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Comovement of Institutional Equity Flows: Evidence from ASEAN+3

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[Reviewed by Chaipat Poonpatpibul, and approved by Hoe Ee Khor]

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Abstract

This paper uses a factor model to explore the driving forces of institutional equity flows in ASEAN+3 region. It shows that global and regional comovement and momentum explain 46% to 78% of the variations of the economy-level equity flows. The above three factors also well incorporate the effects of major global push factors and other unobservable common drivers on equity flows. We find significant evidence of escalating global comovement during US tantrum, and increasing regional comovement during the Global Financial Crisis and European Debt Crisis.

JEL classification: G15, F36, F65

Keywords: Comovement, Contagion, Factor Model, Push-Pull

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Contents

I. Executive Summary

Sudden capital outflows generate significant international spillovers, which not only disrupt financial markets but also threaten macroeconomic stability. Emerging markets are particularly vulnerable to such external shocks in capital market. This paper explores how insitutional equity flows in ASEAN+3 region comove with global and regional market and how such comovements evolve in different stages of global financial cycles to understand the patterns of shock transmissions. We find that all ASEAN+3 economies exhibit significant comovement with global market. Except for Japan, all the other ASEAN+3 economies also comove substantially with the regional market. Moreover, the global and regional comovement explains 46% to 78% of the variations in equity flows to ASEAN+3 economies.

Understanding the magnitude of global and regional comovement especially during financial stress is important to decipher international spillovers. Focusing on four recent financial stress episodes, namely Global Financial Crisis, European Debt Crisis, US taper tantrum and China stock market crash, we explore whether global and regional comovement escalates during financial stress. Should the magnitude of an economy's capital comovement with the global and regional market in the financial stress period remains the same as in the normal period, the spillover effects will be relatively predictable because they are proportional to the extent of comovement that transmits the shock. However, if the magnitude of capital comovement escalates during the financial stress period, the external shocks can be amplified unexpectedly, which generates tail risks and may even trigger unexpected cascading effects that jeopardize the global capital market in an extreme case. Our finding shows that regional comovement increased during the Global Financial Crisis and European Debt Crisis, while global comovement escalated during US taper tantrum for many emerging economies. These findings highlight the potential usefulness of enhancing policy coordination, especially within the region, to mitigate shock transmission.

II. Introduction

Sudden capital outflows generate significant international spillovers, which not only disrupt financial markets but also threaten macroeconomic stability (Calvo and Talvi, 2005; Rothenberg and Warnock, 2011). Emerging markets were particularly vulnerable to such shocks during the Mexican currency crisis and Asian financial crisis in the 1990s. Over the past two decades, policy makers have actively employed macroprudential policies in an attempt to enhance market resilience to external shocks. This paper seeks to explore the patterns and magnitude of international capital comovement in different stages of global financial cycles using a factor model.

Existing literature generally uses the push-pull framework to analyze capital flows.[1] Push factors capture the global driving forces of capital flows to all economies such as global financial cycles, and pull factors reflect the domestic conditions that attract capital flows to a specific economy, i.e. economic growth. Push factors are particularly useful in explaining international capital flows (Rey, 2015; Cerutti et al., 2019), yet it is pragmatically impossible to exhaust all of them especially when they are unobservable, which leads to under-estimation of capital comovement. Moreover, neither push nor pull factors can justify the increasing popularity of index tracking and benchmarking (Raddatz and Schmukler, 2012; Cremers et al., 2016), which synchronize capital flows not just to global market but also groups of economies sharing similar characteristics. To mitigate these issues, we tailor the multi-factor model in Bekaert et al. (2009), which is analogous with world capital asset pricing model (CAPM), to analyze international capital flows.[2] In particular, we model equity flows to an economy as a function of equity flows to the rest of the world and region as well as one month lagged flows. The extent of comovement between equity flows to an economy and the rest of the world is then measured by the beta coefficient in the regression of the former on the latter, which equals to the covariance of equity flows to the economy and the rest of the world divided by the variance of equity flows to the rest of the world. Note that any common drivers such as push factors and global investment strategies, whether observable or not, would affect equity flows to all economies, their impacts shall be incorporated in the relation between equity flows to an economy and the rest of the world as summarized by the beta coefficient. Such a beta coefficient captures an economy's sensitivity to global capital flows, with a higher value corresponding to stronger capital comovement with the global market and greater sensitivity to global shocks. If it is higher than one, shocks are amplified in this economy such that sudden capital outflows in the rest of the world trigger even more extreme capital outflows in this economy. If it is positive but smaller than one, external

[1] See Koepke (2019) for a comprehensive literature survey.

