCH) model. The findings of this study show that only four countries, out of the 17 countries that relaxed capital control on foreign capital flows, exhibit a slight increase in volatility. In fact, Bekaert and Harvey find that the volatility significantly decreases in emerging markets after controlling the potential influences of asset concentration, stock market development, microstructure effects, and macroeconomic and political risk on the conditional volatility. In the same context, Bekaert and Harvey (2000) study the liberalization effects over a longer period by extending the time series data used in their previous paper. They find that the increase in the volatility of stock returns following capital market liberalizations is small but mostly insignificant. Similar to their findings from the previous paper, the effect of liberalization on the volatility of emerging stock markets is found negative when control variables are taken into account.

Kim and Singal (2000) employ various versions of ARCH/GARCH models to estimate the volatility of stock returns around market liberalization dates in 14 emerging markets. They find that the stock returns increase immediately after capital liberalization without adverse effect on its volatility.

Holmes and Wong (2001) examine the nature and structure of volatility in the stock exchanges of three South-east Asian markets namely Singapore, South Korea, and Taiwan, both before and after the openness of these markets to foreign investors. The results from the asymmetric GARCH model show that liberalization has led to decrease in the volatility of the three stock markets.

Hargis (2002) examines the effect of investment liberalizations on domestic volatility with liberalization dates in Latin America and Asia's emerging stock markets. The author also tests for the effects of other forms of liberalization such as ADRs, country funds, and foreign ownership of the emerging market on indexes. The results show the volatility does not increase but rather decline after liberalization in Latin America's emerging markets. The decline of volatility is also found with the other forms of liberalization. The results for Asia's emerging markets are less clear, but the author concludes that the Asian markets do not experience a significant increase or decrease in volatility after liberalization.

Kassimatis (2002) analyses volatility changes between pre-liberalization and post-liberalization periods in the stock markets of six emerging economies. By employing the EGARCH model to measure volatility, the author finds that the volatility falls after important liberalization policies were implemented.

Wang (2007b) uses daily equity transactions to examine the relationship between foreign participation and emerging stock market volatility in Indonesia and Thailand. The results indicate that the equity trading of foreign investors is negatively associated with the stock market volatility in both countries.

Umutlu et al. (2010) investigate whether the aggregated total volatility of stock returns responds to the degree of financial liberalization in emerging markets. The results show that the aggregated total volatility is negatively responding to the degree of financial liberalization, even after controlling for market development, liquidity, country, and crisis effects.

Li et al. (2011) construct a measure of actual large foreign ownership (LFO) to study the impact of large foreign shareholders on the stock return volatility in 31 emerging markets. Using different analyses of both cross-sectional and cross-time variations, they find a significantly negative relationship between LFO and stock return volatility at the firm level.

Garg and Bodla (2011) analyze the impact of foreign institutional investments (FIIs) on stock market return and volatility in India. Through a comparative analysis of stock return volatility before and after stock market liberalization, they find that volatility of Indian stock market as well as its return decline after opening the stock market for FIIs.

The nexus between capital inflows and stock prices, although anecdotally established in many theoretical works such as Caballero and Kirshnamurthy (2006) and Aoki et al. (2009), has been rarely empirically investigated. Among the few studies that did address the impact of capital flows on stock prices, Kim and Yang (2009) find that the capital inflows have indeed contributed to the increase of stock prices in South Korea. Kim and Yang (2011) extended his previous work to other EMEs in the region but find that capital inflow shocks explain a relatively small portion of asset price fluctuations. Similarly, Tillmann (2013) estimate the impact of capital inflows on asset prices in a set of Asian emerging markets. The findings of this study show that capital inflows have significantly pushed up asset prices.

Ling et al. (2011) also find a significant impact of FDI and hot money on stock prices in China.

1.4. Research Methodology

To investigate the behaviors of stock prices throughout the episodes of capital flows, first, we follow Ghosh et al. (2014) approach to identify extreme capital flows using the threshold and the k-means clustering methods. Then, The Pruned Exact Linear Time (PELT) approach presented by Killick et al. (2012) is applied to the daily stock indices of 15 EMEs to detect the variance changepoints in the index. The data sample of the daily stock indices spans over the period from January 3, 2000 through April 31, 2017. Finally, the results of the measurements of capital flow episodes and the PELT method are together combined by distributing the detected index changepoints over the capital flow episodes identified by the threshold and the clustering approaches.

1.4.1. Changepoint detection

The changepoint detection methods perform a segmentation analysis to obtain intervals in which the time series behaves as approximately stationary. Then uses this information in order to identify the moment of change and determine the pattern in the nonstationary time series. These methods are applied in several disciplines, like neurology, cardiology, speech recognition, finance, and others. In many cases of time series, the statistical properties do not remain the same throughout the series. One of the possible ways to deal with this is to identify a set of changepoints, between which the statistical properties of the series remain constant. A range of different test statistics can be used to identify specific types of changes, such as changes in mean or variance.

To simplify the procedure of setting the changepoints, let us assume we have an ordered sequence of data, $y_{1:n} = (y_1, \dots, y_n)$. The model will have a number of changepoints, m, together with their positions, $\tau = (\tau_1, \dots, \tau_m)$. Each changepoint position is an integer between 1 and $n - 1$ inclusive. The positions are defined as $\tau_0 = 0$ and $\tau_{m+1} = n$, and it is assumed that the changepoints follow an order such that $\tau_i < \tau_j$ if and only if, $i < j$. Consequently, the m changepoints will split the data into $m + 1$ segments, with the ith segment containing $y(\tau_{i-1} + 1): \tau_i$.

1.4.2. Pruned Exact Linear Time (PELT)

This search method was introduced by Killick et al. (2012). A key feature of this method is its ability to balance the competing computational cost and accuracy properties. The PELT method considers the data sequentially and searches the solution space exhaustively. Computational efficiency is achieved by removing solution paths that are known not to lead to optimality. The assumptions and theorems which allow removal of solution paths are further explained in Killick et al. (2012). A key assumption is that of a penalty, C, linear in the number of changepoints m. As such the optimal segmentation is $F(n)$ where,

$$F(n) = \min_{\tau}\left\{\sum_{i=1}^{m+1}\left[C\left(y_{(\tau_i+1):\tau_i}\right) + \beta\right]\right\} \tag{1.1}$$

Conditioning on the last point of change, τ_m and calculating the optimal segmentation of the data up to that changepoint gives,

$$F(n) = \min_{\tau_m}\left\{\min_{\boldsymbol{\tau}|\tau_m}\sum_{i=1}^{m}\left[C\left(y_{(\tau_{i-1}+1):\tau_i}\right) + \beta\right] + C\left(y_{(\tau_m+1):n}\right)\right\} \tag{1.2}$$

This could equally be repeated for the second to last, third to last, . . . changepoints. The recursive nature of this conditioning becomes clearer as one notes that the inner minimization is reminiscent of equation (1.1). In fact, the inner minimization is equal to $F(\tau_m)$ and as such (1.1) can be re-written as

$$F(n) = \min_{\tau_m}\left\{F(\tau_m) + C\left(y_{(\tau_m+1):n}\right)\right\} \tag{1.3}$$

The function starts by calculating $F(1)$ and then recursively calculate $F(2)$, . . .,$F(n)$. At each step, the optimal segmentation is stored up to τ_{m+1}. When $F(n)$ is reached, the optimal segmentation for the entire data has been identified and the number and location of changepoints have been recorded. This procedure can be applied to the mean and the variance of the time series or to both of them simultaneously. However, mean changepoint is highly sensitive. Therefore, this study follows variance changepoint detection.

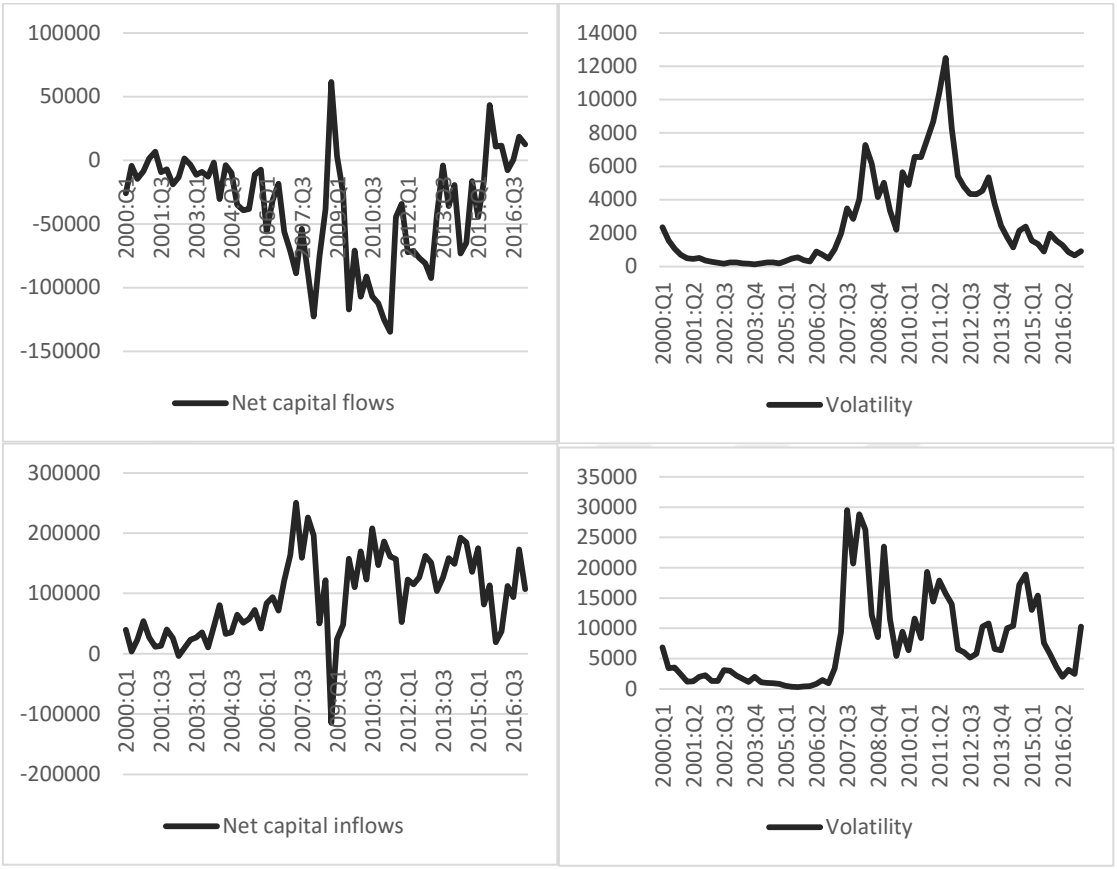
1.5. Analysis of the empirical results

1.5.1. Identifying episodes of extreme capital flows

This section focusses on the analyses of extreme episodes of foreign capital flows in the selected EMEs, the country sample includes 15 EMEs. The period of the study spans over

69 quarters from 2000Q1 to 2017Q1. Data of the net capital flows are collected through two steps: Firstly, data of direct investment, portfolio investment, and other investment flows are obtained from IMF's balance of payment statistics. Secondly the net incurrence of liabilities in each category is subtracted from its net acquisition of assets.

As shown in figure 1.2, clearly the aggregate capital flows of the selected EMEs have been extremely volatile after the GFC. During the year 2007, the drop of capital inflows in some countries such as Brazil, Hungary, Malaysia, Philippine, Singapore, South Africa, South Korea, and Thailand was very steep exceeding a 50% decline from the previous period. The decline of capital inflows in the rest of the countries i.e. Columbia, Indonesia, Romania, and Turkey ranged between 10% and 20% from the previous period. In India and Poland, unlike the other countries, the halts of capital inflows occurred between the second and the last quarter of 2008. Except Hungary and Turkey, capital inflows in most of the selected countries showed signs of recovery in the last two quarters of 2009 and reached its highest level since the GFC in the Q3 of 2010. However, another systemic decline of capital flows to selected EMEs is noticed in the period between 2010 Q3 and 2011 Q3. In the subsequent period, capital inflows continued to slowdown despite its overall slight increase in Q2 of 2014 for most of the countries. Bems and Catao (2016) document this slowdown in 45 EMEs. Their findings indicate that the slow economic growths in these countries played a major part in the slowdown of capital flows. According to Broner and Ventura (2016) the volatility of capital flows is an outcome of the financial globalization in EMEs, which simultaneously has been one of the main drivers of capital inflows and higher investments and growth in the region. The figure 1.2 also exhibits an increase of volatility in net flows around the taper tantrum episode while it decreases in the case of capital inflows. Pagliari and Hannan (2017) observe the same volatility spikes around this period in all the EMEs and the developing economies as well, at least in the case of net flows. However, their sample looked far smoother because of the inclusion of developing countries in their study.



Notes: The volatility calculations are based on the conditional variances of the GARCH (1, 1) model.

Figure 1.2. *Capital flow volatility in selected EMEs.*

The threshold approach is the most commonly used to identify surge episodes in capital inflows. As mentioned in the previous section, measures of surge episodes in capital flows vary considerably in the literature. In studies such as Reinhart and Reinhart (2009), Ghosh et al. (2014) and Qureshi and Sugawara (2018), the thresholds for surges and outflows are determined by dividing the distribution of net flows into percentiles[9]. Cardarelli et al. (2009) and Fecuri et al. (2011) use a smoothing approach based on the Hodrick-Prescott filter. According to this approach, the net inflow observation is coded as surge if it is above the HP-filtered trend by at least one standard deviation[10]. In this study, surge episodes are identified using two methods. In the first method, we apply a threshold approach following

[9] Reinhart and Reinhart (2009) set the cut-off for surges at the top 20th percentile, whereas in Ghosh et al. (2014) the threshold is set at the top 30th percentile.

[10] Balakrishnan et al. (2013) apply criteria combined of both approaches. Firstly, they identify surges as one standard deviation above the HP-filtered trend, then add all the inflow observations that fall in the 75th percentile.

Ghosh et al. (2014) and Qureshi and Sugawara (2018) in which the thresholds are set at the top and the bottom 30th percentile of the distribution of the quarterly net capital flows (in percent of GDP). Net flow observations that fall in the top 30th percentile are coded as surges and those that fall in the bottom 30th percentile are coded as outflows. The remaining observations are considered as normal flows. In the second method, the actual net flows of each country are divided into three groups using a statistical clustering technique known as k-means clustering. The k-means clustering technique classifies observations into a set of k groups (i.e. k clusters) such that the observations within the same group are as similar as possible. The first step is to define the number of groups which in our case is three groups. After defining the number of the groups, the k-means clustering technique selects random means from the data set in which around each mean the within-cluster sum of squared distances are minimized while the between-cluster distances are maximized. In this way, the observations are assigned to their closest mean. This process is iterated until the cluster assignments stop changing or the maximum number of iterations is reached. The k-means clustering technique employs different algorithms but the Hartigan-Wong (1979) algorithm is the most commonly used in this technique (more details available in Appendix A.1). In both approaches, only two and more than two consecutive surge quarters are considered as an episode. In other words, the surge must be continuous to the next quarters and not interrupted by the normal or the outflow observations.

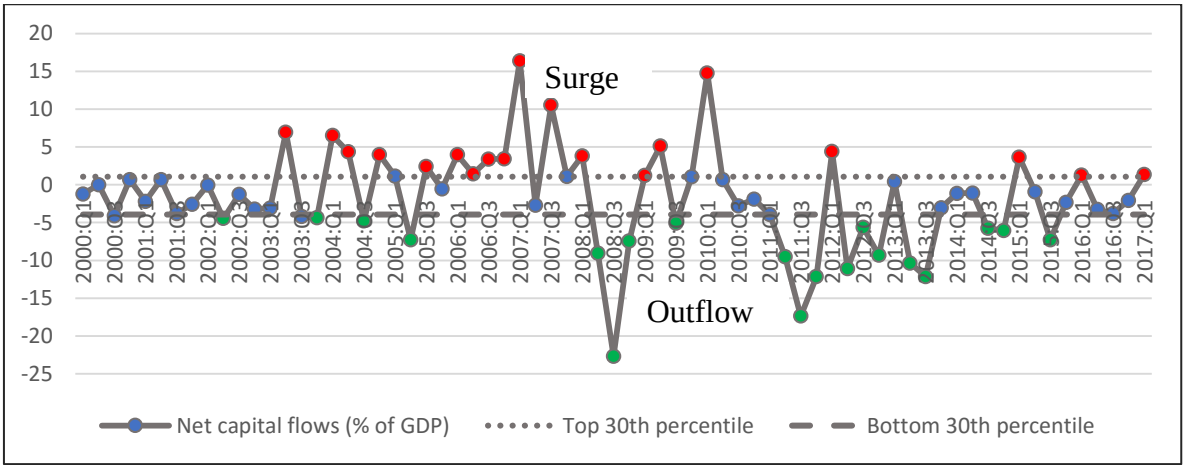


Figure 1.3. *Surges and outflows in Chile's net flows by the threshold approach.*

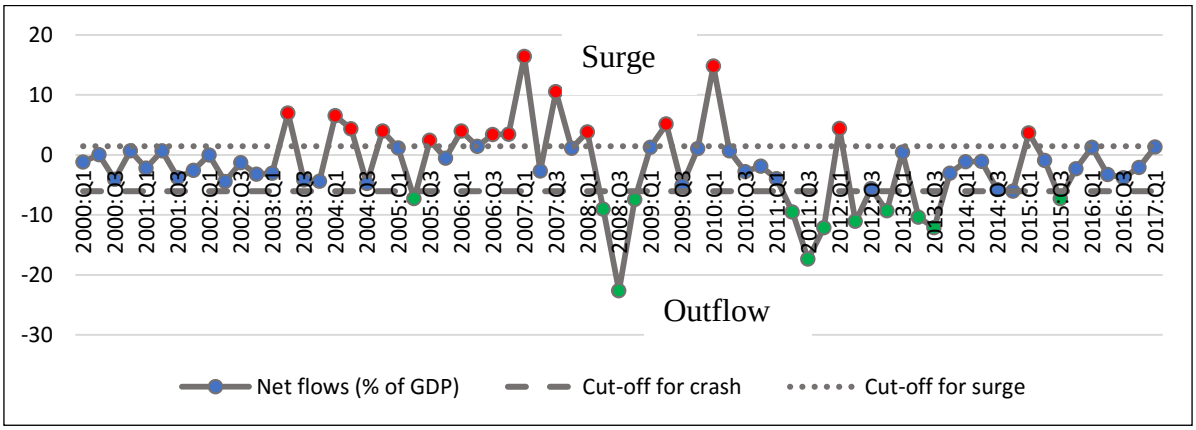


Figure 1.4. *Surges and outflows in Chile's net flows by the clustering approach.*

Under both approaches, the results show that the surge episodes were more persistent before the GFC. Taking Chile as an example as it is shown in figures 1.3 and 1.4, the longest surge episode indicated by the threshold approach took place in the period 2006Q1-2008Q1. This pattern is also noticed in most of the countries except South Korea, Indonesia, India, and Romania. In the clustering approach, however, the longest surge episodes are documented after the GFC in most of the countries. The number of surge episodes yielded by both approaches is slightly different as shown in table 1.1, and the length of episode is not significantly different. The results also show that the number of surge episodes slightly decreased after the GFC. The threshold approach recorded 31 surge episodes before the GFC and 28 episodes after it. On the other hand, the clustering approach captured 32 surge episodes before GFC and 30 episodes after it. The three Latin American countries in the sample namely Brazil, Chile and Columbia experienced most of its surge episodes before the GFC. In fact, the longest outflow episodes in the three countries are seen after the GFC. Surges in South Africa are almost similar to Latin American countries. The opposite is observed in the three European emerging countries i.e. Hungary, Poland and Romania where most of the surge episodes occurred after the GFC. The rest of the countries from emerging Asia have heterogeneous dynamics of capital flows. The capital flows in countries such as South Korea, Singapore and Thailand have become frequently surging after the GFC. In contrast, the surges of capital flows were more frequent before the GFC in India, Indonesia, Philippine, and Turkey. The number and the timing of the identified surge episodes may differ between the two approaches, which is generally the norm in the measuring methods of surge episodes. However, the number of identified surge episodes is not widely different

between the two approaches, except in Chile's case, in which the threshold approach has identified five surge episodes, while only two surge episodes were identified by the clustering approach. In total, the surge episodes span over 238 and 246 quarters as shown by the threshold and the clustering approach respectively. On the other hand, the difference in the outflow episodes identified by both approaches is comparatively remarkable. The outflow episodes identified by calculations of the threshold approach totally spread out on 243 quarters, while the clustering approach shows a total of 170 quarters of outflow episodes. By both approaches, we observe that the outflow episodes have more frequently taken place before the year 2013 in all the 15 emerging markets. Beyond this date, we document less incidence of outflow episodes. In addition, it should be noted that considerable amount of outflow episodes has been seen around the crisis periods (the complete results are reported in appendix A.1).