[2] In CAPM, the excess return of a stock $r_{i,t}$ is proportional to that of a market portfolio $r_{m,t}$, the market capitalization weighted average excess returns of all tradable stocks, such that $r_{i,t} = a + \beta r_{m,t}$, where β measures the stock's exposure to the market risk. Similarly, the capital flows to an economy $K_{i,t}$ could be modeled as a function of its exposure to the global market β and the average capital flows to the global market $K_{G,t}$ such that $K_{i,t} = a + \beta K_{G,t}$. A higher β indicates stronger capital comovement and shock transmission, i.e. economy i will experience more capital outflows when there are capital outflows from the global market. In such a framework, the estimation of β is not biased due to ommitted push factors or linkages. This is because any common drivers of capital flows, either observable or unobservable, would affect capital flows to all economies, and are therefore incorporated into $K_{i,t}$ and $K_{G,t}$. We can extend the model to account for various investment practices that target a specific group of markets beyond geographic distributions.

shocks decay as they transmit to this economy. If it is negative, equity flows to the economy help stabilize the global market by moving in the opposite direction with the rest of the world that set off the shocks.

Capital flows to an economy are exposed not only to global but also regional markets. Some investors are interested in a group of economies sharing similar patterns to better utilize their expertise. Indeed capital flows to economies within the same region are more correlated (Froot et al., 2001; Jinjarak and Zheng, 2014), which cannot be explained by their sensitivity to global capital flows. It is therefore important to consider an economy's sensitivity to the regional market when analyzing its equity flows. To differentiate the sensitivity to regional and global market, we first orthogonize equity flows to the rest of the region with respect to those to the rest of the world, and get the residuals that filter out the component of the equity flows driven by common global factors. We then regress equity flows to an economy on the orthogonized equity flows to the rest of the region so that the beta coefficient captures the economy's sensitivity to regional equity flows. Past equity flows are also included in the model to account for the economy-specific flow patterns that persist over time (Froot et al., 2001; Kaminsky et al., 2004; Jinjarak et al., 2011a) and the widely-used momentum strategy, which buys (sells) stocks that have performed well (poor).

Using monthly economy-level equity flows from EPFR for the sample period of 2004M1 to 2018M12, we show that equity flows to the rest of the world and region together with the one-month lagged equity flows explain substantial variations in equity flows to each AEAN+3 economy in our sample, with the adjusted R-squared as high as 78%. The explanatory power of push factors on equity flows largely disappears once we control for these three elements, which suggests that the latter have well incorporated the effects of push factors. Moreover, the three elements exhibit higher explanatory power than a large set of push factors, which implies that they capture effects of other common drivers of equity flows in addition to push factors. Based on such a model, we find significant evidence that equity flows to an economy move together with the rest of the world and region. Additionally, the magnitudes of global and regional comovement vary substantially across economies.

To explore how the capital comovement evolve with global financial cycles, we follow the definition of Forbes and Rigobon (2002) to differentiate comovement into interdependence, the component of comovement that prevails in all market states, and contagion, the additional comovement triggered by shocks. Such differentiation is useful for identifying the nature, and estimating the magnitude, of spillover effects. If the degree of comovement remains the same after a shock, the spillover effects will be relatively predictable because they are proportional to the strength of existing linkages that transmit the shock. If the extent of comovement diminishes, the shock will decay during the transmission process as if the other markets switch into a self-protected mode to absorb the shock. If the magnitude of comovement escalates, the shock can be amplified unexpectedly, which generates tail risks that are difficult to gauge. The first scenario is relatively tranquil as expected shocks are less devastating to the real economy than unexpected shocks (Kaminsky et al., 2003). The last scenario, an evidence of contagion, is the most alarming, because it may trigger unexpected cascading effects that jeopardize the global capital market in an extreme case. Focusing on four recent episodes of major shocks including the Global Financial Crisis (GFC), European Debt Crisis (EDC), US taper tantrum, and Chinese stock market crash (CSMC), we document substantial heterogeneity in capital comovement over time, which also varies with the types of crisis. During GFC and EDC, we find that regional comovement escalated as a result of intensified sensitivity to regional equity flows, which provides evidence of regional contagion. During US taper tantrum, equity flows to ASEAN+3 became more sensitive to global shocks, which provides evidence of global contagion. Neither global nor regional comovement changed during CSMC, which suggests that the observed capital comovement amid CSMC are mainly driven by interdependence, the inter-market linkages that exists in all market states.

The rest of the paper is organized as follows. Section II reviews the related literature. Section III describes the data and basic patterns of capital flows. Section IV explains the methodology for identifying capital comovement. Section V presents the estimation results on the patterns, magnitude and channels of capital comovement, which are further decomposed into interdependence and contagion. Section VI concludes.

III. Literature Review

Our work enriches the evidence of interdependence and contagion in the context of capital flows. Ever since Forbes and Rigobon (2002) popularized the concept of contagion as the significant increase in cross-border linkages after a shock, many studies have proposed different methodologies and come up with heterogeneous evidence on contagion (see for example Bae et al., 2003; Kenourgios et al., 2011; Bekaert et al., 2014). Most of these studies focus on asset returns, leaving the international capital comovement largely under-explored. Contagions on asset price returns can be driven by domestic investors who overreact to external shocks (Choe et al., 1999; Bekaert et al., 2014), or by international capital flows that transmit shocks across borders (Broner et al., 2006; Jotikasthira et al., 2012; Raddatz and Schmukler, 2012). Understanding the domestic and international origins of contagions helps us to predict asset returns and justify discretionary regulations on foreign capital. It is therefore important to investigate international capital comovement separately. Our study on international capital comovement is closely related to Fratzscher (2012a), who also use a factor model similar with Bekaert et al. (2009) to study how capital flows responded to push and pull factors during and after GFC. Fratzscher (2012b) find that push factors were the main drivers of capital flows during GFC while pull factors dominated after GFC. Moreover, capital flows become more sensitive to push factors during GFC. These findings shed important lights on international capital comovement due to time-varying common exposure to push factors. Our study differs from Fratzscher (2012a) in several dimensions. Instead of evaluating the impact of push factors directly, we measure an economy's sensitivity to global capital flows by checking the covariance of capital flows to this economy and the rest of the world relative to the variance of capital flows to the rest of the world. Such a measure incorporates the effects not only of push factors but also index tracking and benchmarking, which has become an important source of international comovement in recent decades (Raddatz and Schmukler, 2012; Raddatz et al., 2017 and Cremers et al., 2016). We further consider an economy's sensitivity to regional capital flows, which cannot be captured by either push or pull factors, and show that this is an important driver of capital flows. In addition, other than GFC, we also examine other recent episodes of crisis that have not been explored extensively. We not only document evidence of global and regional contagion, that is, additional sensitivity to global and regional equity flows after shock, but also show that contagion effects vary with the nature of the crisis.

Finally, we contribute to the literature by employing a factor model to analyze institutional equity flows, which allows us to capture various channels through which the capital flows comove. For example, the investment mandates of index funds require investors to passively adjust their asset allocation to track the index. Thus the capital flows into an economy might comove with those into the other economies simply because of a change in the compositions or economy weights of an index (Raddatz et al., 2017). Noting the increasing popularity of fund indexing and bench-marking, we tailor the factor model in Bekaert et al. (2009) to explain international capital flows. This model links economy-level capital flows with global and regional capital flows analogously with a world CAPM and exhibits impressive explanatory power, despite having only three explanatory variables. It provides an alternative to the push-pull framework to analyze capital flows. It also points to the possibility of borrowing insights from asset pricing literature, which is quite well developed, to deepen our understanding of capital flows.

IV. Data

A. Data Source

Our dependent variable is monthly economy-level equity flows from EPFR,[3] normalized by the market capitalization of all listed domestic firms at the end of the previous year. EPFR tracks the global capital allocation by institutional investors. Data on market capitalization are obtained from World Development Indicator (WDI). Similarly, we calculate the equity flows to the rest of the world (region) as the market-capitalization-weighted equity flows to the world (region). We focus on ASEAN+3 for the period from 2004M1 to 2018M12. Due to limit data availability, we exclude Brunei, Cambodia, Myanmar, Laos and Vietnam from the sample. The sample starts from 2004M1 because it is the earliest date the market capitalization data are available for all of the ASEAN+3 economies in our sample. The sample covers 9 markets over 15 years (180 months).

[3]The equity flows from EPFR reflect the asset allocation of thousands of institutional investors world-wide. It is a sub-component of the cross-border equity flows. Although bond flows are also available, the total market capitalization of all oustanding bonds in each economy is relatively scarce, which makes it difficult to evaluate the relative importance of institutional bond flows on domestic market.