Table 1.1. *Number of the surge and outflow episodes by country.*

Country	Threshold approach		Clustering approach	
	Number of surge episodes	Number of outflow episodes	Number of surge episodes	Number of outflow episodes
Brazil	4	5	6	3
Chile	5	6	2	3
Columbia	5	3	6	3
Hungary	5	3	4	5
Korea, Rep.	3	9	3	9
Malaysia	4	6	3	5
India	4	6	5	1
Indonesia	5	7	5	1
Philippine	5	4	4	5
Poland	5	3	5	3
Romania	3	4	3	3
Singapore	6	6	4	6
South Africa	4	6	4	4
Thailand	5	3	6	2
Turkey	5	7	5	3
Total	68	78	65	56

1.5.2 Stock index changepoints and capital flows episodes

As shown in tables 1.2 and 1.3, the PELT approach has detected a total of 210 changepoints in the stock indices of the 15 EMEs. The number of changepoints across all the selected emerging countries ranges between 10 and 20 index changepoints. The least changepoints are documented in Chile and Columbia, whereas stock indices in Romania and

Singapore display the largest numbers of index changepoints. We followed the post-changepoint trend to distinguish between the positive and the negative changepoints. After distributing the detected index changepoints over the identified capital flow episodes[11], we noticed that most of index changepoints whether positive or negative occur during the episodes of normal inflows. However, stock indices in Chile and Hungary have displayed most of its changepoints during the capital flow surge episodes. For the other countries, the stock indices are rarely pushed to higher levels during the surge of capital inflows. In fact, in countries such as South Korea and Thailand, the stock indices never showed any response over the entire capital surge episodes. The stock indices in the rest of the countries have barely responded to surges of capital flows. For instance, four surge episodes of foreign capital were identified in Brazil lasting for 16 quarters combined. Yet stock prices picked up only twice during the surge episodes. In some cases, we find one increase in stock prices during the entire surge episodes. Broadly speaking, the stock indices of the selected EMEs have displayed only 26 increases over the 68 surge episodes identified by the threshold approach and have ascended just 22 times over the 65 surge episodes identified by the clustering approach. It is also noticed that even when the foreign investments are at extremely high level, the stock prices have not been held from turning down in many EMEs, meaning that the additional demand created by foreign investors does not necessarily lead to the rise of stock prices. Likewise, on the downside of foreign capital flows, it is found that foreign capital reversals are not often affecting the stock indices in EMEs. Except for Chile's case, stock indices in all the other emerging markets have experienced positive changepoints more than negative ones. Indeed, in some emerging countries such as Hungary, Malaysia, Indonesia, and Thailand, the stock prices were never negatively affected by the outflow of foreign capital. In this respect, Kim and Yang (2011) state that in terms of portfolio investments in debt and equity markets, the direct impact of reversals is less likely to severely affect the economy because asset equity price adjustments will quickly reduce the balance of payments impact of sudden large outflows. Another explanation could be that these

[11] The index changepoints that neither fall under surge episodes nor under outflow episodes were designated to the episodes of normal capital flows. The distribution of index changepoints over the episodes of capital flows is done through the date references to each index changepoints (See appendix 3).

countries are somehow able to fill the void left by the migration of foreign capital with the local investors or possibly through the repatriation of its investments abroad. Additionally, some EMEs have imposed some capital control policies or barriers to the exit of foreign investments, Other EMEs were not largely opened up to hot money in the first place, rendering their markets less vulnerable to foreign capital reversals. Overall, the positive index changepoints have notably overwhelmed the negative ones even during the outflow episodes, particularly the episodes of the normal flow in which most of positive changepoints are displayed. This may suggest that stock indices in emerging markets grow steadily as the foreign capital is regularly flowing into the market.

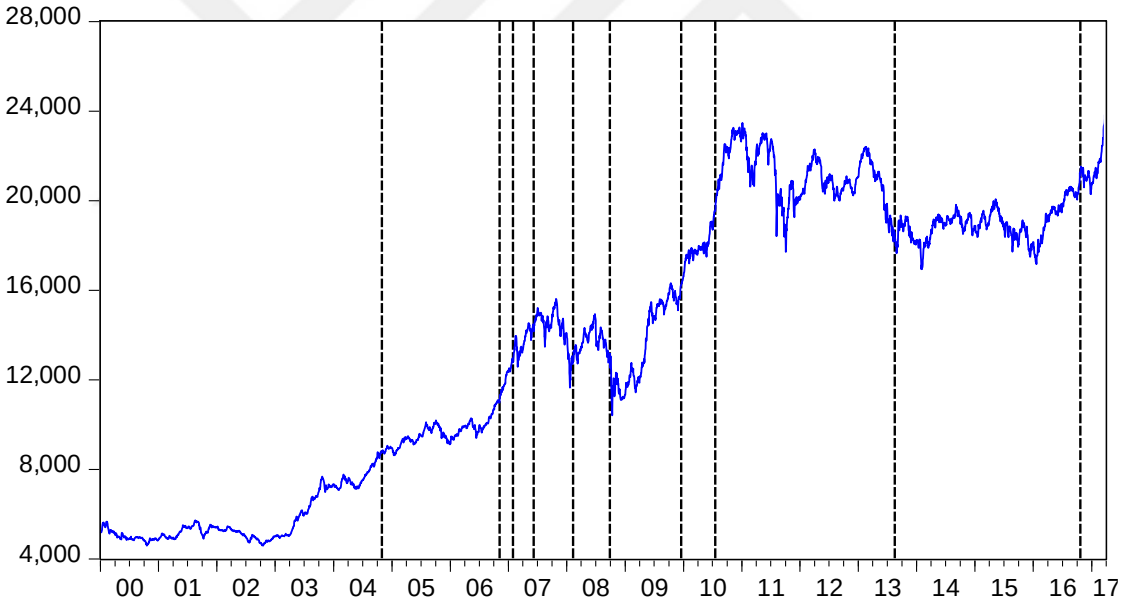


Figure 1.5. *Changepoints in Chile's stock price index.*

Table 1.2. *The index changepoints distributed on capital flow episodes of threshold approach.*

Country	Surge		Normal		Outflow		Change points by country
	Positive	Negative	Positive	Negative	Positive	Negative	
Brazil	2	3	5	2	2	1	15
Chile	6	-	2	-	-	2	10
Columbia	2	-	5	1	1	1	10
Hungary	4	4	3	1	4	-	16
Korea, Rep.	-	-	3	3	6	1	13
Malaysia	3	2	3	1	3	-	12
India	1	-	3	1	8	2	15
Indonesia	1	-	4	2	4	-	11
Philippine	1	-	6	3	2	-	12
Poland	1	1	7	2	3	2	16
Romania	2	1	9	1	4	3	20
Singapore	1	2	8	4	3	2	20
South Africa	1	-	4	2	6	1	14
Thailand	-	-	3	2	4	-	9
Turkey	1	1	7	3	4	1	17
Total	26	14	72	28	54	16	210

Table 1.3. *The index changepoints distributed on capital flow episodes of clustering approach.*

Country	Surge		Normal		Outflow		Changepoints by country
	Positive	Negative	Positive	Negative	Positive	Negative	
Brazil	2	3	5	2	2	1	15
Chile	2	-	6	1	-	1	10
Columbia	4	-	3	1	1	1	10
Hungary	4	4	2	1	5	-	16
Korea, Rep.	-	-	3	3	6	1	13
Malaysia	-	2	7	1	2	-	12
India	2	1	9	1	1	1	15
Indonesia	-	2	8	-	1	-	11
Philippine	2	-	6	2	1	1	12
Poland	1	1	9	1	2	2	16
Romania	4	1	8	4	3	-	20
Singapore	-	1	9	4	3	3	20
South Africa	-	-	9	3	2	-	14
Thailand	-	-	5	2	2	-	9
Turkey	1	1	9	4	2	-	17
Total	22	16	98	30	33	11	210

1.6. Conclusion

The foreign capital flows to EMEs have been on a roller-coaster ride since the liberalization of these markets at the end of the 1980s and early 1990s. This study pursues the behavior of stock prices throughout the episodes of foreign capital flows in 15 EMEs. To this end, a three-stage empirical analysis is followed. In the first step, the episodes of foreign

capital flow in the selected EMEs were identified using two methods. The threshold method suggested by Ghosh et al. (2014) and Qureshi and Sugawara (2018) and the k-means clustering approach. In the second step, we first employed the PELT method developed by Killick et al. (2012) to detect the changepoints in the stock indices of the selected EMEs, then the post-changepoint trend was followed to distinguish between the positive and the negative changepoints. Finally, the detected index changepoints with reference to its dates are distributed over the identified episodes of foreign capital flows.

The difference in the timing and the number of surge episodes has been generally the norm in the capital surge measuring methods followed in the literature. In this study, we find a slight difference between the number of capital surge episodes identified by the threshold and the clustering approach. Meanwhile, the difference has been comparatively remarkable in terms of the capital outflow episodes identified by the two approaches. As for the stock prices, the PELT method has detected a total of 210 index changepoints in the stock indices of the 15 EMEs. Romania's stock index displayed the largest index changepoints, whereas the least index changepoints are found in the stock indices of Columbia and Chile.

After distributing the detected index changepoints over the identified capital flow episodes, it is observed that surges of capital flows do not necessarily lead to further appreciation of stock prices. In most of the selected EMEs, the stock indices have been rarely pushed further during the entire surge episodes identified by both approaches. However, there have been few exceptions such as Chile and Hungary where stock indices have indeed more frequently increased during the surge episodes. In the meantime, we observe a significant appreciation of stock prices during the normal state of capital flows, meaning that the steady capital flows which last longer can effectively push up stock prices. For the policymakers, it means that they should care less about the effect of the temporarily surging foreign capital inflows, but rather should regulate and control the steady foreign capital inflows because it may have an accumulative effect on the stock prices. On the other hand, it is noticed that the stock prices have not often depreciated during the episodes of foreign capital outflows in all the selected EMEs, which means that stock prices have been less vulnerable to reversals of foreign capital flows.

2. THE TIME-VARYING DYNAMICS BETWEEN THE STOCK RETURNS AND FOREIGN EQUITY FLOWS

2.1. Introduction

The opening of financial markets in emerging economies has resulted in significant international capital movements, most of which have been short-term portfolio investments and short-term instruments. However, equities from the emerging and developing markets were the main target of foreign investors. According to Bussiere et al. (2018), the share of portfolio flows increased from about one-third to more than half in recent years. This increase was mainly due to the significant rise of equity share to more than half of the portfolio flows. Against this backdrop, there has been increased attention placed on the implications of foreign portfolio flows to emerging and developing markets[12]. In addition, the empirical research in this area has followed a disparate path such as the implications to productivity and economic growth. In regard to the stock market, the bulk of the literature has explicitly been more concerned with the price impact and the volatility effect of foreign portfolio flows on equities.

Emerging stock markets have several aspects that characterize it from other markets. The high volatility is probably the most known characteristic of these markets. Early studies have consistently found evidence of high volatility and price changes in emerging markets compared to developed markets (see e.g., Bekaert and Harvey, 1997; De Santis and Imrohoroglu, 1997; Schaller and Van Norden, 1997; Bekaert et al., 1998; Kawakatsu and Morey, 1999; Harvey et al., 2000). Despite the inconclusiveness of empirical evidence regarding the emerging market liberalization and its implications on the volatility of equity returns[13]. The volatility of returns in emerging stock markets has been acknowledged to be time-variant. For instance, Ahmed and Sehgal (2013) study the volatility of stock returns in seven emerging markets using Markov switching model. The study showed that volatility is switching between two regimes in each of the studied markets. Similarly, Maharaj et al. (2011) observe that volatility of stock returns is a time scale-dependent in all the selected emerging and developed markets.

[12] See Kose et al. (2010) for complete review on the effects of financial globalization.
[13] See a complete review by Atilgan et al. (2015) on the studies of equity returns of emerging markets.

In the context of time-varying dynamics, foreign portfolio flows have not been much different than the case of stock returns. In a study carried out by Pagliari and Hanan (2017) on 65 countries including emerging markets, the portfolio flow is found to be following different trends over time. According to Pagliari and Hanan (2017), the volatility of overall portfolio flows is lower at certain periods. Additionally, they find equity flows to follow a slight upward trend for volatility until the global financial crisis and a downward trend thereafter. In addition, capital flows have been constantly changing in size over time, surging at some point then suddenly reversing and falling dramatically. These dynamics reflect what is called the episodes of capital flows. If the capital flows are changing over time, so should be their impact on stock returns. Consequently, the relationship between capital flows and stock returns is likely to be time-variant and non-linear. Based on this perspective, the time-varying parameter VAR (TVP-VAR) model with stochastic volatility is applied to time series of stock returns and US equity flows of pacific Asia's emerging markets. The empirical analysis also includes estimations of cumulative orthogonal impulse response functions based on the traditional Cholesky method of standard VAR model. This method is applied to subsamples of US equity flows and stock returns in the selected pacific Asia's emerging markets, while the TVP-VAR model is applied to the full sample.

The remaining sections of this chapter are ordered as follows; section two includes the literature review. Section three introduces the data and research methodology. Section four analyses the empirical results.

2.2. Literature review

The literature of financial theory has established that the changes in stock returns have a significant long-run relationship with macroeconomic activities. Accordingly, the capital inflows like other macroeconomic factors have been found to be linked with the stock market performance. Theoretically, there are several competing hypotheses put forth to explain this relationship. The first hypothesis is the base-broadening hypothesis by Merton (1987). Merton suggests that an expansion of investor base in the market leads to increased diversification and reduces the risk. With lower risk, the investors would require less risk premium and consequently the equity share price would increase. Clark and Berko (1997) find a similar relationship between foreign equity purchases and market returns in Mexico.

Another hypothesis that conjectures the effect of foreign equity inflows on stock returns is the price pressure hypothesis[14]. The rationale behind this hypothesis is that the shocks in equity capital flow drive the stock price temporarily away from the fundamentals. The third hypothesis of interest is often referred to as the feedback trading hypothesis, according to which the foreign investors are return chasers. Bohn and Tesar (1996) find evidence that U.S investors move into the market when high returns are foreseen and pull out when the returns are expected to be low[15]. Therefore, feedback trading by foreign portfolio investors may cause excess market volatility.

Many studies have empirically investigated the joint dynamics of capital flows and equity returns. These studies agree that increases in capital flows raise stock market prices, but there has not been any sort of consensus on whether the price effect is temporary or permanent. Warther (1995) investigates aggregate monthly inflows into mutual funds and their impact on stock and bond prices. He finds that unexpected increases in inflows are highly correlated with contemporaneous returns, but that expected inflows are not. His data suggest that an unexpected inflow equal to 1% of total stock fund assets corresponds to a 5.7% increase in the stock price index.

Edelen and Warner (2001) also examine the relation between stock market returns and the aggregate daily flows into U.S. equity funds. In line with Warther (1995), their findings suggest that the market returns respond to the unexpected fund flows, the days with positive (negative) unexpected flows were shown to have abnormal market returns of 25 (-25) basis points.

Choe et al. (1999) examine the impact of foreign investors on stock returns in Korea from November 30, 1996 to the end of 1997. They find strong evidence that large buy (sell) trades initiated by foreign investors are indeed associated with a stock price increase (decline), but this trend dies out quickly rendering the effect of feedback trading by foreign

[14] The temporary price pressure associated with individual trades has been difficult to identify empirically (see, e.g; Chan and Lakonishok, 1995; Keim and Madhavan, 1996) and has been rejected in some studies such as Clark and Berko (1997). In contrast, the evidence from studies such as Bekaert and et al. (2002) has been supportive of the price pressure hypothesis.

[15] Similarly, Tesar and Werner (1994, 1995a,b) and Brennan and Cao (1997) find pattern of positive feedback trading in the activities of U.S. investors concluding that the international prices tend to rise when international investors purchase local equities .

investors insignificant. As conceived by Choe et al. (1999), this in part is due to the fact that local-market residents have a greater presence in the Korean stock market and their trading activities overwhelm the trades of their foreign counterparts.

Froot et al. (2001) use data of daily cross-border flows for 44 countries, of which 16 are developed countries and the rest 28 countries are emerging markets. Their study finds that the capital flows are correlated with future equity returns and currency returns in emerging markets. In addition, Froot et al. (2001) detect a small contemporaneous price impact of the trades of the foreigners in the emerging markets. This impact, however, has been persistent for the weeks and the months following the foreign investors' trades.

Richards (2005) analyses daily data over the period 1999-2002 on total foreign net inflows into six Asian Equity markets using VAR model. The included markets in their sample are the Jakarta Stock Exchange, Korea Stock Exchange, Philippine Stock Exchange, Stock Exchange of Thailand, Taiwan Stock Exchange, and Kosdaq Stock market. Contrary to Froot et al. (2001), the price impact of unexpected foreign inflows estimated by Richards (2005) is substantially large and almost completely dwindles within a few days after the foreigners' trades.

The second strand of the literature suggests that foreign inflows affect local stock markets permanently. Clark and Berko (1997) measure the impact of the monthly net purchases of Mexican equities by foreigners on stock prices in the period from January 1989 through March 1996. Their empirical analyses indicate a large price impact in which foreign purchases of 1% of market capitalization are associated with a 6% rise in the stock index. This impact even grows larger from 6% to 13% when the anticipated equity inflows are replaced with surprising inflows. In spite of the large effect, they find no evidence of price reversal leading to the conclusion that the price change is rather permanent.

Bekaert et al. (2002) study the interrelationship between capital flows, returns, dividend yields and world interest rates in 20 emerging markets. Their analyses include first detecting the breaks in the variables of interest, then studying the interrelationship among the variables in the post-break period using the impulse response model. They find that a shock in equity flows contemporaneously increases the stock price level by 6%. Even with the evidence found that this impact dwindles immediately, the incomplete reversal of the cumulative effect

which remains positive and significantly smaller over the 60-month horizon led Bekaert et al. (2002) to conclude that price impact is permanent.

Dahlquist and Robertson (2004) also employ the impulse response analysis to study the impact of foreigners' purchases and sales on the stock returns of Swedish firms. Similar to Bekaert et al. (2002), their empirical results indicate a positive contemporaneous correlation between flows and returns and no reversal of price impact throughout the sample period. On the contrary, they find that the immediate price impact increases gradually in the following months.

Swanson and Lin (2003) investigate the relationship between international equity flows and returns in the eight largest emerging Asian markets, namely Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand. The price impact of equity flows in the study of Swanson and Lin (2003) is measured separately for each type of flows i.e inflows, outflows and net flows. They find that the changes in inflows and net flow positively impact the stock returns but not in all the countries. The effect of inflows on returns is not found in the cases of Indonesia, Philippines, and Taiwan, while for the net flows, the price impact is insignificant in the cases of Indonesia and Singapore.

Porras and Ülkü (2015) study the stock market returns' response to net foreign flow shock in Spain using monthly foreign flow data from the Madrid stock exchange. The dataset they use also consists of nonresidents' monthly purchases and sales and data on U.S. investors obtained from US Treasury International Capital (TIC). Their empirical analyses suggest that the US investors represented in TIC data do not have significant price impact, while the total net flows show significant contemporaneous association with stock returns. They also find the initial price impact is ensued by partial reversal.

Samarakon (2009) measures the impact of equity flows on future returns in Sri Lanka using daily trades data categorized by investor classes. His empirical results show that foreign individual purchases of equity lead to higher returns in the future, but the equity purchases by foreign institutional investors do not have such an impact.

2.3. Data and methodology

2.3.1. Data

The empirical investigations in this research are carried out using monthly time series of stock returns and US equity flows to three Pacific Asian emerging economies namely Indonesia, South Korea, and Thailand. The data sample covers the period from January 1995 through April 2017. The calculations of monthly stock returns are based on the national stock indexes of the three countries by using the following formula

$$R_t = ln(P_t/P_{t-1}) \times 100 \quad (2.1)$$

The US equity flows are obtained from the US treasury international capital (TIC) system, this database maintains a monthly record of bilateral trades of financial assets between the US and large number of countries around the world. The TIC database has many limitations as pointed out by Edison and Warnock (2008). One of its main limitations is that TIC database only tracks US portfolio inflows and outflows while other cross-border flows are excluded. Moreover, the transactions taking place via a third country are recoded against the foreign intermediary rather than the residency place of the foreign security issuer, which likely leads to financial center bias. Lastly, the analysis of equity flows can be difficult due to the financing of cross-border mergers via stock swaps. However, Caporale et al. (2017) argue that the second and third limitations are likely to be trivial in the context of emerging and developing economies. In addition, the TIC data has been used in large number of studies for different purposes.

2.3.2. Methodology

The main purpose of the empirical analysis is to estimate the time-varying relationship between capital flows and stock returns. To this end, we implement the time-varying parameter vector autoregressive (TVP-VAR) model developed by Nakajima (2011).

2.3.2.1. Time-Varying Parameter VAR Model with Stochastic Volatility

The main advantage of the TVP-VAR model is that the parameters of the VAR matrix are allowed to change over time by incorporating the stochastic volatility in the estimation process. Although computationally it is far complicated than the standard VAR model, it has been consistently found to be outperforming the standard VAR model (see e.g., Lai and Wang, 2014; Kumar, 2010).

The TVP-VAR model developed by Nakajima (2011) is derived from the basic structural VAR model which can be defined as follows:

$$Ay_t = F_1 y_{t-1} + \ldots\ldots + F_s y_{t-s} + \mu_t,\ t = s+1, \ldots\ldots, n, \tag{2.2}$$

where y_t is a $k \times 1$ vector of observed variables, $A, F_1, \ldots, F_s$ are $k \times k$ matrices of coefficients.

The disturbance μ_t is a $k \times 1$ structural shock and, it is assumed that $\mu_t \sim N(0, \Sigma\Sigma)$, where

$$\Sigma = \begin{pmatrix} \sigma_1 & 0 & \cdots & 0 \\ 0 & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & \sigma_k \end{pmatrix} \tag{2.3}$$

The simultaneous relations of the structural shock are specified by recursive identification, assuming that A is lower-triangular,

$$\mathrm{A} = \begin{pmatrix} 1 & 0 & \cdots & 0 \\ a_{21} & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ a_{k1} & \cdots & a_{k,k-1} & 1 \end{pmatrix} \tag{2.4}$$

The model (2.2) can be rewritten as the following reduced-form VAR model:

$$y_t = B_1 y_{t-1} + \ldots\ldots + B_s y_{t-s} + A^{-1}\Sigma\varepsilon_t, \quad \varepsilon_t \sim N(0, I_k), \tag{2.5}$$

where $B_i = A^{-1}F_i$, for $i = 1, \ldots, s$. Stacking the elements in the rows of the B_i's to form β ($k^2 \times 1$ vector), and defining $X_t = I_s \otimes (y'_{t-1}, \ldots\ldots, y'_{t-s})$ where $\otimes$ denotes the Kronecker product, the model can be written as

$$y_t = X_t\beta + A^{-1}\Sigma\varepsilon_t \tag{2.6}$$

The parameters of the model (2.6) are all time-invariant, but they can be allowed to change over time by extending it to the TVP-VAR model.

Consider the TVP-VAR model stochastic volatility specified by

$$y_t = X_t\beta_t + {A_t}^{-1}\Sigma_t\varepsilon_t, \quad t = s+1, \ldots, n, \tag{2.7}$$

where the coefficients β_t, and the parameters A_t, and Σ_t are all time-varying. There would be many ways to model the process for these time-varying parameters.