The global risk is proxied by VIX, calculated as the monthly return on the Chicago Board Options Exchange (CBOE) volatility index. The global liquidity TED is measured by the interest difference between three-month LIBOR based on US dollars and three-month US Treasury bill. US short- and long-term interest rates, Fed fund effective interest rate and bond yield reflect US monetary policy from different dimensions. Shadow Fed Funds rate is the interest rate adjusted for the macroeconomic impact of monetary policy at the zero lower bound, following Wu and Xia (2016). MSCI return captures the the global market performance, which is computed as the monthly return of MSCI world index. USD valuation is the return on real effective exchange rate of USD. Business confidence is the monthly return in OECD's business confidence index. Policy uncertainty is measured by the monthly return in the Global Economic Policy Uncertainty Index. Oil price shock is measured by the monthly return in the crude oil price. Gold return is the monthly return in gold price. Non-farm payroll is the log difference of monthly number of paid workers in non-farm sectors, with a positive value indicating improvement in employment. Table A1 provides a detailed description of each variable.

B. Basic Patterns and Summary Statistics

Appendix Figure A1 shows the time trends of cumulative equity flows in USD to each economy, which exhibits substantial comovement especially among ASEAN economies. Larger markets tend to receive more equity flows in USD. To compare equity flows across borders, we normalize flows to each economy by the corresponding market capitalization at the end of the previous year. Such normalization captures the relative market share of international flows in the host economy, with larger values corresponding to the greater relative importance of cross-border equity flows. Table 1 shows that market-capitalization-weighted equity flows exhibit similar patterns of comovement to the equity flows in USD. The correlation coefficients of the market-capitalization-weighted equity flows to ASEAN+3 except for Japan is substantially positive and statistically significant. These statistics could be as high as 83% (for equity flows to Indonesia and the Philippines). The market-capitalization-weighted equity flow to Japan is not significantly correlated with other regional economies with an exception of Singapore. From here onward, to facilitate discussion, equity flows are referred as market-capitalization-weighted equity flows unless otherwise specified.

Table 2 provides the summary statistics for equity flows to each of the ASEAN+3 economies in our sample over the period 2004M1 to 2018M12. The equity flows are generally larger in bigger economies.[4] The average monthly international equity flows to Japan are the largest among the 9 economies studied, followed by Korea and China. The capital flow volatility, measured by the standard deviation (sd), is highest for China (17.4 bp) and lowest for Hong Kong (3 bp). The most extreme capital outflows happen in China (-43.8 bp) while the strongest capital inflows occur in Thailand (51.5 bp). Appendix Figure A2 further shows the scope and mean of the market-capitalization-weighted equity flows to each of the ASEAN+3 economies in our sample.

[4]The same patterns are observed for equity flows in USD. This suggests that such a pattern is not driven by market size.

Table 1. Capital flow correlations.

This table summarizes the correlation coefficients for cross-border equity flows weighted by market capitalization in host economies, with larger value corresponding to darker cell. Correlation coefficients that are not statistically significant at 5% are marked in gray.

	JPN	KOR	CHN	HKG	SGP	IDN	MYS	PHL
KOR	0.08							
CHN	0.00	0.40						
HKG	0.00	0.70	0.66					
SGP	0.20	0.62	0.56	0.80				
IDN	-0.06	0.76	0.47	0.70	0.62			
MYS	0.04	0.70	0.42	0.70	0.77	0.77		
PHL	-0.03	0.75	0.49	0.77	0.68	0.83	0.80	
THA	0.03	0.76	0.42	0.63	0.53	0.76	0.65	0.74

V. Empirical Framework

We first propose a baseline model to understand the relation between economy-level equity flows and their sensitivity to the rest of the world and region. We show that sensitivity to the rest of the world and region well captures the effects of most push factors on equity flows. We then extend the baseline model to differentiate capital comovement into interdependence, the extent of comovement that prevail in all market states, and contagion, the additional comovements after a shock. Finally, we explore the potential channels of interdependence and contagion.

A. Baseline Model

If all investors were to hold international portfolios that cover all publicly listed firms worldwide in proportion to their market capitalization, the equity flows to one economy shall comove perfectly with the rest of the world. In reality, some investors may choose to overexpose to markets, in which they have better expertise and underexpose to those they are not familiar with.[5] Moreover, equity flows to some economies may be more volatile than to others, i.e. because of different investment strategies. To capture an economy's sensitivity to the global and regional markets, we tailor the factor model in Bekaert et al. (2009) to fit into the context of international equity flows such that:

[5]Moreover, some may focus on a regional or a single market or direct capital to well-identified firms in selected industries and economies, which further complicates the international capital comovement.