Following Primiceri (2005), let $a_t = (a_{21}, a_{31}, a_{32}, a_{41}, \ldots, a_{k,k-1})'$ be a stacked vector of the lower-triangular elements in A_t and $h_t = (h_{1t}, \ldots, h_{kt})'$ with $h_{jt} = log{\sigma_{jt}}^2$, for

$j = 1,\ldots,k, t = s+1,\ldots,n$. The parameters in (2.3) are assumed to follow a random walk process as follows:

$$\begin{matrix}\beta_{t+1} = \beta_t + \mu_{\beta t}, \\ a_{t+1} = a_t + \mu_{at}, \\ h_{t+1} = h_t + \mu_{ht},\end{matrix} \quad \begin{pmatrix}\varepsilon_t \\ \mu_{\beta t} \\ \mu_{at} \\ \mu_{ht}\end{pmatrix} \sim N\left(0, \begin{pmatrix} I & 0 & 0 & 0 \\ 0 & \Sigma_\beta & 0 & 0 \\ 0 & 0 & \Sigma_a & 0 \\ 0 & 0 & 0 & \Sigma_h \end{pmatrix}\right) \quad (2.8)$$

for $t = s+1,\ldots,n$, where $\beta_{s+1} \sim N(\mu_{\beta 0}\mu, \Sigma_{\beta 0})$, $a_{s+1} \sim N(\mu_{a0}, \Sigma_{a0})$ and $h_{s+1} \sim N(\mu_{h0}, \Sigma_{h0})$.

As in Nakajima (2011), the recursive identification of VAR system assumes a lower triangular matrix for A_t, and Σ_a and Σ_h are assumed to be diagonal matrices.

2.4. The empirical results

We start the empirical analyses by reporting the descriptive statistics for US equity flows (U.S. EF) and stock returns in the three countries. As seen in table 2.1, the standard deviation of US equity flows in Indonesia does not greatly differ from that of South Korea, which may indicate homogeneity of FPI to the two countries. The US equity flows to Thailand, on the other hand, have a higher standard deviation. This may imply that the US equity flows to Thailand have been more volatile compared to Indonesia and South Korea. In terms of stock returns, Indonesia has on average the highest returns among the three markets. The reported Jarque-Bera test statistics which measure the normality of distribution indicate that all the variables are normally distributed. Table 2.2 reports the unit root tests as well as the results of the Bai-Perron (2003) test for structural breaks in equity flows. The results of the latter are also plotted in the appendix.

Table 2.1. *Descriptive statistics.*

Country	Variables	Mean	Median	Maximum	Minimum	Std.dev	Jarque-Bera	Probability
Indonesia	R	0.930	1.615	25.019	-37.856	7.861	368.144	0.000*
	U.S. EF	264.168	194.500	1143.000	10.000	226.962	45.862	0.000*
South Korea	R	0.285	0.401	41.06	-31.810	7.971	156.600	0.000*
	U.S. EF	1951.231	1814.400	11189.000	61.000	1465.988	309.048	0.000*
Thailand	R	0.395	0.882	32.880	-30.176	8.27	81.261	0.000*
	U.S. EF	319.485	255.500	1247.000	11.000	282.180	38.315	0.000*

Note: The single asterisk indicates for significance level at 1%.

Table 2.2. *Unit roots and breakpoints in US equity flows.*

	Unit root tests at level				Breakpoints
	ADF test statistics	P value	PP test statistics	P value	
U.S. EF to Indonesia	-3.669	0.026**	-6.021	0.0000*	5
U.S. EF to South Korea	-11.405	0.0000*	-12.311	0.0000*	3
U.S. EF to Thailand	-3.993	0.0100**	-6.933	0.0000*	3

Note: The single and double asterisks indicate significance levels at 1% and 5% respectively.

2.4 .1. The constant short-run dynamics

In many financial analyses, vector autoregressive (VAR) models are established tools for describing the bilateral interactions between equity trading flows and returns with lagged responses. However, the direct interpretation of VAR parameters is often difficult. Therefore, the impulse response functions and related quantities are widely used to reveal the interaction between the variables involved. Such interactions involve tracking the effect of shock and compactly describe the contemporaneous relationship and lagged responses. Consequently, this enables us to distinguish temporary and permanent responses and measure the economic significance of any potential forecast ability or feedback trading. The estimation of impulse response functions depends on the VAR implementations which are far from uniform and there exist several schemes on how it should be done based on theoretical perspectives. In the traditional VAR model, the contemporaneous effect can be modeled by orthogonalizing the reduced form of shocks, also referred to as Cholesky decomposition or Wold causal chain. Orthogonalization, in turn, is achieved by triangularization which imposes a recursive structure on the contemporary relationship between the variables. Under this scheme, the order of variables determines which variable affects the other. This issue has been frequently discussed in the context of the flow-return relationship. Following Hasbrouck (1991), many studies have ordered flows before returns assuming that returns can only affect flows with lag. This assumption is confined to tick data under daily frequency, but under long scale such as monthly frequency, the short-run interactions might be different. In addition, many recent studies using daily data such as Griffin et al. (2004), Richards (2005) and Ülkü and Weber (2014) have found that net foreign flows strongly and positively respond to the local past returns. Therefore, the assumption of Hasbrouck (1991) would not hold true in the case of monthly frequency as suggested by Porras and Ülkü (2015).

The impulse response functions are typically used to capture the interdependent dynamics of data. In terms of the flow-return relationship, the contemporaneous effect also called "price impact" is implied when the response starts at the zero lag. The positive (negative) lagged responses of flows to return shocks indicate positive (negative) feedback trading, whereas positive lagged responses of returns to flow shocks imply that the flows can be a predictive factor to the future returns. The inference of permanent impact requires continuation of the positive response of returns to flow shocks. This impact is rather considered temporary if any subsequent reverse follows the contemporaneous positive response. To test for the existence of such dynamics in the interactions between the US equity flows and stock returns of emerging pacific Asian markets, orthogonalized impulse response functions are estimated based on the traditional VAR model of Sims (1980). However, the impulse response function resulting from the VAR model is known to be sensitive to the sample size. As Killian (1998) points out most of confidence intervals of impulse response function, which are basically derived from asymptotically justified formulae, tend to be extremely inaccurate in small samples. To avoid small-sample biases, the statistical inference is based on bootstrapped 95% confidence bands. The response is deemed statistically significant provided that neither of the lower and upper bands come across the zero line. The estimations of the impulse response functions are conducted over three subsamples corresponding to the sub-periods Jan 1995-Apr 2002, May 2002-Oct 2009, and Nov 2009-Apr 2017, respectively. The results are depicted in figures 2.1, 2.2 and 2.3.

While it is commonly assumed that only flows can affect returns contemporaneously in daily frequency, this assumption seems to not hold in the case of monthly US equity flows as we notice a lagged response of returns to flows shocks in the selected emerging markets. The contemporaneous impact is not found in the response of flow to shocks in returns either. The other thing to note from the figures below is the quick reverse of the response of returns to equity flow shocks after the second month, meaning that the impact of shocks in US equity flows is trivial and short-lived in the stock markets of the selected emerging pacific Asian economies. On the right side of the figures, which depicts the response of US equity flows to shocks in stock returns, we find evidence of feedback trading behaviors throughout the subperiods. The impact of the feedback trading of US investors on the stock returns is

positive and statistically significant over most of the periods following the shocks in stock returns.

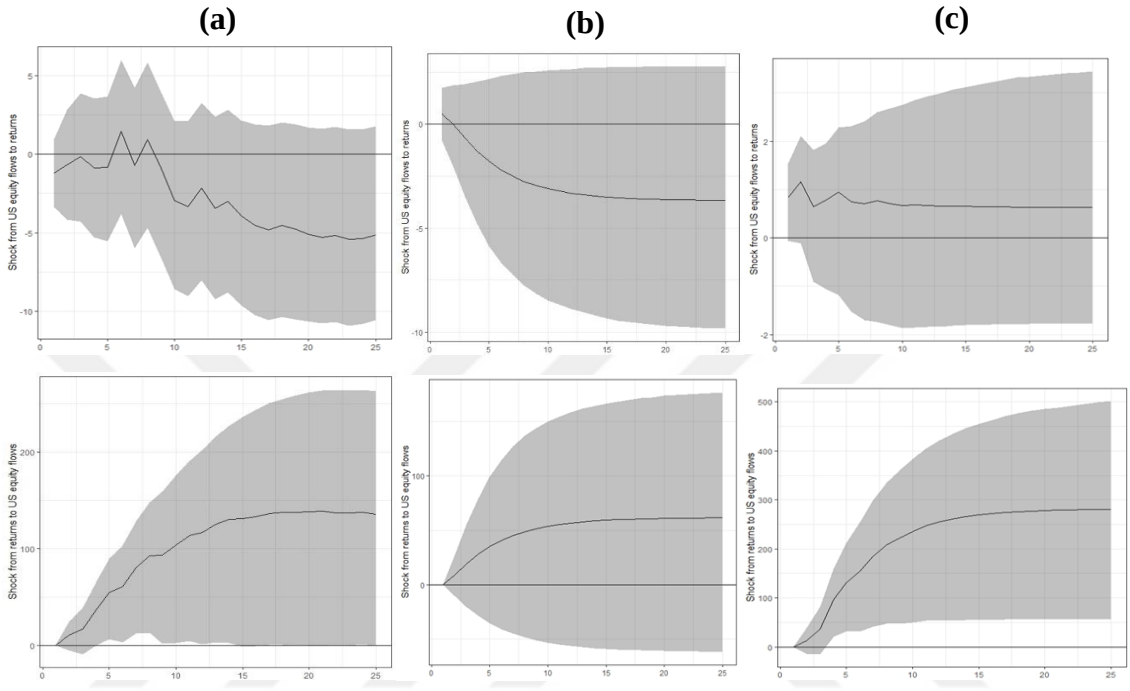


Figure 2.1. *Impulse response functions of US equity flows and stock returns in Indonesia*. The columns a, b and c correspond to the subsamples: Jan 1995-Apr 2002, May 2002-Oct 2009, and Nov 2009-Apr 2017 respectively.

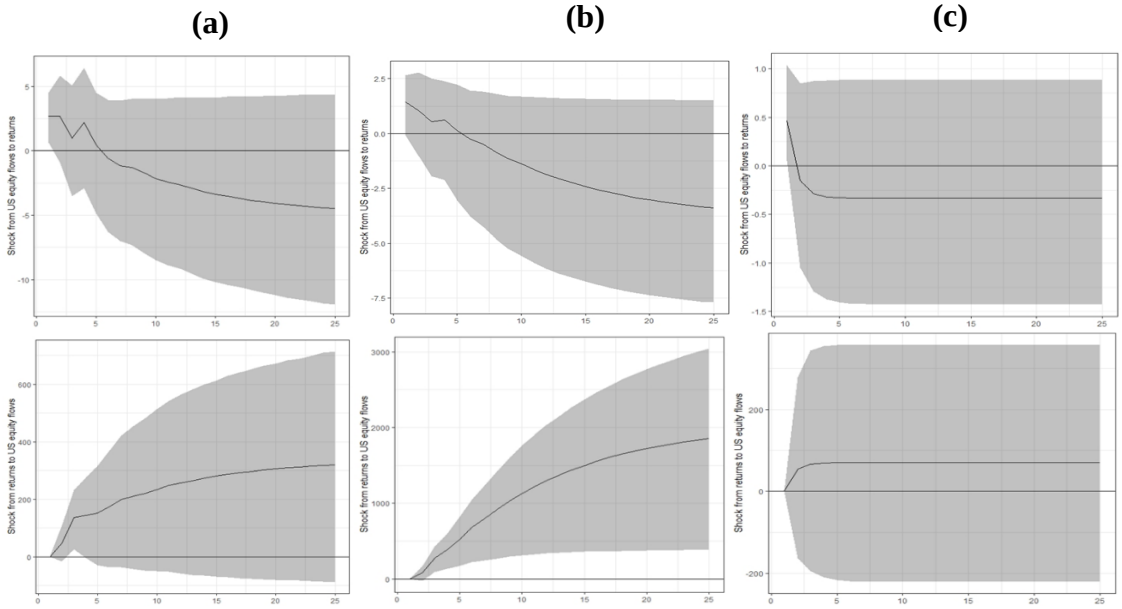


Figure 2.2. *Impulse response functions of US equity flows and stock returns in South Korea*. The columns a, b and c correspond to the subsamples: Jan 1995-Apr 2002, May 2002-Oct 2009, and Nov 2009-Apr 2017 respectively.

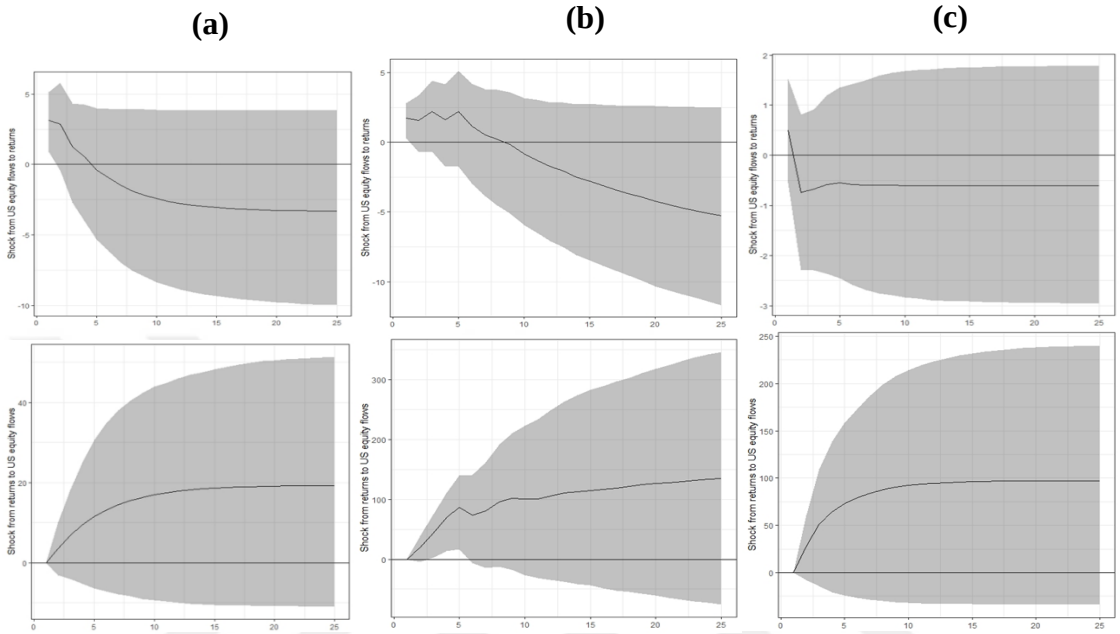


Figure 2.3. *Impulse response functions of US equity flows and stock returns in Thailand*. The columns a, b and c correspond to the subsamples: Jan 1995-Apr 2002, May 2002-Oct 2009, and Nov 2009-Apr 2017 respectively.

2.4.2. The analysis of time-varying parameter VAR model

2.4.2.1. The MCMC simulations

The time-varying coefficients of the TVP-VAR model are formulated to follow first-order random walk process. This process can be estimated using the Markov Chain Monte Carlo (MCMC) method in the context of the Bayesian inference which involves specifying a prior density to construct a posterior distribution. In this context, the MCMC algorithm proceeds by recursively sampling the conditional posterior distribution where the most recent values of the conditioning parameters are used in the simulation. As already mentioned, the recursive sampling of the VAR system is based on a lower triangular matrix. In this study, the priors described below are assumed for the ith diagonals of the covariance matrices for the three TVP-VAR models respectively.

$$(\Sigma_a)_i^{-2} \sim Gamma(60, 0.2)\ (\Sigma_b)_i^{-2} \sim Gamma(4, 0.2)\ (\Sigma_h)_i^{-2} \sim Gamma(4, 0.2)$$
$$(\Sigma_a)_i^{-2} \sim Gamma(60, 0.2)\ (\Sigma_b)_i^{-2} \sim Gamma(4, 0.2)\ (\Sigma_h)_i^{-2} \sim Gamma(4, 0.2)$$
$$(\Sigma_a)_i^{-2} \sim Gamma(40, 0.2)\ (\Sigma_b)_i^{-2} \sim Gamma(4, 0.2)\ (\Sigma_h)_i^{-2} \sim Gamma(4, 0.2)$$

For the initial state of the time-varying parameter, rather flat priors are set; $\mu_{\beta_0} = \mu_{a_0} = \mu_{h_0} = 0$ and $\Sigma_{\beta_0} = \Sigma_{a_0} = \Sigma_{h_0} = 10 \times I$. Using the MCMC algorithm, we draw M=10000 samples after discarding the initial 1000 samples.

The sample of the autocorrelation function, the sample paths and the posterior histograms for the selected parameters are shown in figure 2.4. The autocorrelation sample shows a steep decrease in the autocorrelations of the samples drawn by the MCMC algorithm. The sample paths in the middle are stable indicating that MCMC sampling has efficiently produced most of the samples with low autocorrelations. Therefore, the sequence of the MCMC sampling is stationary and it converges in distribution to normal standards as shown in the bottom row.

Table 2.3 gives the estimates for posterior means, standard deviations, the 95% credible intervals, the convergence diagnostics (CD) of Geweke (1992) and the inefficiency factors, which are computed using the MCMC samples. In the estimated results, the null hypothesis of the convergences to posteriors distribution is not rejected at 5% for all the parameters except the parameter $(\Sigma_a)_1$ in the TVP-VAR models of US equity flows and stock returns in Indonesia and Thailand. Meanwhile, the inefficiency factors are quite low, meaning that the number of efficient samples is highly sufficient. The posterior means of the parameters also fall within the 95% credible intervals.

Table 2.3. *Estimation results of the TVP-VAR parameters.*

Country	Parameters	Mean	St.Dev	95% U	95% L	Geweke	Inef.
Indonesia	$(\Sigma_\beta)_1$	0.0018	0.0002	0.0016	0.0022	0.22	9.8
	$(\Sigma_\beta)_2$	0.0018	0.0002	0.0015	0.0021	0.116	9.48
	$(\Sigma_a)_1$	0.0055	0.0014	0.0034	0.0089	0	54.47
	$(\Sigma_h)_1$	0.1162	0.0341	0.0564	0.1914	0.421	90.87
	$(\Sigma_h)_2$	0.4352	0.0775	0.2992	0.61	0.461	48.69
South Korea	$(\Sigma_\beta)_1$	0.0022	0.0001	0.0021	0.0024	0.285	2.12
	$(\Sigma_\beta)_2$	0.0022	0.0001	0.002	0.0024	0.77	2.14
	$(\Sigma_a)_1$	0.0057	0.0017	0.0035	0.01	0.933	70.55
	$(\Sigma_h)_1$	0.4446	0.0462	0.3635	0.5469	0.518	48.2
	$(\Sigma_h)_2$	0.2597	0.0628	0.1458	0.3942	0.689	67.34
Thailand	$(\Sigma_\beta)_1$	0.0023	0.0003	0.0018	0.0029	0.172	17.77
	$(\Sigma_\beta)_2$	0.0023	0.0003	0.0018	0.0029	0.442	15.59
	$(\Sigma_a)_1$	0.0055	0.0017	0.0033	0.0101	0.009	73.06
	$(\Sigma_h)_1$	0.1262	0.0371	0.0611	0.2083	0.325	83.18
	$(\Sigma_h)_2$	0.0052	0.0014	0.0032	0.0085	0.465	68.46

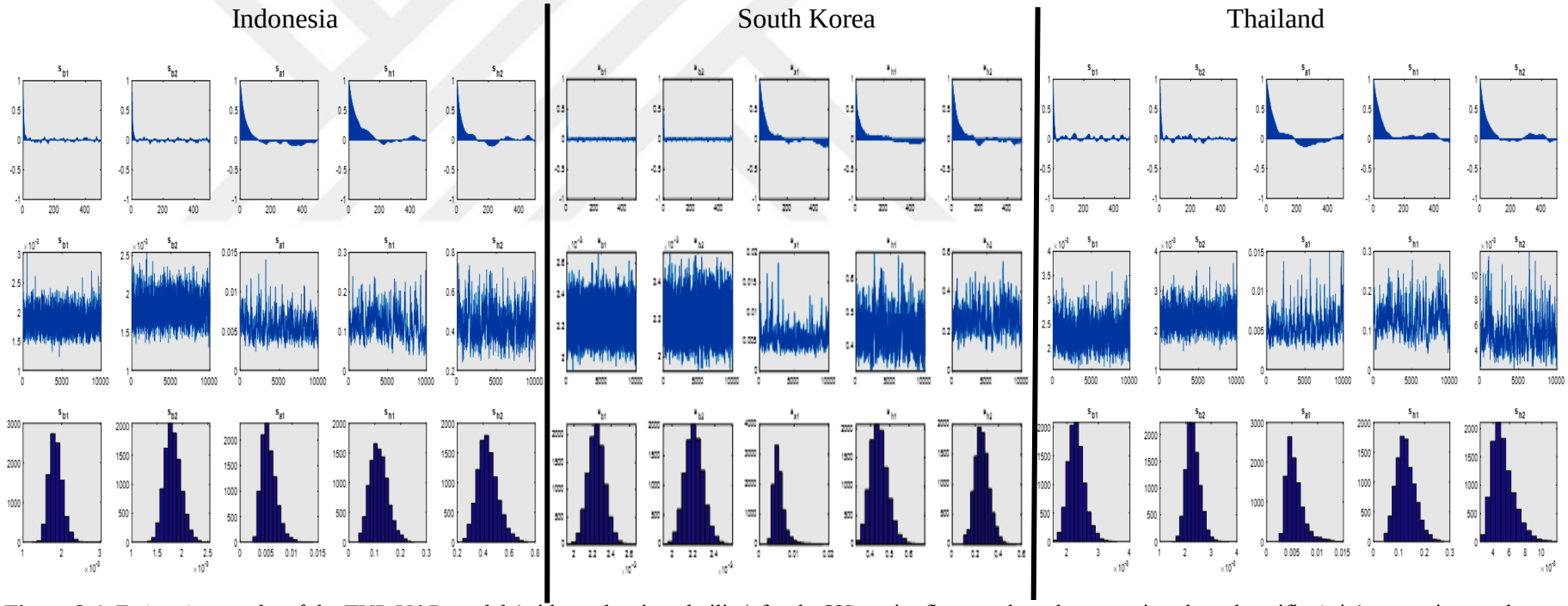


Figure 2.4. Estimation results of the TVP-VAR model (with stochastic volatility) for the US equity flows and stock returns in selected pacific Asia's emerging markets. Sample autocorrelations (top), sample paths (middle) and posterior histograms (bottom). The estimates of Σ_β and Σ_a are multiplied by 100. The TVP-VAR models are estimated using the lags 3, 4 and 6 for the selected markets respectively.

2.4.2.2. The time-varying dynamics

The three-dimensional time-varying impulse response is one of the main characteristics of the TVP-VAR model. Using the estimated time-varying parameters, the response can be estimated at all time points, so at each point, there will be a different set of impulse response functions. In the setting of TVP-VAR model of Nakajima (2011), the response corresponds to a shock size equal to the average of stochastic volatility of each variable in the VAR system. Since the computation of the impulse response functions is based on time-variant parameters, the effects and contributions of shocks may also change over time. Surprisingly, although structural breaks are commonly found in equity flows, the possibility of time-varying responses of stock returns has never been considered in the literature of flow-return relationship. Therefore, the time-variant specification would better fit the non-constant dynamics of returns and flows, particularly in emerging markets whose stock markets are characterized by high volatility. In addition, the capital flows to this region have been plagued with numerous boom-bust cycles. Therefore, the time-varying dynamics of equity flows and stock returns are highly possible under these circumstances. The historical impulse responses reported in figures 2.5, 2.6 and 2.7 clearly show some over-time variations in the dynamics of equity flows and stock returns in the selected pacific Asia's emerging markets. However, the response of stock returns shows more variations than response of equity flows, particularly in Indonesia and South Korea. The response of flows in Thailand, on the other hand, is highly variant than the response of stock returns to shocks in US equity flows.

As it is shown in figure 2.5, most of the changes in the response of stock returns occur within the first five months after shocks in US equity flows to Indonesia. At the beginning of the sample, the initial response of the returns to flow shocks is positive but comes a month later to the shock. In fact, the stock returns generally show a lagged response to flow shocks throughout the sample period. The positive response shown in the beginning quickly dwindles and turns negative four months after the shock, then it bounces back and remains positive in the subsequent periods on the dimension of shock time horizons. Moving forward to 2003, the lagged response of stock returns turns negative and remains below zero in the subsequent periods up till 2012. From this date forward, the lagged response of stock returns to flow shock turns positive again but falls shortly after two months from the shock as shown by the third dimension. Overall, the

highest impact of the shock in US equity flows on Indonesian stock returns is observed at the beginning of the sample period. As the response of the returns in this period is shown to be positive within four months after the shock, it can be concluded stock returns are to some extent forecastable by US equity flows. The US equity flows, in contrast, do not show significant time-varying responses to shocks of stock returns in Indonesia. However, unlike the response of stock returns, US equity flows seem to be highly flexible as it shows contemporaneous response to shocks of stock returns. This contemporaneous response is shown to be positive and increasingly grow in the first three months after shocks in stock returns, which indicates feedback trading behaviors by US equity investors in this time horizon.

The time-varying dynamics between US equity flows and stock returns in South Korea, as shown in figure 2.6, are not substantially different from the case of Indonesia, particularly the response of US equity flows to the shock of stock returns. The time-varying responses of US equity flows remain largely unchanged throughout the sample period despite some minor changes taking place around the middle and the end of the dimension of shock time horizon. In addition, the evidence of positive feedback trading by the US equity investors is clearly seen during the first three months after shocks of stock returns. The responses of stock returns to shocks in US equity flows in South Korea are found to be relatively similar behaviors to the responses of stock returns in Indonesia. During the period 1995-1999, the stock returns have been negatively affected by the US equity flows, this period is corresponding to the breakout of the Asian crisis which ended in 1999. As shown by the dimension of time horizon of the shock, the responses of stock returns turn positive four months after the shock. Following the Asian crisis, the initial responses of stock returns turned positive up until 2005. The negative impact of US equity flows on stock returns in South Korea is also noticeable during the period of the last global recession, but it is less effective than period of the Asian crisis. The stock returns began to show positive response as the US equity flows continued to recover from the repercussions of the global financial crisis. The positive response of returns, although can be clearly seen in some periods, does not indicate significant forecast ability of US equity flows to stock returns during these periods.

Regarding the dynamics of US equity flows and stock returns in Thailand, the shocks of US equity flows have not triggered any changes in the responses of stock returns. As

it is shown in figure 2.7, the impulse responses of stock returns have maintained almost the same patterns throughout the sample period. On the other hand, US equity flows have been unresponsive to shocks in stock returns in Thailand up till 2011. This finding is due to the weak presence of US investors in the stock market of Thailand. During the period 1995-2005, equity purchases by US investors have been very low ranging between 30 and 200$ million. In the period between 2005 and up to the global financial crisis, the US equity flows significantly increased but have rarely risen above 500$ million. The major breakout of US equity flows to Thailand took place around the years 2011-2012 (See figures in appendix B.1), which also coincides with the change in the impulse responses of US equity flows in our empirical estimations.

The major findings from the historical impulse responses of US equity flows and stock returns can be summed up as follows; feedback trading behaviors are commonly seen within the first four months after shock in Indonesia and South Korea. The forecast ability of US equity flows to stock returns is weak during most of the sample period. There is no evidence of a permanent impact of US equity flows on stock returns in selected Pacific Asian emerging markets. The impulse responses of stock returns vary significantly over time in Indonesia and South Korea but remain unchanged in the case of Thailand.

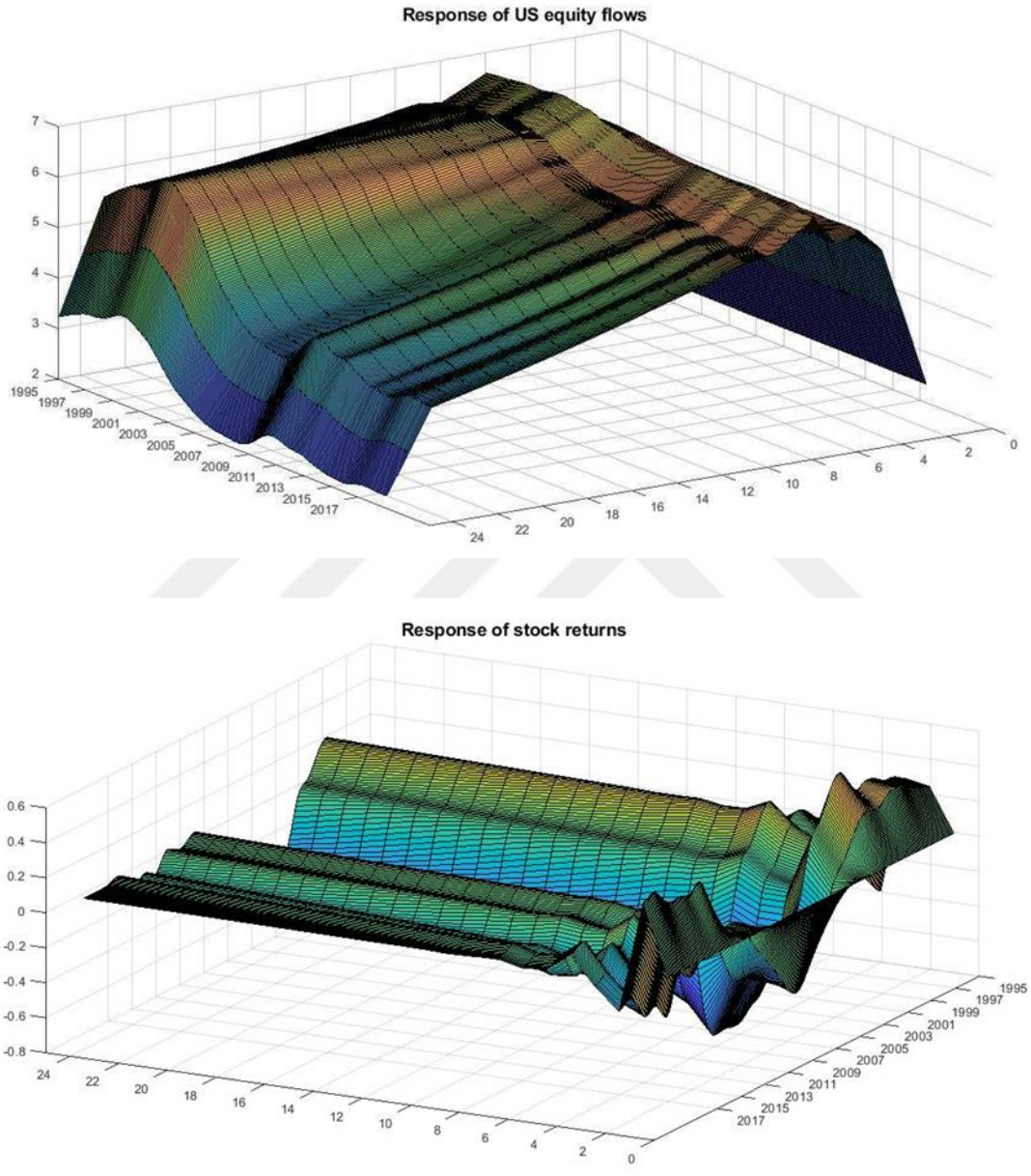


Figure 2.5. *Historical impulse responses of stock returns and US equity flows in Indonesia.*

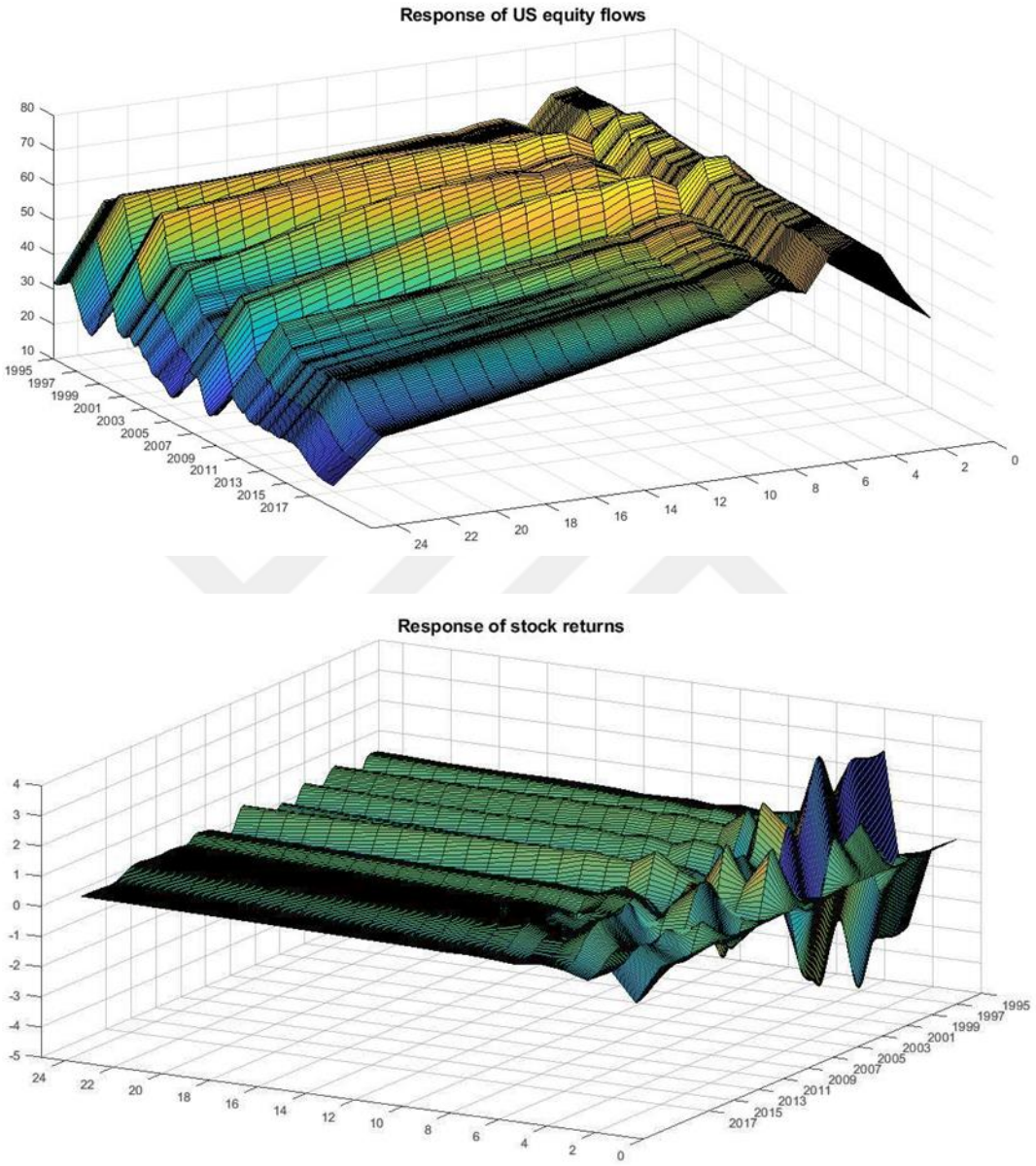


Figure 2.6. *Historical impulse responses of stock returns and US equity flows in South Korea*.

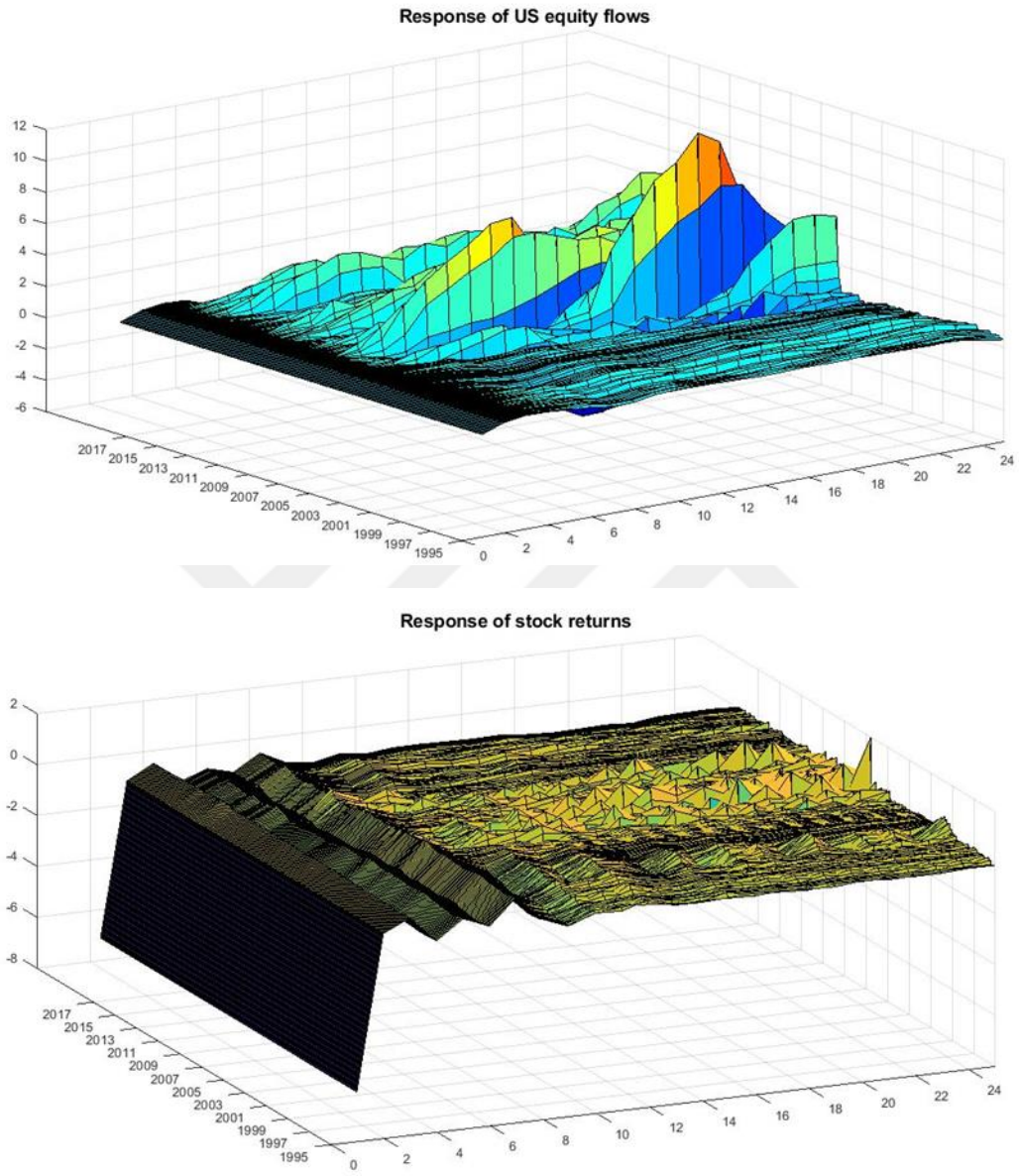


Figure 2.7. *Historical impulse responses of stock returns and US equity flows in Thailand.*

2.5. Conclusion

The flow-return relationship has been extensively studied with the intention being mostly given to stock markets of advanced and emerging economies. The extant literature, in this framework, analyses the flow-returns relationship using time-invariant versions of structural VAR models. However, equity flows have been susceptible to structural breaks caused by boom-bust cycles in international equity flows. Therefore,

assuming constant dynamics between international equity flows and equity returns might be unrealistic and empirically too restrictive to the parameters of the VAR model. For this reason, the time-varying parameter VAR model with stochastic volatility developed by Nakajima (2011) was employed in this chapter to uncover the time-varying dynamics between equity flows and stock returns. The study was specifically concerned with the impact of equity purchases by the US investors in the stock markets of major Pacific Asian emerging economies, namely Indonesia, South Korea, and Thailand. Before the estimation of the TVP-VAR model, the cumulative orthogonal impulse response function of the standard VAR model was estimated over three subsamples of stock returns and US equity flows. The results showed evidence of feedback trading behaviors by US investors in some subsamples but did not detect any contemporaneous correlations between stock returns and US equity flows. The findings from standard VAR also indicated weak impact of US equity flows on stock returns. Overall, the dynamics between stock returns and US equity flows have been remarkably different among the subsamples. The latter finding has provided initial evidence that the dynamics of stock returns and equity flows are not time-invariant as assumed in most of the studies, but it is still insufficient to accurately depict the dynamics of flow-return relationships throughout the sample period. Therefore, the historical impulse responses of TVP-VAR model was used in order to track the time-varying dynamics between US equity flows and stock returns at each time point. The findings from TVP-VAR model, in contrast to standard VAR, indicate that stock returns contemporaneously affect the US equity flows but not vice versa. In general, the main findings from the historical impulse responses of US equity flows and stock returns can be summed up as follows; feedback trading behaviors are commonly seen within the first four months after shock in Indonesia and South Korea. The forecast ability of US equity flows to stock returns is weak during most of the sample period. There is no evidence of permanent impact of US equity flows on stock returns in selected Pacific Asian emerging markets. The impulse responses of stock returns vary significantly over time in Indonesia and South Korea but remain unchanged in the case of Thailand.

3. THE FOREIGN CAPITAL INFLOWS AND THE BOOM IN HOUSE PRICES: TIME-VARYING EVIDENCE FROM EMERGING MARKETS

3.1. Introduction

Over the past years, the global liquidity conditions such as the monetary easing policies in the advanced economies created abundancy and high mobility in international capital flows. The emerging market economies, due to the relaxation of regulatory measures on capital portfolio flows and capital markets, have been a favorite destination of international capital flows. Despite the benefits that international capital flows imply for the recipient economies, many researchers have explicitly associated capital inflows with higher asset prices (see e.g. Jansen, 2003; Kim and Yang, 2011; Olaberría, 2014). In Asia, for instance, the massive capital inflows have led to appreciation of exchange rates and liquidity extension, ultimately causing asset prices to rise. Regarding the transmission channels through which the capital inflows impact the asset prices, Kim and Yang (2009) assume three distinctive channels. First, additional demand for a certain asset created by foreign investors could lead to an increase in the price of the asset. The prices of the other assets are also likely to increase through possible spillover effects to other financial markets such as the real estate market. The second channel is established through an increase in the liquidity and money supply caused by foreign capital inflows, which in turn might boost asset prices. Thirdly, the capital-receiving countries often experience an economic boom, which subsequently leads to an increase in asset prices.

The housing markets have been particularly relevant to international capital flows. The massive swings observed in capital flows over the last fifteen years were accompanied by a dramatic boom-bust cycles in real estate prices around the globe. Favilukis et al. (2012) state that the largest house price increases are often found in countries that received large and increasing net inflows of foreign capital. However, it is noteworthy that capital inflows may precipitately raise house prices compared to tradable assets, this is because the supply of non-tradable assets is not elastic enough to cover the sudden increase in demand. In this respect, Asnell et al. (2018) argue that foreign money flood creates new domestic demand directed to both internationally traded and non-tradable goods and services. With respect to traded goods, the increase in demand can be readily accommodated by imports. In contrast, the supply of non-tradable goods does not increase immediately with the increase in demand, which drives up the prices. Stated more clearly by Olaberría (2014), when capital inflows enter an economy, the demand

for assets that are at a relatively fixed supply, increases, and asset prices move up. Nevertheless, surges in house prices could have been also exacerbated by domestic factors. Glindro et al. (2011) emphasize the role of institutional factors in explaining house prices. Similarly, Caballero and Krishnamurthy (2006) argue that the low quality of institutions could amplify the asset price bubble. The Asian real estate bubble in the 1990s, for example, still believed to be primarily related to the surge of capital inflows to East Asia. However, Quigely (2001) documents excessive bank lending and rampant speculation in the real estate markets of many Southeast Asian economies during that period. The monetary easing policies following the 1997-1998 Asian crisis could be another reason for the asset prices boom in the region.

Focusing on three emerging markets, namely, South Africa, South Korea and Thailand, this study identifies periods of the boom in house prices and estimates the impact of foreign capital inflows on house prices during these periods using the time-varying parameter regression model. The time-varying parameter (TVP) regression models present a generalization of the constant regression models in which the coefficients are allowed to vary over time according to a particular stochastic process. Harvey and Phillips (1982) categorize the dynamic parameter models into two classes. In the first class, the parameters are generated by non-stationary stochastic processes. The parameters, in this case, are likely to follow a random walk. On the contrary, the second class consists of parameters generated by stochastic stationary processes about a fixed but unknown mean. The TVP regression approach used in this study is known as the flexible least square (FLS) developed by Kalaba and Tesfatsion (1989). A key advantage of this approach is that it does not require the imposition of problematic distribution assumptions on the model's residuals. In addition, this study considers the possibility that foreign capital inflows might have been affected by increases in house prices. The infrastructures and housing markets have greatly expanded during the last decades in many emerging markets. These developments might have been certainly attractive to return-chasing foreign investors. Additionally, as shown in a review by Koepke (2019) the asset return indicators are empirically recognized as a strong pulling factor for all the components of capital inflows to the emerging markets. Based on these findings, it is fairly reasonable to assume the existence of bi-directional causality between house prices and foreign capital inflows at certain time points. This conjecture is empirically tested by applying the tests of time-varying causality proposed by Shi et al. (2018).