Table 2. Summary statistics.

The table reports the mean, standard deviation (sd), minimum (min), median and maximum (max) value of the market-capitalization-weighted equity flows (%) to each individual economy as well as the whole sample over the period of 2004M1 to 2018M12. All statistics except for the number of observations (N) are in percentage.

Economy	ISO	Mean	sd	Min	Median	Max	N
Japan	JPN	0.043	0.092	-0.187	0.019	0.355	180
Korea	KOR	0.042	0.102	-0.205	0.036	0.302	180
China	CHN	0.040	0.174	-0.438	0.014	1.152	180
Hong Kong	HKG	0.009	0.030	-0.069	0.005	0.125	180
Singapore	SGP	0.017	0.054	-0.124	0.013	0.228	180
Indonesia	IDN	0.030	0.088	-0.167	0.019	0.336	180
Malaysia	MYS	0.011	0.055	-0.154	0.016	0.232	180
Philippines	PHL	0.017	0.055	-0.195	0.020	0.167	180
Thailand	THA	0.028	0.108	-0.239	0.021	0.515	180
Total		0.026	0.094	-0.438	0.015	1.152	1620

$$K_{i,t} = c_i + \beta^w ROW_{i,t} + \beta^R ROR_{i,t} + \beta^K K_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

where K_{it} represents the equity flows to economy i (normalized by its market capitalization at the end of the previous year); $ROW_{i,t}$ is equity flows to the rest of the world; and $ROR_{i,t}$ is the component of equity flows to the rest of the region that is not related to $ROW_{i,t}$; c_i records the economy fixed effects and $\varepsilon_{i,t}$ is the error term. The element $ROW_{i,t}$ is calculated as the total equity flows to all economies except for economy i normalized by the corresponding total market capitalization. The element $ROR_{i,t}$ is calculated in two steps. First, the aggregate equity flows to ASEAN+3 excluding Japan and economy i are normalized by the corresponding market capitalization. Second, the market-capitalization-weighted regional flows are regressed on $ROW_{i,t}$ so that the resulting residual is $ROR_{i,t}$. This step filters the component of regional flows driven by global factors so that $ROR_{i,t}$ is region specific. Excluding economy flows of interest when calculating the two elements $ROW_{i,t}$ and $ROR_{i,t}$ helps avoid adding up constraint and bias towards big markets. The orthogonization of $ROR_{i,t}$ mitigates spurious correlations and facilitates the interpretation of β^R, the sensitivity of economy i to the rest of the region. The greater the value of β^w (β^R), the greater the comovement of equity flows to the economy and global (regional) market, and the more sensitive the economy is to external global (regional) shocks. International equity flows are found to exhibit substantial momentum (Froot et al., 2001; Kaminsky et al., 2004; Jinjarak et al., 2011a). The inclusion of one-month lagged equity flows $K_{i,t-1}$ captures the expected equity flows based on such a momentum in equity flows, with a greater value of the coefficient β^Kcorresponding to stronger momentum.

The growing popularity of index funds has strengthened the global and regional capital co-movement (Raddatz and Schmukler, 2012; Cremers et al., 2016): whenever equity flows to one market increase, their investment in the other markets covered by the index shall also increase so as to track the index. The common exposure to various external driving forces, i.e. global financial cycles, also synchronize equity flows to emerging markets (Rey, 2015; Passari and Rey, 2015). If these driving forces of capital comovement were to dominate the market, the two beta coefficients β^w and β^R that reflect an economy's sensitivity to global and regional equity flows shall be positive and statistically significant. For an economy that is overweighed in global (regional) portfolios or more sensitive to global (regional) driving forces than the rest, the coefficient β^w (β^R) could be greater than one. When $\beta^w > 1$ ($\beta^R > 1$), shocks are amplified in an economy such that sudden equity outflows in the rest of the world (region) trigger even more extreme outflows in this economy. If an economy is underweighed in the global (regional) portfolios or less sensitive to global (regional) driving forces, or more frequently becomes the single investment target of international investors, the coefficient β^w (β^R) would be positive but less than one, which implies that external shocks decay as they transmit to this economy.