3.2. Identifying the boom cycles in the housing market

In many studies, the price cycles of residential properties have been considered as a critical ingredient for financial stability and policy analysis. For instance, Claessens et al. (2010) found that most of the systemic banking crises were preceded by house price boom-bust patterns. Another study of Claessens et al. (2008) found that the crises that followed a house price bust were a quarter longer than the other crises. In addition, the financial stability indicators which gauge the resilience of the entire financial system are strongly interconnected with the real estate sector. Given this importance of the housing market, economic policy researchers have developed several methods to identify asset-price boom and bust cycles. even though, the proposed methods are computationally different and in some cases are at odds with each other in term of the outcomes, the basic idea of these methods is to identify major and persistent deviations from a long-run trend which is estimated by using either the Hodrick-Prescott (HP) filter or the growth rate's moving average. For instance, according to Bordo and Jeanne (2002) and Borio and Lowe (2002), the boom and bust cycles of asset price occur when the three-year moving average of its price growth rate falls outside a confidence interval defined by reference to the historical first and second moments of the series. Detken and Semts (2004) calculate the long-run trend using the recursive HP filter, and then define the boom as a period in which the asset prices are more than 10% above the calculated trend. Agnello and Schuknecht (2011) use the triangular method proposed by Harding and Pagan (2002) to calculate the severity of changes in the house price cycles. After that the severity index is sorted in ascending order. This method identifies booms as those episodes that fall above the third quartile of the empirical distribution of the severity index, while bust episodes must fall below the first quartile of the severity index' distribution. In the majority of these studies, the price cycles are derived from a long-run trend which is estimated using the HP filtering method. This type of decomposition has also been widely used in macroeconomic applications by national and international economic institutions, such as central banks, governments, and international economic agencies. However, the HP filtering method has often been subject to criticism and some of its drawbacks have been known for quite some time. Cogley and Nason (1995) find that the HP filter can generate spurious cycles when it is applied to a persistent time series. Similar issues have been found when the HP filter was used to detrend series of credit, credit gap, house prices, equity prices, and bond prices (Schüler, 2018). More recently, Hamilton (2018) joined

this line of criticism revealing some serious potential shortcomings with the HP filter. Hamilton even went further to suggest that the HP filter should never be used for any purpose. Besides the spurious cycle problem which already been known, Hamilton finds that values filtered by HP filter at the end of the sample are very different from those in the middle and are also characterized by spurious dynamics. Hamilton also stresses that the standard implementation of the HP filter stands at stark odds from its statistical foundations. To avoid these drawbacks, Hamilton proposes a linear model in which the non-stationary time series is dependent on a constant and its four more recent values back-shifted by two years. The cyclical component in this method is obtained from the residuals (More details on HP and Hamilton's methods available in the appendix C.1).

To empirically illustrate the differences between the HP filter and Hamilton's regression filter, both methods are applied to a series of home price indexes from three emerging markets, namely South Africa, South Korea, and Thailand. More specifically, Hamilton's filter is based on two-year regression while the HP filter is applied with the smoothing parameter $\lambda = 1600$. Then, the boom periods are identified by applying a threshold approach to the cycles obtained from both filters. The threshold method applied here is similar to the one used in Mendoza and Terrones (2008) for identifying credit booms. According to this method, the boom period is defined as the period when the cyclical component of the house price index is above one standard deviation.

The house price cycles obtained from the HP filter and Hamilton's regression filter are presented in figure 3.1, while the housing booms based on the two methods are shown in the figures 3.2 and 3.3. The first thing to note from figure 3.1 is the remarkable differences between the cycles of HP filter and Hamilton's filter in the case of house prices in Thailand. The house price cycles in South Africa and South Korea also show a relatively wide gap between the two filters, but this gap becomes smaller toward the end of the sample. Furthermore, the detrended series of HP filter seem to have greater fluctuations than the detrended series of Hamilton's filter. As it is shown in figures 3.2 and 3.3, the length of the housing booms is considerably different between the cycles of the two filters. The booms identified based on Hamilton's filter span over a longer period, there are also some common boom periods between the two filters. In regard to these common boom periods, the ones identified by Hamilton's filter start a year earlier than those identified by HP filter, while the booms based on HP filter often end a quarter ahead

of the boom periods identified based on Hamilton's filter. The differences between the housing booms identified by both filters are more pronounced in the cases of South Korea and Thailand, whereas in South Africa, the boom periods based on the detrended house prices of HP and Hamilton's filters are not remotely different.

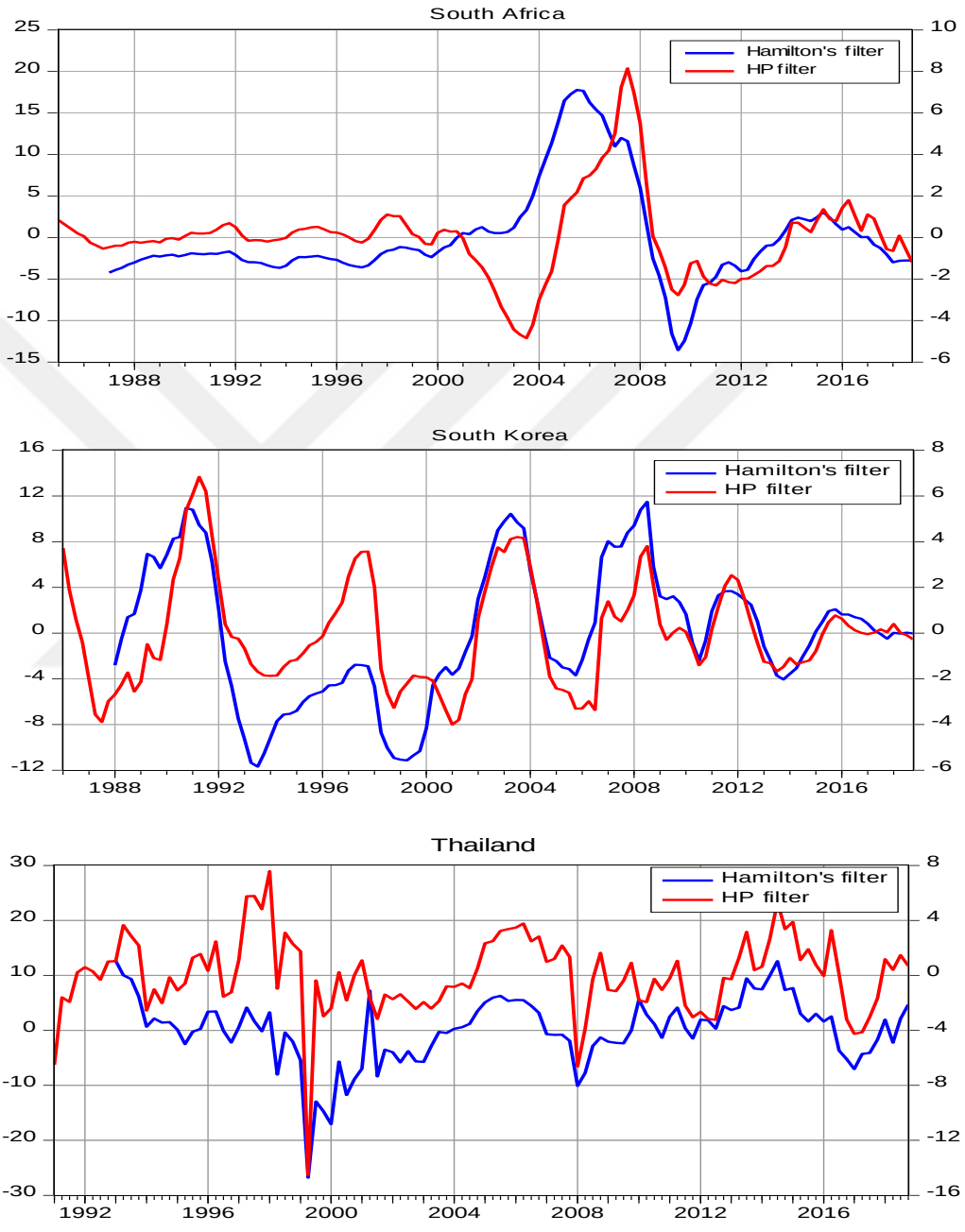


Figure 3.1. *House price cycles in selected emerging markets* (HP filter on the right axis)

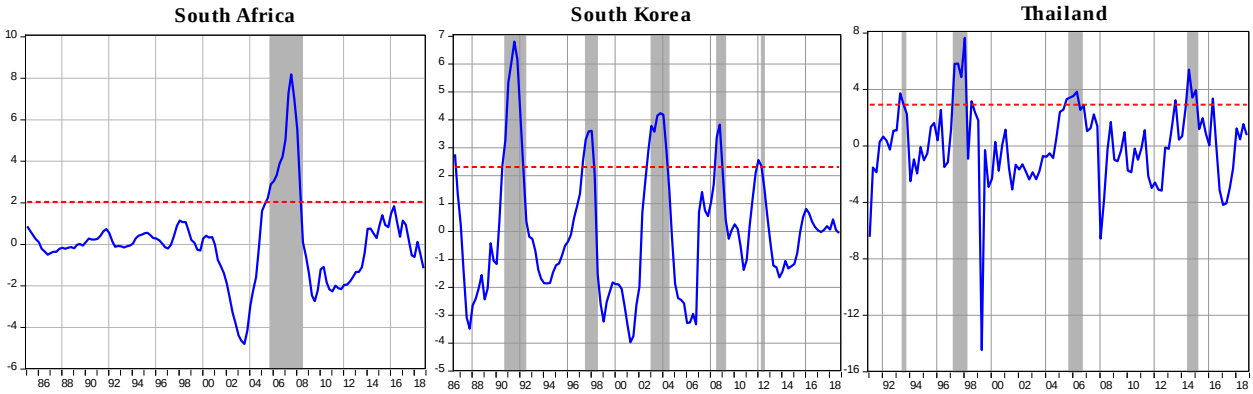


Figure 3.2. *House price booms based on HP filter*. The blue line represents the cycles, the red dashed line represents standard deviation, shaded areas represent the boom episodes.

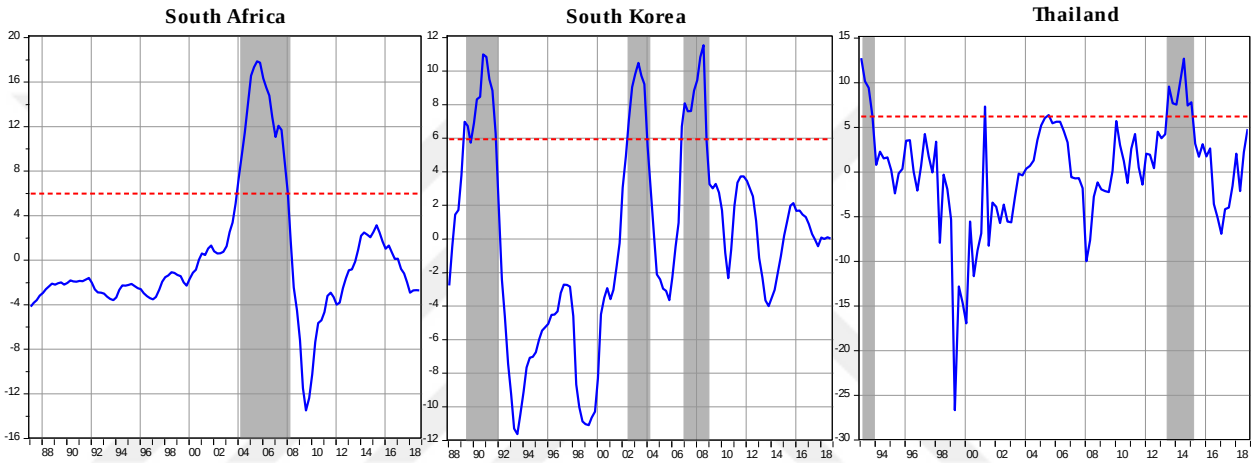


Figure 3.3. *House price booms based on Hamilton's filter*. The blue line represents the cycles, the red dashed line represents standard deviation, shaded areas represent the boom episodes.

3.3. Literature review

There have been numerous empirical works on the impact of foreign capital flows on the house prices. However, the existence of a strong association between capital flows and house prices is still not clearly established.

Some recent studies focus on the relationship between current account deficits and house prices applying panel linear regression to a large sample of advanced and emerging economies. Aizenman and Jinjarak (2009) employing a panel of 43 countries find that one standard deviation increase in lagged current account deficits is associated with a 10% appreciation of real estate prices. Favilukis et al. (2012) also use the current account deficit as a broad measure of capital inflows to study its impact on house prices in both US and international data. Unlike Aizenman and Jinjarak (2009), they find that house price movements are largely explained by credit supply, whereas capital inflows have no explanatory power to house prices in the panel of international data. Similarly, Jinjarak

and Sheffrin (2011) find little evidence for the causal impact of current account deficits on real estate prices in the United States, Spain, and Ireland.

On the other hand, evidence from studies using panel vector autoregressive models show a significant and often a strong relationship between capital inflows and house prices. Cesa-Bianchi et al. (2014) using a panel sample of 30 EMs and 21 AEs, find that house prices in EMs are more closely associated with capital inflows than in AEs, and that the global liquidity shock has a stronger impact on house prices in EMs. In another study, Cesa-Bianchi et al. (2018) find a persistent effect of international credit supply on house prices in the same group of the emerging and advanced economies they used in their previous study. In Banti and Phylaktis (2019) the availability of collateralized funding in the REPO markets of the main financial systems is used to measure the global liquidity. The findings of this study also show a significant impact of global liquidity shocks on house prices in both advanced and emerging economies. Tillmann (2013) studies the response of property prices to inflows of foreign capital using a sample of Asian emerging market economies, he finds not only a significant impact of capital inflow shocks on house prices, but also that the dynamics of capital inflows explain a significant portion of house price movements. Focusing on OECD countries, Sá et al. (2014) find that shocks of monetary policy and capital inflows have a significant and positive effect on real house prices, they also find that the responses of housing variables to both types of shocks are stronger in countries with more developed mortgage markets. Gholipour (2012) investigates the effects of foreign real estate investments on house prices using panel data of 21 emerging economies. Their findings indicate a significant, yet minor contribution of foreign real estate investments to the increases in house prices.

The panel data approaches are commonly used in the studies on capital flows and house prices relationship, probably to overcome issues of small sample size and data constraints especially in emerging markets. However, many of the studies on this subject have been carried out using a single country sample. Yiu and Sahminan (2017) carry out a linear regression analysis on data of the major five ASEAN economies namely Indonesia, Malaysia, Philippines, Singapore, and Thailand. Except in Thailand, the impact of capital inflows on house prices is found statistically significant in all the other countries. Ncube et al. (2016) use a sign restricted VAR model to study the impact of capital inflows on various South African asset prices and macroeconomic variables

including house prices. Their results indicate that shocks in capital inflows lead to significant appreciation in house prices. Feng et al. (2017) analyze the impact of FDI and short-term capital flows on stock and house prices in China using the local projection method. They find that short-term capital flow shocks have an instant influence on both stock and house prices, while FDI net inflow shocks have delayed effects on house prices. Su et al. (2017) also study the relationship between international capital flows and house prices in China using full-sample bootstrap causality and time-varying rolling-window bootstrap causality tests. The full-sample causality tests showed no causal relationship between the two variables, while the rolling-window bootstrap causality test showed that international capital flows did Granger cause house prices in several sub-periods. Based on cointegrated VAR and structural Bayesian VAR analysis, Cuestas (2017) finds that capital inflows and house prices have mutually affected each other during the great moderation period in Spain.

3.4. Data and empirical methodology

3.4.1. Data

In most of the emerging markets, the time dimension of house price data is not long enough to allow carrying out individual regression analysis. The most comprehensive data on house prices is provided by BIS and OECD databases. Unfortunately, house price indexes for most of the emerging markets in these databases are available only after the year 2000. In addition, the macroeconomic variables relevant to this study, such as short-term interest rates and quarterly GDP, are available over a short span in most of the emerging markets. Relying on panel data techniques has been one of the solutions to solve this problem, but the panel data approach may mask significant cross-country variations. Due to these data limitations, the empirical analysis in this study is confined to emerging countries for which the data sample goes back to early 1990s and beyond. Since our methodology follows a time-varying parameters approach, such long sample allows us to cover as many boom periods as possible. South Africa, South Korea, and Thailand are among the few emerging market economies whose house price indexes cover a long period. Quarterly data for these three countries were collected using multiple sources. The house price indices and short-term interest rates for South Africa and South Korea were retrieved from OECD database. As for Thailand, the house price index was obtained from BIS. The short-term interest rate is not available, so the lending interest

rate is used instead. This variable is extracted from IMF's interest rates data. It should be noted that the short-term interest rate and the lending interest rate often move concurrently. The variables of quarterly GDP, CPI, and foreign capital flows were retrieved from IMF databases (IFS, BOP). Finally, the variable of credit to private non-financial sectors is obtained from BIS database. Statistical descriptive of the variables is provided in table 3.1.

Table 3.1. *Descriptive statistics*

Country	Variables	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
South Africa	HPI	44.15792	25.49267	36.73138	0.517365	1.716680	15.39960
	FDI	0.264571	0.154033	0.581090	5.449536	44.37968	9918.284
	FPI	0.650686	0.457670	1.019377	0.456402	4.726711	20.66317
	OFI	0.154140	0.083238	0.651390	0.200943	3.137009	0.976539
	CPI	1.970078	1.834183	1.285771	0.283490	3.013968	1.742338
	Interest rate	14.50390	14.50000	4.220904	0.283442	1.982547	7.348081
	Credit growth	2.978593	2.902094	1.585038	-0.305350	4.551156	14.24257
	GDP	1542813.	1012393.	1346522.	0.841196	2.404746	2.404746
South Korea	HPI	70.68674	64.53744	20.86993	0.220858	1.684965	10.50417
	FDI	0.929922	0.833154	2.910864	0.919404	3.724887	18.06836
	FPI	1.717678	1.816195	-0.37828	-0.378285	4.755369	16.89844
	OFI	0.522832	0.561269	3.376296	-1.142228	9.637981	227.9271
	CPI	0.841753	0.728631	0.827436	1.903598	10.12601	301.8955
	Interest rate	6.858490	4.656667	5.343710	1.020805	2.811269	19.44254
	Credit growth	2.388548	2.021629	1.840635	0.042315	3.962380	4.355570
	GDP	1.90E+08	1.72E+08	1.25E+08	0.320297	1.851666	9.437630
Thailand	HPI	91.38464	85.53000	20.53908	0.560948	2.277375	8.162165
	FDI	2.781552	3.041755	2.119828	-1.177141	9.757692	221.9059
	FPI	1.023976	1.059893	2.836510	0.131268	3.658222	2.176119
	OFI	-0.37295	0.384926	6.545882	-0.229679	3.511010	2.045950
	CPI	0.691886	0.586610	0.954913	0.054540	6.769389	61.62085
	Interest rate	7.304109	5.775855	3.330771	1.042037	2.713840	19.17611
	Credit growth	1.677942	1.459855	2.794964	-0.535370	3.767608	7.521395
	GDP	2159484.	2029988.	998219.8	0.393881	1.823715	8.684929

3.4.2 Empirical methodology

3.4.2.1 Time-Varying Tests of Granger Causality

The Granger causality test has often been the typical test to analyze the dynamic relationship between bivariate time series. However, it is well known that the Granger causality is sensitive to the time period of estimation. In many studies, the causal links are found to be varying across subsamples. In this situation, a full-sample test is ineffective because it fails to capture the changes in the relationship. This issue has pointed to the need for an endogenous approach to ascertain the dates of changes in the

Granger causality. In this regard, several methods have been proposed to deal with the time-varying nature of causal relationships. The earlier time-varying causality methods proposed by Thoma (1994) and Swanson (1998) involve using a forward expanding window or rolling window version of the Granger causality test. A similar procedure has been later implemented in other studies such as Balcilar et al. (2010) and Arora and Shi (2016). Recently, Shi et al. (2018) proposed a new recursive test based on the work of Phillips et al. (2015a,b).

The testing procedure proposed by Shi et al. (2018) is as follows. For each observation of interest ($f \in [f_0, 1]$), the Wald statistics are computed for a backward expanding sample sequence. The endpoint of the sample sequence is fixed at f. However, the starting point of the samples extends backward from ($f - f_0$); which is the minimum sample size to accommodate the regression to 0. The Wald statistic obtained for each subsample regression is denoted by $W_{f_2}(f_1)$ and the sup Wald statistic is defined as

$$\sup W_f(f_0) = sup\{W_{f_2}(f_1): f_1 \in [0, f_2 - f_0], f_2 = f\} \tag{3.1}$$

The origination and termination points in the causal relationship are denoted by f_e and f_f. In the case of a single switch, the dating rules are given by the following crossing times:

Forward:

$$\hat{f}_e = \inf_{f \in [f_0, 1]} \{f: W_f(0) > cv\} \text{ and } \hat{f}_f = \inf_{f \in [\hat{f}_e, 1]} \{f: W_f(0) < cv\} \tag{3.2}$$

Rolling:

$$\hat{f}_e = \inf_{f \in [f_0, 1]} \{f: W_f(f - f_0) > cv\} \text{ and } \hat{f}_f = \inf_{f \in [\hat{f}_e, 1]} \{f: W_f(f - f_0) < cv\} \tag{3.3}$$

Recursive rolling:

$$\hat{f}_e = \inf_{f \in [f_0, 1]} \{f: SW_f(f_0) > scv\} \text{ and } \hat{f}_f = \inf_{f \in [\hat{f}_e, 1]} \{f: SW_f(f_0) < scv\} \tag{3.4}$$

where cv and scv are the corresponding critical values of the W_f and SW_f statistics. In case of multiple switches in the same period, the origination and termination of the ith causal relationship are denoted by f_{ie} and f_{if} for successive episodes $i = 1,2, \dots, I$. The same procedure of a single switch case is used for the estimation of dates associated with the first episode.

The Wald statistics of the subsamples have two forms, homoskedastic and heteroskedastic. Under the assumption of homoskedasticity, the Wald statistic follows the usual form which is given by

$$\mathcal{W}_{f_2}(f_1) = \left(\mathbf{R}\hat{\pi}_{f_1,f_2}\right)' \left\{ \mathbf{R} \left[\widehat{\Omega}_{f_1,f_2} \otimes \left(\sum_{t=\lfloor Tf_1 \rfloor}^{\lfloor Tf_2 \rfloor} x_t x_t' \right)^{-1} \right] \mathbf{R}' \right\}^{-1} \left(\mathbf{R}\hat{\pi}_{f_1,f_2}\right) \qquad (3.5)$$

where **R** is the coefficient of the restriction matrix, $\hat{\pi}_{f_1,f_2}$ is the estimated coefficient of the population, $\widehat{\Omega}_{f_1,f_2}$ is the estimator of the residual variance matrix. The heteroskedasticity consistent version of the Wald statistic is denoted by $\mathcal{W}_{f_2(f_1)}$ and defined as

$$\mathcal{W}_{f_2(f_1)} = T_w\left(\mathbf{R}\hat{\pi}_{f_1,f_2}\right)' \left[\mathbf{R} \left(\widehat{\mathbf{V}}_{f_1,f_2}^{-1} \widehat{\sum}_{f_1,f_2} \widehat{\mathbf{V}}_{f_1,f_2}^{-1} \right) \mathbf{R}' \right]^{-1} \left(\mathbf{R}\hat{\pi}_{f_1,f_2}\right) \qquad (3.6)$$

where $\widehat{\mathbf{V}}_{f_1,f_2} \equiv \mathbf{I}_n \otimes \widehat{\mathbf{Q}}_{f_1,f_2}$ with $\widehat{\mathbf{Q}}_{f_1,f_2} \equiv \frac{1}{T_w}\sum_{t=\lfloor Tf_1 \rfloor}^{\lfloor Tf_2 \rfloor} x\, x'$, and $\widehat{\sum}_{f_1,f_2} \equiv \frac{1}{T_w}\sum_{t=\lfloor Tf_1 \rfloor}^{\lfloor Tf_2 \rfloor} \hat{\xi}_t \hat{\xi}_t'$ with $\hat{\xi}_t \equiv \hat{\xi}_t \otimes x_t$. The corresponding heteroskedasticity consistent sup Wald statistic is

$$SW_f^*(f_0) = \sup_{(f_1,f_2) \in \Lambda_0, f_2 = f} \left\{ \mathcal{W}_{f_2}^*(f_1) \right\} \qquad (3.7)$$

3.4.2.2. Flexible least squares (FLS)

The FLS method was introduced by Kalaba and Tesfatsion (1989) as a generalization of the standard linear regression in order to allow for time-variant regression coefficients. A time-varying coefficients model estimated by FLS can be written as follows

$$y_t = x_t'\beta_t + \mu_t, \qquad t = 1, \dots \dots, T \qquad (3.8)$$

where $x_t = \left(x_{0,t}, \dots, x_{K-1,t}\right)$ denotes a $K \times 1$ vector of known independent variables, and $\beta_t = \left(\beta_{0,t}, \dots, \beta_{K-1,t}\right)$ denotes the $K \times 1$ vector of the coefficients to be estimated. As it is known in the standard ordinary least squares, the best estimators are those whose values minimize the error function

$$C(\beta) = \sum_{t=1}^{T} (y_t - x_t'\beta)^2 \qquad (3.9)$$

However, the FLS method imposes two conceptually distinct types of error, measurement and dynamic, specified as

$(y_t - x_t'\beta) \approx 0, t = 1, \dots, T$

$\beta_{t+1} - \beta \approx 0, t = 1, \dots, T-1$

The measurement and dynamic specifications reflect the prior beliefs of linear measurement and coefficient stability in a simple direct way, without augmentation by any stochastic restrictions. The two types of error are assigned to each possible coefficient to be estimated. For each coefficient, the squared residual measurement error and squared residual dynamic error are summed as

$$C(\beta_1, \dots, \beta_T, \mu, T) = \mu \sum_{t=1}^{T} (\beta_{t+1}, \beta_t)' D(\beta_{t+1}, \beta_t) + \sum_{t=1}^{T} (y_t - x_t'\beta)^2 \qquad (3.10)$$

where μ is the weighting parameter, D is a fixed dynamic scaling $(K \times K)$ matrix. Like Tesfatsion and Veitch (1990), D is defined as a diagonal matrix with ith diagonal term $d_{ii} = (x_{1i}^2 + \cdots + x_{Ti}^2)/T$, $t = 1, \dots, T$. Therefore, the multiplication of a regressor by a constant cannot cause any changes in the shape of the time path of the corresponding coefficients.

It is important to note that the weighting parameter μ is the only parameter whose value needs to be determined prior to estimation. Some authors such as Darvas and Varga (2012, 2014) argue that FLS smoother with a weighting parameter 100 works reasonably well and typically outperforms other methods used to uncover the time-varying parameters such as the Kalman filter. In addition, as stated by He (2005) the parameter μ plays an important role in the coefficient variation over time. As μ approaches 0, the squared residual measurement error can generally be reduced to 0 and the corresponding value for the squared residual dynamic error will be relatively large. Thus, β_t tend to become more volatile as the value of μ decreases. The FLS method has many advantages. Unlike standard OLS, it does not require the imposition of problematic distribution assumptions on the model's residuals. In addition, it can deal with stochastic processes generated by unit root or unknown breakpoints.

3.5. Empirical analysis

3.5.1. Analysis of the time-varying causality

The results of time-varying Wald test statistics for the causal relationship between growth rate of the house price index (HPG) and gross capital inflows (CFI) are displayed in the figures 4, 5 and 6 for the three emerging countries South Africa, South Korea, and Thailand respectively. The gross capital inflows are expressed as a percentage of GDP. The sequences of Wald test statistics are obtained from the rolling window and recursive-

evolving procedures, these procedures are implemented using minimum window size with a 4-year span for all the selected emerging markets. The selected lag order is assumed to be the same for all the subsamples. The null hypothesis of no Granger causality can only be rejected once the Wald test statistics rise above the 5% critical value sequence. A summary of causality intervals is provided in the appendix C.2.

With regard to South Africa, as it is shown in figure 3.4, the homoskedastic Wald test statistics with both procedures have detected four intervals of causality running from gross capital inflows to growth of home prices. The rolling homoskedastic test statistics, however, show short-lived Granger-causal links running from gross capital inflows to house prices. According to this test, the gross capital inflows have Granger caused house prices growth in the periods Dec-1997, Jun-Sep 2000, Mar-Sep 2001 and Jun-Dec 2017. The causality intervals detected by the recursive evolving procedure under the homoskedasticity assumption are much longer, the first interval of causality from gross inflows toward house prices extends over the period between Jun-1995 and Mar-1997. The second, third and fourth intervals span over the periods Dec 1997-Mar 1998, Jun 2000-Sep 2002, and Jun 2014-Dec 2016 respectively. Although the rolling and recursive evolving procedures disagree on the starting and termination dates of the causality episodes, there is little overlap between some causality intervals. Nonetheless and rather surprisingly, none of the causality intervals detected by both procedures coincide with the periods of the housing boom in South Africa. Moreover, the rolling and recursive evolving procedures under the heteroskedasticity assumption indicate no change in the causal relationship over the entire sample period. Similarly, by reversing the causality direction from gross capital inflows to house prices growth to the opposite direction, the Wald test statistics in panel (b) show an unequivocal failure to reject the null hypothesis over the entire sample period, which indicates that house prices have never had any impact on gross capital inflows.

The interactions between the growth of house prices and gross capital inflows in South Korea and Thailand are more intense compared to South Africa. More importantly, the episodes of housing booms occur within the causality intervals of capital inflows and house prices in the two countries. On the evidence from South Korea, which is presented in figure 3.5, the rolling window procedure under homoskedasticity assumption has once again detected causality intervals considerably shorter than the episodes detected by the procedure of the recursive evolving window under the same assumption. From figure 3.5,

as indicated by the rolling homoskedastic Wald statistics, it can be concluded that the gross capital inflows to South Korea have caused home prices growth in the periods Jun-Sep 2006, Mar-Jun 2007, and Jun 2010-Jun 2012. Meanwhile, the recursive evolving heteroskedastic Wald test shows evidence of a causal impact of gross capital inflows on house price growth in the periods Mar-Sep 1999, Jun 2001-Dec 2008, and Jun 2010-Sep 2018. In addition, we find a significant overlap between the causality episodes detected under homoskedasticity assumption. The heteroskedastic version of the rolling and recursive evolving procedures also indicate existence of causal impact of gross capital inflows on house prices growth. The causality intervals shown by these procedures are remarkably shorter compared to the homoskedasticity tests. The heteroskedastic rolling Wald test suggests that the gross capital inflows have Granger caused house prices growth during the periods Mar 1998 and Sep 1998-Mar 1999. As for the recursive evolving heteroskedastic Wald test, the evidence of causal impact of gross capital inflows on house price growth is found during the periods Mar 1999 and Sep 98-Jun 1999. On top of this, the causality intervals identified by the rolling and recursive evolving procedures under the heteroskedasticity assumption seem to have witnessed a bi-directional causality between gross capital inflows and house price growth. During these episodes, the homoskedastic Wald statistics in panel (b) show evidence of causal impact of house price growth on gross capital inflows.

The estimation results for Thailand given in figure 3.6, show a highly dynamic relationship between gross capital inflows and house prices growth. Under the homoskedasticity assumption, one could clearly notice very limited evidence of Granger causality running from gross capital inflows to house prices. Under this assumption, the rolling and recursive evolving Wald statistics point out to sharp rise in the causal impact of gross capital inflows on house prices at the end of the sample, implying that null hypothesis of no Granger causality from gross capital inflows to house prices growth can be rejected only for a brief period starting from Mar 2017. In addition, for the first time, we obtain similar starting and termination dates between different testing procedures. However, there seems to be remarkable disagreement in terms of duration and timing of causality episodes between the rolling and recursive evolving tests under the heteroskedasticity assumption. The heteroskedastic rolling Wald statistics indicate that the gross capital inflows have affected house prices growth during the periods Sep-Dec 2001 and Jun 2005. On the contrary, the heteroskedastic recursive evolving Wald

statistics show a strong causal impact of gross capital inflows on house prices growth spanning over a long period start from Sep 2003 through Mar 2012. This impact is also detected in the periods between Sep-Mar 2003 and Mar 2012-Dec 2016. Similar to the case of South Korea, we find evidence of bi-directional causality between gross capital inflows and house prices growth in Thailand. As indicated by the rolling and recursive evolving homoskedastic Wald statistics in panel (b), a significant causal impact of house prices growth on gross capital flows is found during the same periods in which gross capital inflows are Granger causing house prices growth.

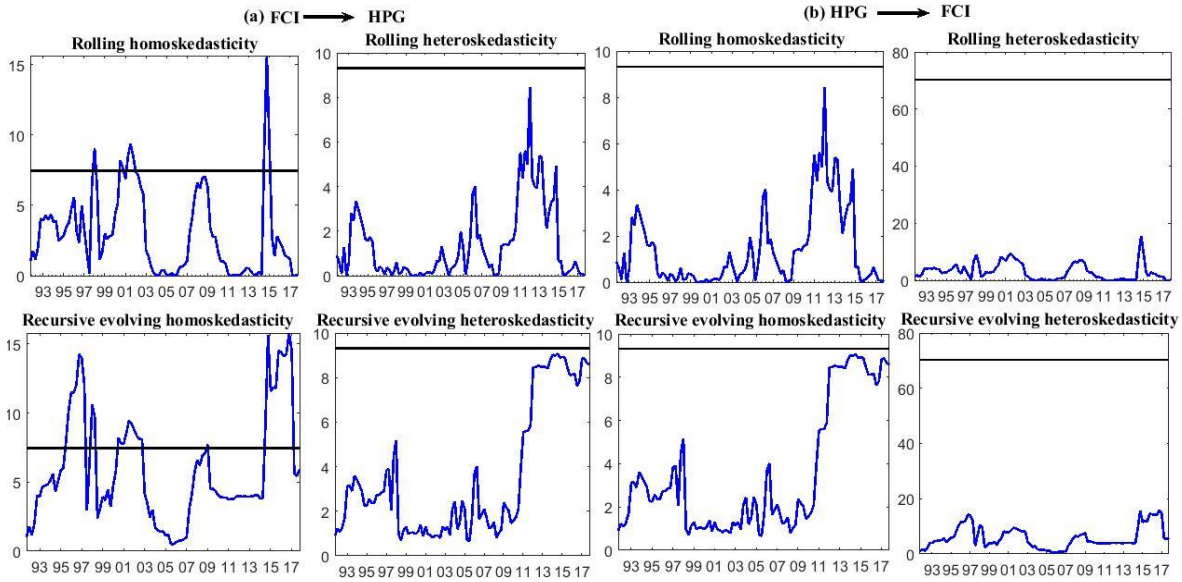


Figure 3.4. *The time-varying causality between FCI and growth rate of HPI in South Africa*. The arrow refers to the causality direction, the blue line represents the test statistic sequence, the black line represents the 5% critical value sequence.

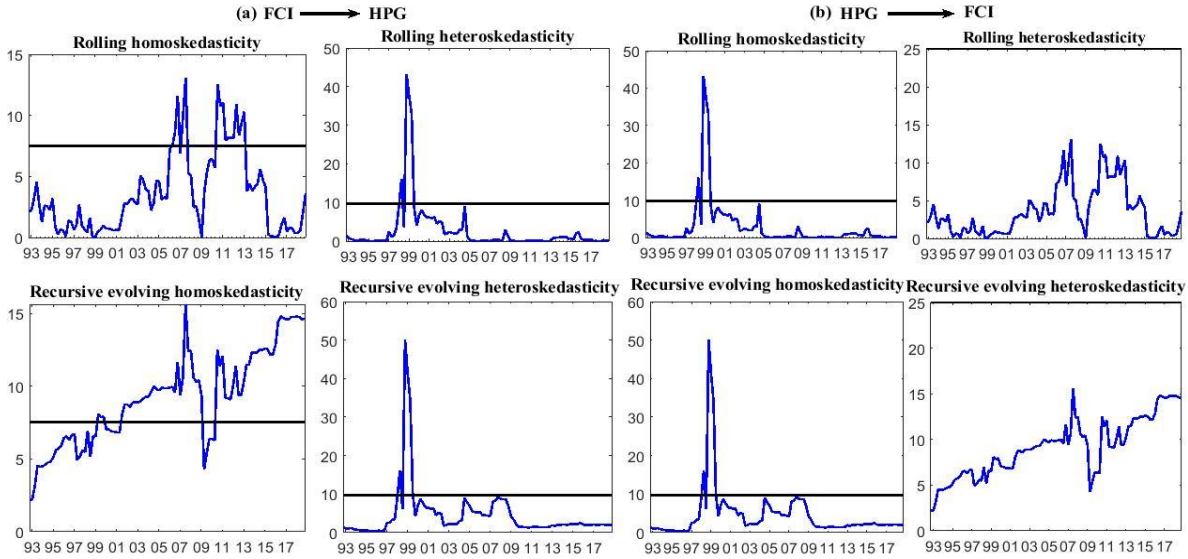


Figure 3.5. *The time-varying causality between FCI and growth rate of HPI in South Korea*. The arrow refers to the causality direction, the blue line represents the test statistic sequence, the black line represents the 5% critical value sequence.

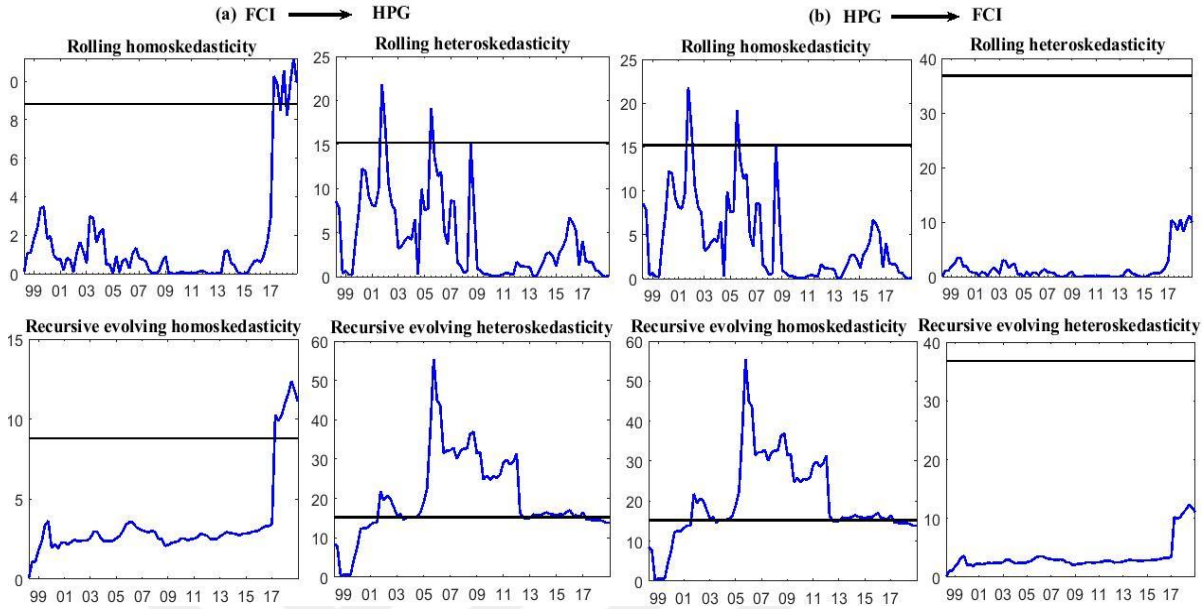


Figure 3.6. *The time-varying causality between FCI and growth rate of HPI in Thailand*. The arrow refers to the causality direction, the blue line represents the test statistic sequence, the black line represents the 5% critical value sequence.

3.5.2. The time-varying impact of foreign capital inflows on house prices

The role played by the housing market at the onset of the last global recession has motivated many researchers to study the impact of international capital flows on house prices with special focus on the housing boom periods. For instance, Olaberría (2014) and Jara and Olaberría (2013) construct an indicator for price boom, in which only the deviations from the trend during boom periods are considered. Cesa-Bianchi et al. (2014) estimate the impact of capital inflows on house price changes corresponding to the boom episodes. The price movements in other periods and its drivers were censored in order for the boom episodes to stand out. Although this method proved to be useful if one is only interested in the drivers of the boom in asset prices, it still generates a general cumulative one-point estimation of the impact of foreign capital flows during the boom episodes collectively. In doing so, it disregards the possibility that foreign capital inflows might have not contributed at least to some of the asset boom episodes. In contrast, by using full-sample regression, the price behaviors characterizing each cycle and its relevant determinants would be also reduced to one-point estimation. Obviously, there are some compromises in both approaches. One way to overcome these compromises is to generalize the one-point estimations throughout the cycles of the sample period by

using the time-varying parameter regression method. In addition, we argue that not all the boom episodes of house prices were mainly prompted by foreign capital inflows. Therefore, to empirically test the merit of this argument, the impact of foreign capital inflows on house prices during boom episodes needs to be distinguished from other periods. For this purpose, the FLS method of Kalaba and Tesfatsion (1989) is applied to the following model

$$Y_{it} = X_t B_{1t} + Flows_t B_{2t} + \varepsilon_t \tag{3.11}$$

where Y_{it} is Hamilton's cyclical component of the house price index. X_t is a vector of control variables include the consumer price index (CPI), interest rate, and credit growth. $Flows_t$ represents the components of foreign capital inflows i.e. foreign direct investments (FDI), foreign portfolio flows (FPI), and other foreign investments (OFI). These variables are taken as a percentage of GDP. The terms B_{1t} and B_{2t} are the time series of time-varying coefficients generated by the FLS method. The coefficient estimates for the independent variables were derived using a smoothness weight $\mu = 100$. The choice of μ determines to some extent the coefficient variations. Kalaba and Tesfatsion (1989) argue that the FLS estimates for each coefficient b_{it} at time t contracts toward its corresponding OLS value as the smoothness weight becomes arbitrarily large. The time paths of the coefficients estimated by FLS are depicted in figures 3.7, 3.8 and 3.9 for the countries South Africa, South Korea, and Thailand, respectively. The time paths of FLS estimates show a rise in the impact of foreign capital flows on house prices during the boom episodes. The extent of this impact not only differs across the selected emerging market countries, but it is also found to be dependent on the component of the capital inflows. The sharp increase during the boom episodes is also observable in the time paths of control variables' coefficients. For instance, in South Africa, the OFI's time-varying impact begins to gradually increase during the period up to the beginning of the boom before reaching its peak during the boom episode. This peak is followed by a sharp decrease in the impact of OFI on house prices. The same pattern is noticed in the time path of FDI impact. The upward trend of FDI, however, starts shortly before the house prices breaking to an extreme level. The time path of FPI's coefficients does not show any significant shift during the boom episode, suggesting that the FPI has not largely contributed to the build-up of the housing boom. Notice also that there is a dramatic decline in the FPI impact during the boom and post-boom periods. The decline noticed in the time-varying coefficients of FDI and other capital inflows simultaneously

occur with the break-out of the 2008 global recession. In addition, the time paths of FDI and OFI coefficients before and during the boom episode leave no doubt that foreign capital inflows have caused boom-bust cycles in the South African housing market. Nevertheless, the time-varying impact of interest rate and credit growth should not be neglected as the time paths of both variables' coefficients show a dramatic increase during the boom episode.

In the case of South Korea, the time paths of coefficient estimates traced out by FLS also show a significant overall increase in the time-varying impact of the capital flows and the control variables during the second and third episodes of the housing boom. The difference between the components of foreign capital inflows is that FDI seems to be exerting downward pressures on house prices in South Korea throughout the sample period. The FDI time-varying impact, even though, remains negative, becomes gradually less effective toward the end of the sample period and especially during the boom episodes. This, in general, can be held as a demonstration of the Krugman (2000) argument that FDI may help flatten cycles in asset prices through fire-sale FDI during busts. The downward price pressures of FDI seem to be overwhelmingly contrasted by the positively trending time paths of FPI, CPI, credit growth and interest rate's coefficients over most of the sample period and particularly during the second and third episodes of the housing boom. The time paths of the coefficients of these variables reach their heights during the boom episodes. The culmination of time path of CPI coefficients may indicate that the house prices were also driven by the overall increase in commodity prices. The time path of OFI coefficients, on the other hand, has taken on a direction opposing the time paths of the other variables' coefficients. In fact, the time-varying impact of OFI precipitously picked up at some time points without causing an extreme increase in house prices. Interestingly, time-varying impact of OFI is found to be gradually decreasing before and during the second housing boom episode. However, time path of OFI coefficients picked up again shortly before the third housing boom episode. The Korean housing market seems to be also affected by the sudden reversal of international capital inflows induced by the 2008 global crisis at the end of the third housing boom.