However, equity flows to some economies may move in the opposite direction with the rest of the world or region. When the market switches to a risk-off mode, in seeking for safety, capital may leave risky markets for safe-haven economies, whose asset valuations increase or stabilize during market turmoil. In addition, some funds have to rebalance portfolios by moving the capital from the outperformed markets to the underperforming markets to achieve the desired economy exposure so as to safeguard overexposed risk and best utilize the fund manager's expertise (Broner et al., 2006). If these forces were to dominate, we would expect the sensitivity to global and regional capital flows, β^w and β^R, to be negative and statistically significant. In such a scenario, equity flows to the economy contribute to offset external shocks and stabilize the global (regional) market. Finally, equity flows to some economies may be disconnected from the rest of the world or region, i.e. because of a closed capital market. In this case, we would expect β^w and β^R to be statistically insignificant.

B. Decomposing comovement into Interdependence and Contagion

International capital comovement can be further decomposed into interdependence and contagion, depending on whether the extent of comovement increases significantly after shocks (Forbes and Rigobon, 2002). If there is only interdependence between equity flows to an economy and the rest of the world and region, then the sensitivity to the global and regional equity flows, β^w and β^R shall be the same in tranquil and crisis periods so that the degree of capital comovement remains the same.[6] In the case of interdependence, when a market experiences a shock of sudden capital outflows, there would be an increase in capital outflows that are proportional to the shock from other markets, even though their sensitivity to the market of shock origin remains the same. The shock is transmitted from one economy to the other through existing linkages that prevail even in the absence of the shock. To what extent one market would

[6]With orthogonal factors, Eq.(1) can potentially fit the increase in correlations between economy-specific equity flows and equity flows to the rest of the world and region during the crisis through an increase in these two elements' volatility. It therefore avoids the volatility bias described in Forbes and Rigobon (2002).

be affected by the shock in annother economy is thus relatively predictable because it is proportional to the degree of comovement that are already known. However, if there is not only interdependence but also contagion, the sensitivity to the global and regional equity flows, β^w and β^R, will escalate when there is a shock. In the presence of contagion, the shock can be amplified unexpectedly in the transmission process as a result of excessive comovement. How much the comovement would rise is uncertain, which casts more significant risk on the market than the anticipated shock (Kaminsky et al., 2003). Differentiating interdependence and contagion is thus important for designing macroprudential policy and evaluating policy effectiveness in response to external shocks.

To see whether capital comovement during financial crises are dominated by interdependence or contagion, we expand Eq.(1) to allow for state-dependent sensitivity to the global and regional equity flows:[7]

$$K_{i,t} = c_i + \beta_t^w ROW_{i,t} + \beta_t^R ROR_{i,t} + \beta_t^K K_{i,t-1} + \eta CR_t + \varepsilon_{i,t} \quad (2)$$

$$\beta_t^w = \beta_0^w + \gamma^w CR_t \quad (3)$$

$$\beta_t^R = \beta_0^R + \gamma^R CR_t \quad (4)$$

$$\beta_t^K = \beta_0^K + \gamma^K CR_t \quad (5)$$

The stress dummy variable CR_t equals 1 during the financial stress period and 0 otherwise. The coefficient β_t^w now captures the state-dependent sensitivity to the rest of the world, which are binary such that $\beta_t^w = \beta_0^w$ during the normal period and $\beta_t^w = \beta_0^w + \gamma^w$ during the stress period. Under the null hypothesis of no global contagion, that is, no additional sensitivity to global equity flows, the estimated coefficient γ^w shall be statistically indifferent from 0. A positive and statistically significant γ^w indicates additional comvements with global equity flows after a shock, which provides evidence of global contagion. A negative and statistically significant γ^w suggests that the degree of comovement subsides during the stress period. This could happen when the safe-haven market attracts capital from the rest of the world as investors become more risk-averse, or when capital control in an economy effectively cushions it against the external shocks. Similarly, the sensitivity to the regional equity flows is $\beta_t^R = \beta_0^R$ during the normal period and $\beta_t^R = \beta_0^R + \gamma^R$ during the stress period, with a positive and statistically significant γ^R indicating additional sensitivity to regional equity flows after a shock, which provides evidence of regional contagion. As momentum is found to be state-dependent (Jinjarak et al., 2011a), we allow the prediction of lagged flows on current flows to vary with the crisis as well. The coefficient of the stress dummy η captures the episode-specific equity flows that is not related to the rest of the world or region, which corresponds to non-fundamental contagion in Bekaert et al. (2009). A negative η implies excess equity outflows during the stress period, which can be driven by the "wake-up call hypothesis" that a shock in one economy triggers revaluation of risk in other economies with similar characteristics (Eichengreen et al., 1996) or by sentiment

[7]When it comes to estimation, we subsititute Eq.(3), (4) and (5) into Eq.(2) and then estimate the reduced form of Eq.(2).

effects. If equity flows to market i is a substitute of equity flows to the economy of stress, we would expect a positive η as equity flows into market i after the crisis. For example, during GFC, which hit most advanced markets, capital moved to emerging market like Brazil in seeking high yields.