The empirical results paint a different picture for the case of Thailand. Unlike the cases of South Africa and South Korea, we find evidence of limited impact of capital inflows on the housing market in Thailand during the housing booms. The strongest

impact of capital inflows, especially FPI and OFI, are observed in other periods rather than during the housing boom episodes. The time path of time-varying coefficients shows a slight increase in the impact of OFI during the second housing boom in Thailand, but it is still far less than impact recorded in other periods. Similarly, FPI's impact on house prices has been negative in the second housing boom, meaning that FPI has been driving the house prices down during this period. By contrast, FDI is the only component of capital inflows whose coefficients' time path shows an increasing trend throughout most of the sample period reaching its peak during the second housing boom episode. The time-varying coefficients of credit growth, although, found to be negative throughout the sample period, it shows an increasing impact during the housing boom and other periods. The time-varying impact of credit growth seems to be growing in tandem with the time-varying impact of interest rate as evidenced by the co-movements of the time paths of the two variables impact. The interest rate, however, had the sharpest impact during the housing boom episode.

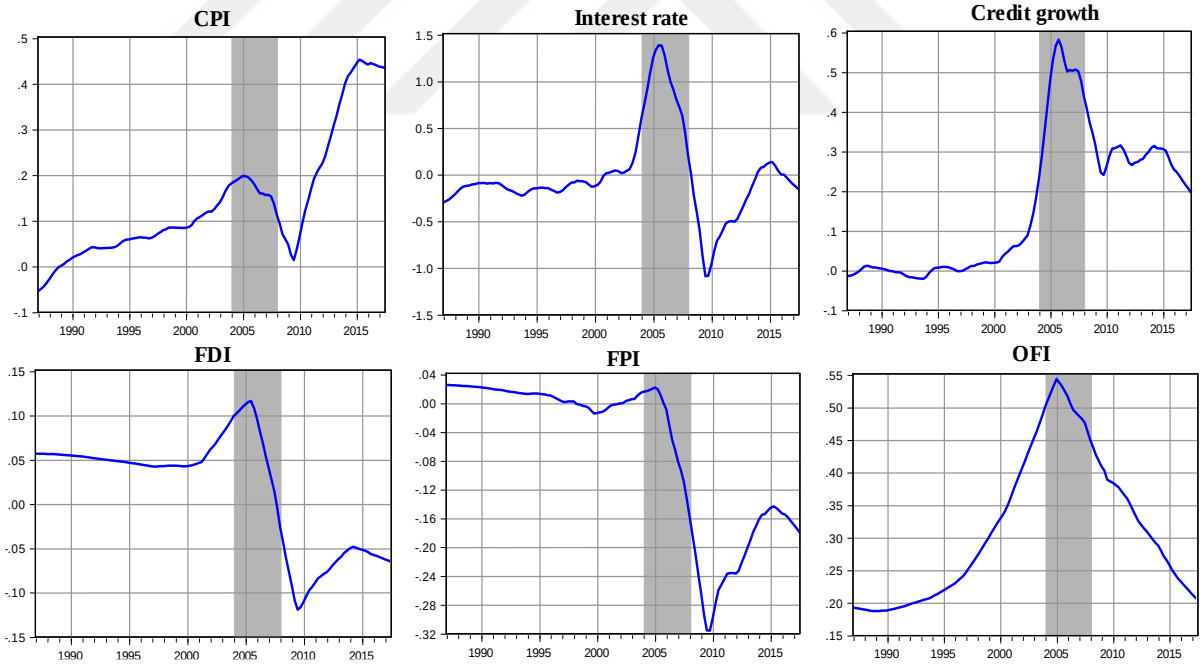


Figure 3.7. *Time paths of the coefficients for the house prices boom model in South Africa*, with smoothness weight $\mu = 100$ over the period 1987Q1:2017Q3. The shaded areas represent the housing boom periods given by Hamilton's filter.

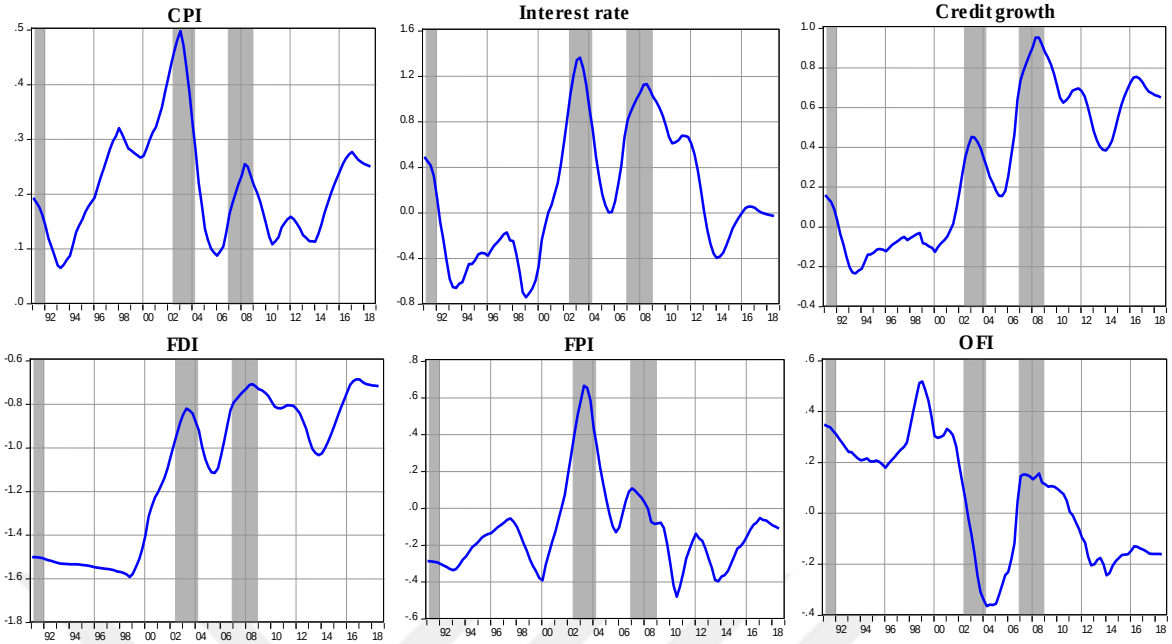


Figure 3.8. *Time paths of the coefficients for the house prices boom model in South Korea*, with smoothness weight $\mu = 100$ over the period 1991Q1:2018Q4. The shaded areas represent the housing boom periods given by Hamilton's filter.

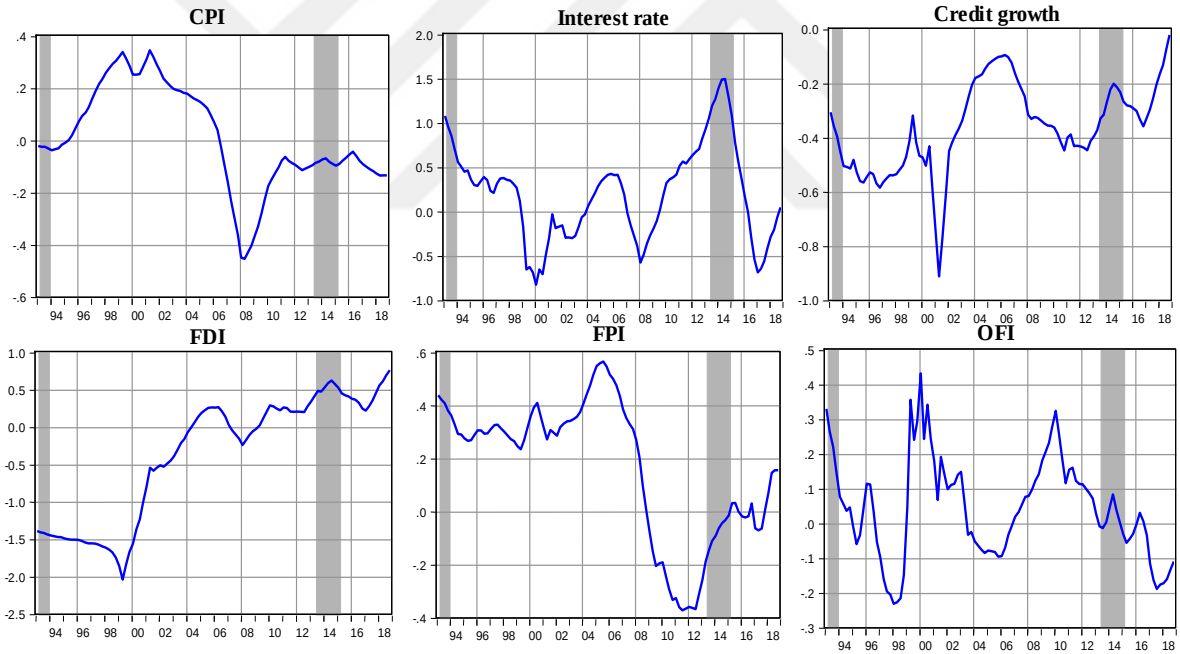


Figure 3.9. *Time paths of the coefficients for the house prices boom model Thailand*, with smoothness weight $\mu = 100$ over the period 1993Q1:2017Q4**.** The shaded areas represent the housing boom periods given by Hamilton's filter.

3.6. Conclusion

In this study, several methods are used to investigate the housing boom and its relationship with the foreign capital inflows in three emerging markets i.e. South Africa, South Korea, and Thailand. The choice of estimation period and the set of countries are dictated by the empirical requirements and data availability. The empirical models of this study rely on time-varying parameter regression methods which require a long time dimension to capture the change in the regression's parameters. Before delving into the empirical analysis, we identified the housing boom episodes in the three countries using the HP filter and the novel filtering method proposed by Hamilton (2018). The HP filter, despite its serious drawbacks, has been widely used to derive business cycles and cyclical components of many financial and non-financial assets. Hamilton's regression filter addresses these drawbacks by using the residuals from a linear model containing the non-stationary time series and its four lagged values back-shifted by two years. By applying the threshold method of Mendoza and Terrones (2008) to the cycles derived from the two filters, we find substantial differences in the housing boom episodes identified by both methods. The most striking difference is the duration of episodes in which episodes based on Hamilton's regression filter tend to last longer than the ones identified by the HP filter. Other differences were shown by the number and the timing of the identified housing boom episodes. The empirical analysis of the relationship between house prices and foreign capital inflows was carried out using two methods. First, the tests of time-varying Granger causality proposed by Shi et al. (2018) were used to investigate the time-varying interactions between house prices and gross capital inflows. Second, the time-varying impact of foreign capital inflows on housing markets was estimated using time-varying parameter regression via FLS method of Kalaba and Tesfatsion (1989). Besides the foreign capital inflows, other variables such as CPI, interest rate and credit growth were included in the regression model as control variables. The tests of time-varying Granger causality show that gross capital inflows and house prices in South Korea and Thailand had intensive interactions during many sub-periods. In addition, the time-varying Granger causality tests show evidence of bi-directional causality between gross capital inflows and house prices in some sub-periods in South Korea and Thailand. This type of relationship was not found in South Africa. According to the time-varying Wald statistics, house prices in South Africa have never affected gross capital inflows. In contrast, we find evidence of gross capital inflows causing house prices at some periods. Surprisingly,

these periods do not coincide with the housing boom episodes in South Africa. Contrarily, in South Korea and Thailand we find a great coincidence between causality intervals and the housing boom episodes.

The evidence from the time-varying parameter regression model shows important cross-country variations in terms of the impact of capital inflows on house prices during housing boom episodes and other periods. Additionally, the magnitude and the extent of the impact was found to be different depending on the component of capital inflows. Consistent with the previous studies, we find evidence that capital inflows have strongly contributed to the boom of house prices in South Africa and South Korea. The contribution of foreign capital inflows is found to be less severe during the boom episodes of the housing market in Thailand. As our argument suggests, the empirical evidence for Thailand provides an example in which foreign capital inflows have not been the primary reason for driving up the house prices, this can be clearly seen in the coefficient paths of the components of foreign capital inflows throughout the housing boom episodes. Moreover, the analysis of time-varying parameter regression model yields several novel empirical findings. First, the impact of FDI and FPI on house prices in South Africa is found to be gradually increasing before peaking during the housing boom episode. Similar patterns, albeit with greater intensity, were noticed in the time-varying impact of FDI and FPI on the housing market in South Korea. In the case of Thailand, this pattern is only seen in the time path of FDI impact. Second, the time-varying impact of capital inflows differs in terms of magnitude and severity from housing boom episode to another. Third, we find evidence that the sharp increase in the impact of capital inflows does not inevitably lead to high house prices. For instance, the strongest impact of OFI in South Korea and OFI and FPI in Thailand is noticed in periods other than the housing boom episodes. However, all the housing boom episodes in South Africa are associated with the strongest impact of capital inflows.

CONCLUSIONS

The main objective of this thesis is to examine the impact of international capital flows on asset prices particularly stocks and house prices. The first chapter follows the studies that have indirectly examined the impact of foreign capital inflows on stock markets by estimating the breakpoints around the financial liberalization events in emerging markets. However, the first chapter looks further to examine the dynamic changes in stock prices throughout the episodes of capital inflows. Therefore, a three-stage empirical analysis was followed in this chapter. In the first step, the episodes of foreign capital flow in the selected EMEs were identified using two methods, the threshold method suggested by Ghosh et al. (2014) and Qureshi and Sugawara (2018) and the k-means clustering approach. In the second step, we first employed the PELT method developed by Killick et al. (2012) to detect the changepoints in the stock indices of the selected EMEs. Then the post-changepoint trend was followed to distinguish between the positive and the negative changepoints. Last but not least, the detected index changepoints with reference to its dates are distributed over the identified episodes of foreign capital flows. The results show that stock prices have been rarely pushed further during the surge episodes of foreign capital flows in most of the selected emerging markets, meaning that surges of capital inflows do not necessarily lead to further appreciations of stock prices. In fact, most of the price appreciations were noticed during the episodes of moderate capital inflows. On the other hand, stock prices have occasionally depreciated during the episodes of capital outflows but not as often as expected.

The second chapter investigates the time-varying dynamics between the US equity flows and stock returns in Pacific Asian emerging markets namely, Indonesia, South Korea, and Thailand. The time-varying dynamics were studied using the historical impulse response functions estimated by the time-varying parameter VAR model with stochastic volatility developed by Nakajima (2011). The main finding indicates that the impact of US equity flows on the stock returns is rather temporary and short-lived throughout the sample period. In addition, the US equity flows are found to be contemporaneously affected by stock returns, while stock returns consistently show lagged response to the shocks in US. The evidence of feedback trading is consistent throughout the sample period, particularly in Indonesia and South Korea. The forecast

ability of US equity flows to stock returns is found to be weak during most of the sample period.

Finally, the third chapter identifies the housing boom episodes and its relationship with foreign capital inflows in three emerging markets: South Africa, South Korea, and Thailand. Several methods were used for this purpose. Firstly, the housing boom episodes were identified using two approaches, the commonly used Hodrick-Prescott filter and the regression filter recently proposed by Hamilton (2018). The differences in the boom episodes identified by the two filters were remarkably visible, especially in terms of the duration and the timing. Generally, the boom episodes identified by Hamilton's regression filter persist over a longer time span compared to the episodes identified based on the Hodrick-Prescott filter. Secondly, the time-varying interactions between growth rate of house prices and gross capital inflows were estimated using the time-varying tests of Granger causality proposed by Shi et al. (2018). The empirical results show that house prices in South Africa have never affected gross capital inflows. In the meantime, there is evidence that gross capital inflows have Granger caused house prices in some periods. Surprisingly, these periods do not coincide with housing boom episodes in South Africa. Contrarily, the causality episodes overlap with the housing boom episodes in South Korea and Thailand. In addition, the causality between gross capital flows and house prices is found to be bi-directional during some subperiods in the samples of South Korea and Thailand. Thirdly, the impact of foreign capital flows on house prices during the housing boom episodes was estimated using the time-varying parameter regression model via flexible least-squares of Kalaba and Tesfatsion (1989). Consistent with the previous studies, the empirical findings show a strong impact of foreign capital inflows on house prices during the housing boom episodes in South Africa and South Korea. This impact is found to be less severe during the housing boom episodes in Thailand. The empirical analysis of the TVP regression also revealed several novel findings. Firstly, the impact of FDI and FPI on house prices in South Africa is found to be gradually increasing before peaking during the housing boom episode. Similar patterns, albeit with greater intensity, were noticed in the time-varying impact of FDI and FPI on housing market in South Korea. In the case of Thailand, this pattern was found only in the case of FDI. Secondly, the time-varying impact of capital inflows differs in terms of magnitude and severity from housing boom episode to another. Thirdly, we find evidence that any increase in the impact of capital inflows will not necessarily lead to high house prices. For instance, the

impact of OFI in South Korea and OFI and FPI in Thailand have been shown to be abruptly increasing in periods other than the housing boom episodes. In South Africa, however, the abrupt shifts in the impact of capital inflows are entirely related to the distinct episodes of the housing booms.

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APPENDICES

Appendix A.1*:* K-means basic ideas

The basic idea behind k-means clustering consists of defining clusters so that the total intra-cluster variation (known as a total within-cluster variation) is minimized. There are several k-means algorithms available. The standard algorithm is the Hartigan-Wong algorithm (1979), which defines the total within-cluster variation as the sum of squared distances Euclidean distances between items and the corresponding centroid:

$$W\ (C_k) = \sum_{x_i \in C_k} (x_i - \mu_k)^2 \qquad \text{(A. 1.1)}$$

- x_i design a data point belonging to the cluster C_k.
- $\mu_k$is the mean value of the points assigned to the cluster C_k.

Each observation (x_i) is assigned to a given cluster such that the sum of squares (SS) distance of the observation to their assigned cluster centers μ_k is a minimum.

the total within-cluster variation is defined as follow:

$$tot.withins = \sum_{k=1}^{k} W(C_k) = \sum_{k=1}^{k} \sum_{x_i \in C_k} (x_i - \mu_k)^2 \qquad \text{(A. 1.2)}$$

The total within-cluster sum of the square measures the compactness (i.e. goodness) of the clustering and we want it to be as small as possible.

Appendix A.2

Table A.2.1. *The results of Threshold approach.*

Country	Surge episodes			Outflow episodes		
	Start	End	Quarters	Start	End	Quarters
Brazil	2002Q3	2002Q4	2	2000Q3	2000Q4	2
	2003Q3	2004Q4	6	2006Q4	2007Q2	3
	2005Q2	2005Q4	3	2008Q1	2008Q2	2
	2015Q3	2016Q3	5	2010Q1	2011Q3	7
				2014Q2	2014Q3	2
Chile	2004Q1	2004Q2	2	2003Q3	2003Q4	2
	2004Q4	2005Q1	2	2008Q2	2008Q4	3
	2006Q1	2008Q1	9	2011Q2	2011Q4	3
	2009Q1	2009Q2	2	2012Q2	2012Q4	3
	2009Q4	2010Q1	2	2013Q2	2013Q3	2
				2014Q3	2014Q4	2
Columbia	2000Q1	2000Q4	4	2007Q1	2007Q2	2
	2001Q2	2001Q3	2	2010Q3	2010Q4	2
	2002Q1	2003Q4	8	2012Q2	2015Q3	14
	2004Q2	2004Q3	2			
	2009Q1	2009Q2	2			
Hungary	2010Q2	2010Q3	2	2004Q1	2006Q1	6
	2011Q4	2012Q4	5	2008Q3	2009Q3	5
	2013Q2	2013Q3	2			
	2014Q2	2014Q4	3			
	2015Q2	2016Q3	5			
Korea, Rep	2012Q3	2012Q4	2	2000Q1	2000Q2	2
	2013Q2	2013Q4	3	2001Q4	2002Q1	2
	2014Q2	2017Q1	12	2003Q2	2004Q1	4
				2004Q4	2005Q1	2
				2006Q1	2006Q2	2
				2007Q1	2007Q2	2
				2009Q1	2010Q1	5
				2011Q1	2011Q2	2
Malaysia	2000Q3	2001Q1	3	2001Q4	2002Q1	2
	2006Q3	2006Q4	2	2004Q4	2005Q1	2
	2007Q3	2007Q4	2	2010Q1	2010Q2	2
	2008Q2	2009Q4	7	2010Q4	2011Q2	3
				2012Q3	2013Q4	6
				2015Q4	2016Q2	3
India	2000Q2	2000Q3	2	2004Q4	2005Q1	2
	2001Q2	2001Q3	2	2006Q1	2008Q1	6
	2008Q4	2009Q2	3	2009Q3	2009Q4	2
	2015Q3	2017Q1	7	2010Q2	2010Q3	2
				2011Q2	2011Q3	2
				2012Q3	2012Q4	2

Threshold approach results (continued)