VI. Results

This section presents empirical results on patterns and magitudes of international capital comovement and their interactions with global financial cycles. We first corroborate the baseline model in Section A. by demonstrating that it explains a significant proportion of variations on equity flows and outperforms a wide range of push factors. We then proceed to document evidence of comovement and the heterogeneity across economies in Section A.. To understand how capital comovement evolve with global financial cycles, we study a series of major financial shocks in Section A. to investigate whether the capital comovement are driven by interdependence or contagion.

A. Baseline Model

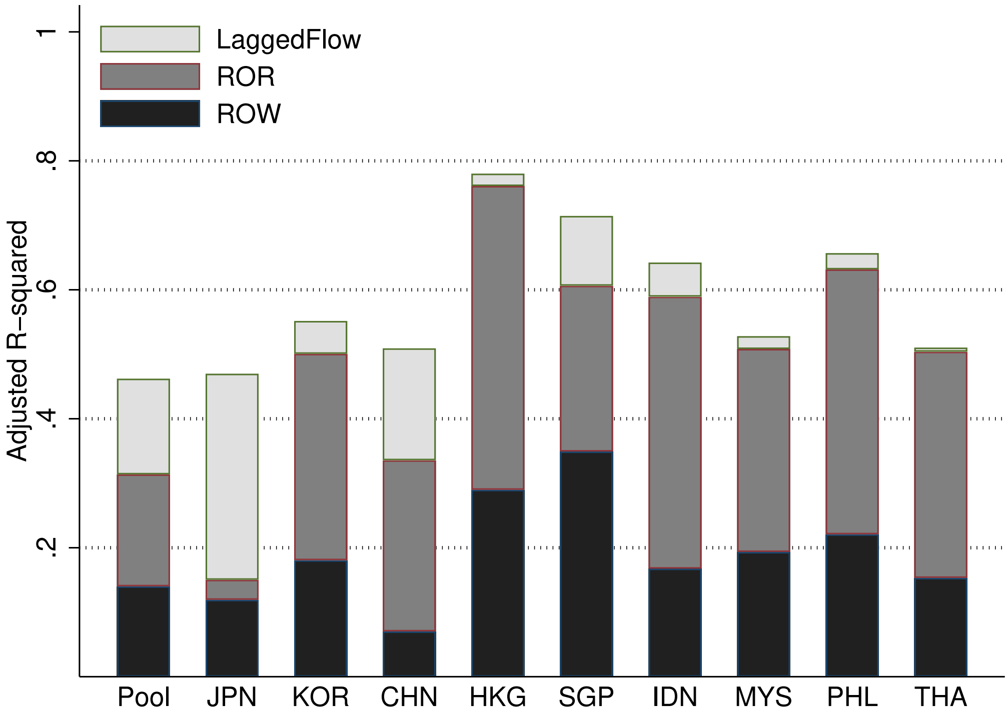
Explanatory Power of the Baseline Model

We first estimate Eq.(1) with pooled ordinary least square (OLS), controlling for economy fixed effects. The adjusted R-squared is illustrated in Figure 1. The equity flows to the rest of the world and region ROW and ROR, along with the lagged flows, explain 46% variations in the equity flows to ASEAN+3 economies. Such a goodness of fit is not driven by economy fixed effects. Estimating Eq.(1) for each economy in our sample, we find that the baseline model explains 47% (Japan) to 78% (Hong Kong) variations of equity flows. The average adjusted R-squared based on the time-series regression for each individual economy is 60%, which is higher than that from the pooled regression with economy fixed effects. This is because pooled regression constrains the relation between equity flows and the three elements in the baseline model to be homogeneous across economies, which costs the degree of fittness when either sensitivity to the global and regional equity flows, or strength of momentum are heterogeneous. The results point out the heterogeneity in equity flows across economies, which is highlighted in recent literature (Fratzscher, 2012a; Cerutti et al., 2019).