Country	Surge episodes			Outflow episodes		
	Start	End	Quarters	Start	End	Quarters
Indonesia	2000Q2	2000Q3	2	2004Q4	2005Q1	2
	2001Q2	2001Q3	2	2006Q1	2006Q2	2
	2008Q4	2009Q2	3	2006Q4	2008Q1	6
	2013Q3	2014Q1	3	2009Q3	2009Q4	2
	2015Q3	2017Q1	7	2010Q2	2010Q4	3
				2011Q2	2011Q3	2
				2012Q3	2012Q4	2
Philippine	2002Q2	2002Q3	2	2001Q4	2002Q1	2
	2004Q3	2005Q1	3	2008Q2	2008Q3	2
	2006Q2	2006Q3	2	2010Q2	2011Q1	4
	2008Q4	2009Q2	3	2012Q3	2013Q1	3
	2013Q4	2014Q1	2			
Poland	2001Q2	2001Q4	3	2005Q1	2005Q2	2
	2004Q3	2004Q4	2	2007Q1	2008Q2	6
	2013Q2	2014Q2	5	2009Q3	2011Q2	8
	2014Q4	2015Q1	2			
	2015Q3	2016Q1	3			
Romania	2011Q3	2011Q4	2	2004Q2	2004Q3	2
	2013Q2	2015Q3	10	2005Q1	2005Q3	3
	2016Q1	2016Q3	3	2006Q1	2006Q2	2
				2006Q4	2008Q3	8
Singapore	2001Q2	2001Q3	2	2000Q2	2001Q1	4
	2011Q4	2012Q3	4	2001Q4	2002Q2	3
	2013Q2	2013Q3	2	2004Q4	2005Q2	3
	2014Q3	2014Q4	2	2007Q4	2008Q1	2
	2015Q2	2015Q4	3	2009Q3	2010Q1	3
	2016Q2	2016Q4	3	2011Q2	2011Q3	2
South Africa	2000Q4	2002Q4	9	2004Q4	2005Q2	3
	2003Q3	2003Q4	2	2006Q1	2006Q2	2
	2008Q4	2009Q1	2	2006Q4	2008Q2	7
	2016Q4	2017Q1	2	2009Q2	2009Q4	3
				2010Q2	2010Q3	2
				2012Q3	2012Q4	2
Thailand	2000Q1	2001Q1	5	2005Q2	2006Q2	5
	2013Q3	2014Q1	3	2009Q3	2011Q1	7
	2014Q4	2015Q1	2	2012Q3	2013Q1	3
	2015Q3	2015Q4	2			
	2016Q3	2017Q1	3			
Turkey	2001Q1	2001Q2	2	2000Q1	2000Q3	3
	2002Q2	2002Q4	3	2005Q4	2006Q1	2
	2008Q4	2009Q2	3	2006Q4	2007Q1	2
	2015Q1	2016Q1	5	2007Q3	2007Q4	2
	2016Q3	2017Q1	3	2008Q2	2008Q3	2
				2010Q4	2011Q2	3
				2013Q1	2013Q2	2

Table A.2.2. *The results of the clustering approach.*

Country	Surge episodes			Outflow episodes		
	Start	End	Quarters	Start	End	Quarters
Brazil	2002Q3	2002Q4	2	2006Q4	2007Q2	3
	2003Q3	2004Q4	6	2007Q4	2008Q1	2
	2005Q2	2005Q4	3	2010Q1	2011Q1	5
	2006Q2	2006Q3	2			
	2008Q4	2009Q1	2			
	2015Q3	2017Q1	7			
Chile	2004Q1	2004Q2	2	2008Q2	2008Q4	3
	2006Q3	2007Q1	3	2011Q2	2011Q4	3
				2013Q1	2013Q2	2
Columbia	2000Q1	2004Q4	4	2010Q3	2010Q4	2
	2001Q2	2001Q3	2	2012Q2	2013Q1	4
	2002Q1	2003Q4	8	2014Q1	2015Q1	5
	2004Q2	2004Q3	2			
	2005Q4	2006Q3	4			
	2009Q1	2009Q2	2			
Hungary	2011Q4	2012Q4	5	2000Q3	2000Q4	2
	2013Q2	2013Q3	2	2004Q1	2006Q1	9
	2014Q3	2014Q4	2	2007Q1	2007Q2	2
	2015Q2	2016Q3	6	2008Q3	2009Q1	3
				2013Q4	2014Q1	2
India	2000Q2	2002Q3	10	2007Q3	2008Q1	3
	2003Q4	2004Q3	4			
	2008Q2	2009Q2	5			
	2014Q1	2014Q3	3			
	2015Q2	2017Q1	8			
Indonesia	2000Q2	2002Q3	10	2007Q3	2008Q1	3
	2003Q4	2004Q3	4			
	2008Q2	2009Q1	5			
	2014Q1	2014Q3	3			
	2015Q2	2017Q1	8			
Korea, Rep	2012Q3	2012Q4	2	2000Q1	2000Q3	3
	2013Q2	2013Q4	3	2001Q3	2002Q3	5
	2014Q2	2017Q1	12	2003Q2	2004Q1	4
				2004Q4	2005Q2	3
				2006Q1	2006Q2	2
				2007Q1	2007Q2	2
				2008Q1	2008Q2	2
				2009Q1	2010Q1	5
				2011Q1	2011Q2	2

The results of the clustering approach (continued)

Country	Surge episodes			Outflow episodes		
	Start	End	Quarters	Start	End	Quarters
Malaysia	2000Q4	2001Q1	2	2001Q3	2002Q1	3
	2008Q3	2009Q2	4	2004Q4	2005Q1	2
	2016Q4	2017Q1	2	2010Q1	2010Q2	2
				2010Q4	2011Q2	3
				2015Q4	2016Q2	3
Philippine	2002Q2	2002Q3	2	2000Q1	2000Q3	3
	2004Q3	2005Q1	3	2001Q4	2002Q2	2
	2006Q2	2006Q3	2	2008Q2	2008Q3	2
	2013Q1	2014Q4	2	2010Q1	2011Q1	5
				2012Q3	2013Q1	3
Poland	2001Q2	2001Q4	3	2007Q4	2008Q2	3
	2004Q3	2004Q3	2	2009Q3	2010Q1	3
	2013Q2	2014Q2	5	2011Q1	2011Q2	2
	2014Q4	2015Q1	2			
	2015Q3	2016Q1	3			
Romania	2011Q3	2011Q4	2	2004Q2	2004Q3	2
	2012Q2	2015Q3	14	2005Q2	2005Q3	2
	2016Q1	2017Q1	5	2006Q4	2007Q4	5
Singapore	2013Q2	2013Q3	2	2000Q2	2001Q1	4
	2014Q3	2014Q4	2	2001Q4	2002Q2	3
	2015Q2	2015Q4	3	2004Q4	2005Q2	3
	2016Q2	2016Q4	3	2007Q4	2008Q1	2
				2009Q3	2010Q1	3
				2011Q2	2011Q3	2
South Africa	2000Q4	2001Q1	2	2004Q4	2005Q2	3
	2001Q3	2003Q1	7	2006Q1	2006Q2	2
	2003Q3	2003Q4	2	2007Q1	2008Q1	5
	2008Q4	2009Q1	2	2012Q3	2012Q4	2
Thailand	2000Q1	2000Q2	2	2006Q1	2006Q2	2
	2000Q4	2001Q1	2	2010Q1	2011Q1	5
	2013Q4	2014Q1	2			
	2014Q4	2015Q1	2			
	2015Q3	2015Q4	2			
	2016Q3	2017Q1	3			
Turkey	2001Q1	2001Q2	2	2000Q1	2000Q3	3
	2002Q2	2002Q4	3	2005Q4	2006Q1	2
	2008Q4	2009Q2	3	2010Q4	2011Q2	3
	2015Q1	2016Q1	5			
	2016Q3	2017Q1	3			

Appendix A.3

Table A.3.1. *Distribution of changepoint dates over the flow episodes (Threshold approach).*

Country	Capital flow episodes		
	Surge	Normal	Outflows
Brazil	12/17/2004, 8/11/2015, 2/17/2015, 3/2/2016, 7/13/2016	1/2/2006, 9/20/2007, 9/3/2008, 12/5/2008, 4/28/2009, 9/10/2009, 6/6/2013	10/12/2006, 4/2/2007, 8/1/2011
Chile	10/25/2004, 10/31/2006 1/23/2007, 6/1/2007 2/4/2008, 12/11/2009	7/13/2010, 10/14/2016	9/19/2008, 8/9/2013
Columbia	5/6/2009, 6/10/2009	2/3/2005, 11/7/2005, 8/2/2006, 7/11/2007, 10/6/2008,9/14/2009	7/20/2010, 12/10/2014
Hungary	6/8/2011, 5/29/2012, 7/10/2012, 9/20/2012, 10/30/2012, 5/8/2014, 10/15/2014, 1/6/2016,	2/13/2007, 11/21/2007, 10/29/2009, 1/23/2015	6/17/2004, 12/7/2004, 5/13/2005, 3/18/2009
Korea, Rep.		11/22/2005, 11/1/2006, 7/1/2008, 8/25/2008, 10/3/2008, 9/1/2010	2/23/2005 4/13/2006 5/12/2006 4/10/2007 5/25/2007 4/9/2009 7/30/2009
Malaysia	11/20/2006, 7/1/2008, 9/10/2008, 7/17/2009, 5/2/2013	1/19/2007, 4/6/2007, 3/4/2008, 8/19/2015	1/10/2005, 3/4/2010, 8/19/2010
India	5/15/2009	7/20/2005, 6/3/2008 ,9/26/2008, 5/8/2014	3/9/2006, 10/12/2006, 4/19/2007, 6/28/2007, 9/18/2007, 2/29/2008, 8/24/2009, 8/17/2010, 8/4/2011, 9/13/2012
Indonesia	5/6/2009	4/13/2007, 9/18/2007, 7/11/2008, 9/9/2008, 3/8/2010, 2/11/2013	4/11/2006, 7/29/2009, 9/14/2009, 9/3/2010
Philippine	5/1/2006	1/12/2007, 5/31/2007, 7/27/2007, 9/25/2007, 1/15/2008, 6/9/2008, 7/24/2009, 4/5/2011, 1/10/2012	4/2/2010, 1/2/2013
Poland	8/12/2013, 12/4/2015	4/1/2004, 7/27/2005, 12/1/2005, 3/29/2006, 10/12/2006, 10/9/2008, 8/4/2011, 9/5/2012 12/27/2016	1/11/2008, 6/26/2008, 7/29/2009, 11/6/2009, 9/7/2010
Romania	7/15/2011, 8/12/2013, 6/27/2014	2/9/2004, 10/21/2004, 10/17/2008, 7/29/2009, 10/13/200,9 2/17/2010, 5/4/2010, 12/31/2010, 7/30/2012, 12/20/2012	4/14/2005, 7/11/2005, 9/12/2005, 1/6/2006, 6/26/2007, 1/18/2008, 7/2/2008,
Singapore	3/12/2001, 1/23/2012, 8/19/2015	7/19/2005, 1/30/2006, 12/1/2006, 4/4/2007, 8/15/2008, 10/3/2008, 5/5/2009, 9/3/2010, 1/1/2013, 1/13/2016, 2/29/2016, 1/6/2017	11/29/2004, 1/15/2008, 7/14/2009, 11/10/2009, 8/9/2011
South Africa	10/31/2005	10/4/2006, 7/7/2008, 9/4/2008, 3/5/2010, 1/18/2012, 7/1/2014	1/11/2007, 9/18/2007, 7/20/2009, 10/13/2009, 5/3/2010, 9/17/2010, 12/14/2012,
Thailand		10/16/2003, 6/29/2007, 6/12/2008, 9/15/2008, 2/6/2012,	8/21/2009, 6/18/2010, 9/21/2010, 12/31/2012
Turkey	10/3/2008, 5/15/2009	1/7/200,5 5/11/2006, 6/29/2007, 1/15/2008, 7/30/2009, 9/22/2009, 12/18/2009, 7/23/2010, 8/4/2011, 7/26/2012	11/22/2005, 1/13/2006, 1/19/2007, 3/28/2007, 5/21/2008,

Table A.3.2. *Distribution of changepoint dates over the flow episodes (Clustering approach).*

Country	Capital flow episodes		
	Surge	Normal	Outflows
Brazil	12/17/2004, 8/11/2015, 12/17/2015, 3/2/2016, 7/13/2016,	1/2/2006, 9/20/2007, 9/3/2008, 12/5/2008, 4/28/2009, 9/10/2009, 6/6/2013,	10/12/2006, 4/2/2007, 8/1/2011,
Chile	10/31/2006, 1/23/2007,	10/25/2004, 6/1/2007, 2/4/2008, 12/11/2009, 7/13/2010, 8/9/2013, 10/14/2016,	9/19/2008
Columbia	11/7/2005, 8/2/2006, 5/6/2009, 6/10/2009	2/3/2005, 7/11/2007, 10/6/2008, 9/14/2009	7/20/2010, 12/10/2014
Hungary	5/29/2012, 7/10/2012, 9/20/2012, 10/30/2012, 10/15/2014, 1/6/2016	11/21/2007, 10/29/2009 6/8/2011, 5/8/2014 1/23/2015	6/17/2004, 12/7/2004, 5/13/2005, 2/13/2007, 3/18/2009,
Korea, Rep.		11/22/2005, 11/1/2006, 7/1/2008, 8/25/2008, 10/3/2008, 9/1/2010	2/23/2005, 4/13/2006, 5/12/2006, 4/10/2007, 5/25/2007, 4/9/2009, 7/30/2009,
Malaysia	7/1/2008 9/10/2008	11/20/2006, 1/19/2007, 4/6/2007, 3/4/2008, 7/17/2009, 8/19/2010, 5/2/2013, 8/19/2015,	1/10/2005, 3/4/2010
India	6/3/2008, 9/26/2008, 5/8/2014	7/20/2005, 3/9/2006, 10/12/2006, 4/19/2007, 6/28/2007, 5/15/2009, 8/24/2009, 8/17/2010, 8/4/2011, 9/13/2012	9/18/2007, 2/29/2008
Indonesia	7/11/2008, 9/9/2008	4/11/2006, 4/13/2007, 5/6/2009, 7/29/2009, 9/14/2009, 3/8/2010, 9/3/2010, 2/11/2013	9/18/2007
Philippine	5/1/2006, 1/2/2013	1/12/2007, 5/31/2007, 7/27/2007, 9/25/2007, 1/15/2008, 7/24/2009, 4/5/2011, 1/10/2012	6/9/2008, 4/2/2010
Poland	8/12/2013, 12/4/2015	4/1/2004, 7/27/2005, 12/1/2005, 3/29/2006, 10/12/2006, 10/9/2008, 9/7/2010, 8/4/2011, 9/5/2012, 12/27/2016,	1/11/2008, 6/26/2008, 7/29/2009, 11/6/2009
Romania	7/15/2011, 7/30/2012, 12/20/2012, 8/12/2013, 6/27/2014	2/9/2004, 10/21/2004, 4/14/2005, 1/6/2006, 1/18/2008, 7/2/2008, 10/17/2008, 7/29/2009, 10/13/2009, 2/17/2010, 5/4/2010, 12/31/2010	7/11/2005, 9/12/2005, 6/26/2007
Singapore	8/19/2015	7/19/2005, 1/30/2006, 12/1/2006, 4/4/2007, 8/15/2008, 10/3/2008, 5/5/2009, 9/3/2010, 1/23/2012, 1/1/2013, 1/13/2016, 2/29/2016, 1/6/2017,	3/12/2001, 11/29/2004, 1/15/2008, 7/14/2009, 11/10/2009, 8/9/2011
South Africa		10/31/2005, 10/4/2006, 9/18/2007, 7/7/2008, 9/4/2008, 7/20/2009, 10/13/2009, 3/5/2010, 5/3/2010, 9/17/2010, 1/18/2012, 7/1/2014,	1/11/2007, 12/14/2012
Thailand		10/16/2003, 6/29/2007, 6/12/2008, 9/15/2008, 8/21/2009, 2/6/2012, 12/31/2012,	6/18/2010, 9/21/2010,
Turkey	10/3/2008 5/15/2009	1/7/2005 5/11/2006, 1/19/2007, 3/28/2007, 6/29/2007, 1/15/2008, 5/21/2008, 7/30/2009, 9/22/2009, 12/18/2009, 7/23/2010, 8/4/2011, 7/26/2012	11/22/2005, 1/13/2006

Appendix B.1

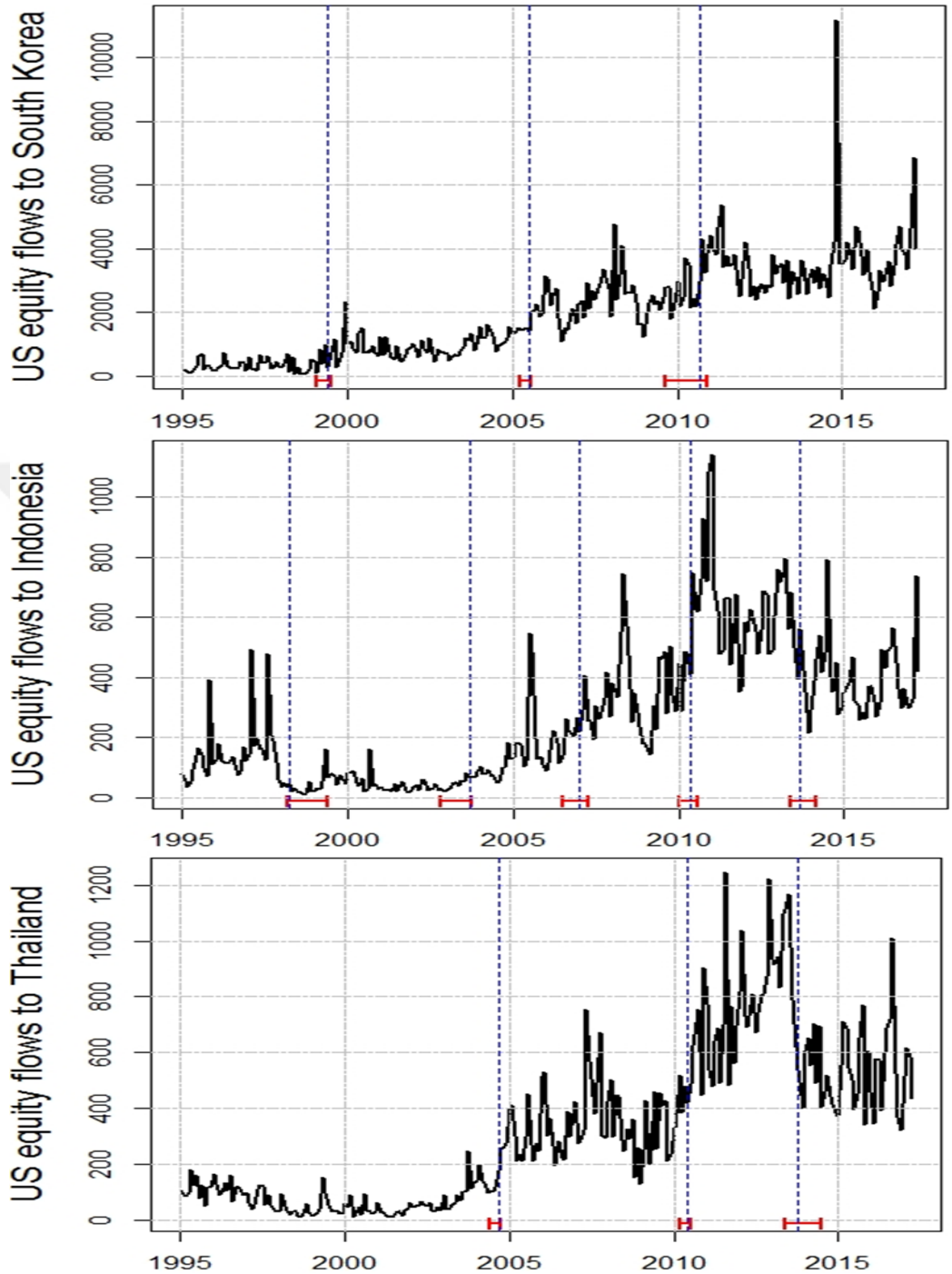

Figure B.1. *Structural breaks of US equity flows*, the dashed blue vertical lines represent the break dates, the short red lines in the bottom represent the 95% confidence intervals.

Appendix C.1

Hodrick-Prescott filter

The HP filter decomposes an observed, possibly nonstationary time series, y_t, into its cyclical and trend component as follows

$$y_t = \tau_t + \psi_t \qquad \text{(C. 1.1)}$$

Where τ_t is the trend and ψ_t is the cyclical component. To separate these two components, one minimizes the variance of ψ_t subject to a penalty for variation in the second difference of τ_t,

$$\min_{[\tau_t]_{t=1}^{T}} \left[\sum_{t=1}^{T} (y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T} \left((\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1}) \right)^2 \right], \lambda > 0 \qquad \text{(C. 1.2)}$$

where λ controls the smoothness of the extracted trend. The higher its value, the smoother is the trend. Using quarterly data, λ is most commonly set to 1,600 for analyzing business cycles.

Hamilton's regression filter

Hamilton (2018) proposes an OLS regression of the observed non-stationary time series, y_t, at date $t + h$ on a constant and its four most recent values as of date t, i.e.,

$$y_{t+h} = \beta_0 + \beta_1 y_t + \beta_2 y_{t-1} + \beta_3 y_{t-2} + \beta_4 y_{t-3} + v_{t+h} \qquad \text{(C. 1.3)}$$

The cyclical component is then obtained from the residuals,

$$\hat{v}_{t+h} = y_{t+h} - \hat{\beta}_0 - \hat{\beta}_1 y_t - \hat{\beta}_2 y_{t-1} - \hat{\beta}_3 y_{t-2} - \hat{\beta}_4 y_{t-3} \qquad \text{(C. 1.4)}$$

In the case of quarterly data, Hamilton (2018) suggests employing $h = 8$ (2 years) for analyses concerned with business cycles and $h = 20$ (5 years) for studies interested in credit or financial cycles.

Appendix C.2

Table C.1.1. *The causality intervals of FCI and growth rate of HPI.*

Causality test procedures	South Africa		South Korea		Thailand	
	FCI ➡ HPG	HPG ➡ FCI	FCI ➡ HPG	HPG ➡ FCI	FCI ➡ HPG	HPG ➡ FCI
Rolling homoskedasticity	Dec 1997 Jun-Sep 2000 Mar-Sep 2001 Jun-Dec 2017	--	Jun-Sep 2006 Mar-Jun 2007 Jun 2010-Jun 2012	Mar 1998 Sep 1998-Mar 1999	Mar-Jun 2017 Dec 2017 Jun-Dec 2018	Sep-Dec 2001 Jun 2005
Rolling heteroskedasticity	--	--	Mar 1998 Sep 1998-Mar 1999	--	Sep-Dec 2001 Jun 2005	--
Recursive evolving homoskedasticity	Jun 1995-Mar 1997 Dec 1997-Mar 1998 Jun 2000-Sep 2002 Jun 2014-Dec 2016	--	Mar-Sep 1999 Jun 2001-Dec 2008 Jun 2010-Sep 2018	Mar 1998 Sep 1998-Jun 1999	Mar 2017-Dec 2018	Sep2001-Mar 2003 Sep 2003-Mar 2012 Mar 2013-Dec 2016
Recursive evolving heteroskedasticity	--	--	Mar 1999 Sep 1998-Jun 1999	--	Sep-Mar 2003 Sep 2003-Mar 2012 Mar 2012-Dec 2016	--

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Prediction IPO initial returns using random forest (Forthcoming in Bursa Istanbul Review)