To better understand the explanatory power of each element, we first regress the equity flows on ROW, then add to the regression one element at a time in the sequence of ROR and $K_{i,t-1}$, and calculate the marginal increase in the adjusted R-squared for each element. The contribution of each element in explaining the variations in equity flows is highlighted in different color blocks in Figure 1. Based on the pooled regression, the three elements ROW, ROR and lagged flows contribute almost equally, explaining 14%, 17% and 15% variations in the equity flows to ASEAN+3 economies, respectively. Accounting for the heterogeneity across economies by examining each economy's equity flows separately, we find that the explanatory

Figure 1. Explanatory power of the baseline model

This figure plots the adjusted R^2 in the regressions of $K_{i,t} = c_i + \beta^w ROW_{i,t} + \beta^R ROR_{i,t} + \beta^K K_{i,t-1} + \varepsilon_{i,t}$, where $K_{i,t}$ is the market-capitalization-weighted equity flows to economy i, ROW and ROR are the equity flows to the rest of the world and region respectively, and c_i is the economy fixed effects. Each color block corresponds to the marginal change in the adjusted R^2 attributed to each element. The adjusted R^2 is reported for the pooled regression with economy fixed effects (Pool) and for each economy in our sample, which includes Japan (JPN), South Korea (KOR), China (CHN), Hong Kong, China (HKG), Singapore (SGP), Indonesia (IDN), Malaysia (MYS), Philippines (PHL) and Thailand (THA).



power of the baseline model is mainly attributed to ROW and ROR, which on average explain 51% of the time-series variations in equity flows. The element ROW alone contributes to an average adjusted R-squared of 19%, with the highest in Singapore (35%) and the lowest in China (7%). The explanatory power of element ROR is even more pronounced, increasing the adjusted R-squared by 32% on average with the highest in Hong Kong (47%) and the lowest in Japan (3%). Adding the lagged flows into the regression increases the adjusted R-squared by an additional 9% on average, with the highest in Japan (23%) and the lowest in Thailand (1%). The roles of ROR appear to be more heterogeneous across economies than the other two elements, which leads to a larger discrepancy between the pooled and time-series regressions. Despite the heterogeneity across economies, the pooled regression summarizes the average roles of the three elements decently in a parsimonious manner. In the following, we shall focus on the pooled regression for general patterns, while referring to the time-series regression for more detailed and heterogeneous analysis.

Comparing Baseline Model with Push Factors

We next compare the explanatory power of our ba seline model with that of push factors, which are found to be important determinants of equity flows. It has been popular to classify the determinants of equity flows into push factors, the common external forces that drive equity flows to all economies such as global risk appetite, and pull factors, the domestic conditions that attract equity flows to a specific economy, i.e. strong economic growth (see for example Calvo et al., 1993; Chuhan et al., 1998; Papaioannou, 2009; Fratzscher, 2012a; Cerutti et al., 2019)). Push factors are often found to be more important than pull factors in determining international equity flows (Fratzscher, 2012a; Rey, 2015; Cerutti et al., 2019). In our baseline model, the equity flows to the rest of the world and region, are expected to capture the common driving forces of equity flows, which include push factors. Note that all common driving forces, either observable or not, affect equity flows to all economies, their impacts on equity flows to a particular economy will be largely mirrored by their impacts on ROW, the equity flows to the rest of the world, unless such impacts are highly diversified.[8] Therefore, by controlling for ROW, the baseline model will incorporate the impacts of all common driving forces including push factors. The equity flows to the rest of the region ROR and the lagged flows help deal with the potentially heterogeneous impacts of push factors on equity flows. Economies within the same region are more similar and are likely to share a more homogeneous response to the same push factors, which makes ROR more informative in explaining region-specific flows. Historical flows contain information about an economy's unique interaction with the rest of the world persisting over time, which helps capture the idiosyncratic response of equity flows to external drivers. If the three elements in our baseline model are effective in capturing the impacts of push factors on equity flows, then the push factors will have little additional explanatory power in relation to equity flows. We now turn to test such a hypothesis.

We orthogonalize each push factor F_t with respect to the three elements to get the orthogonalized factor $f_{i,t}$, which is essentially the residual from the regression of

$$F_t = \tau^w ROW_{i,t} + \tau^R ROR_{i,t} + \tau^K K_{i,t-1} + f_{i,t}. \quad (6)$$

The orthogonalized factor $f_{i,t}$ thus captures the part of F_t that is not embedded by the three elements in the baseline model. We compared the explanatory power of each push factor on equity flows before and after orthogonalization by running the following two pooled regressions with economy fixed effects:

$$K_{i,t} = C_i + \tau^F F_t + e_{i,t} \quad (7)$$

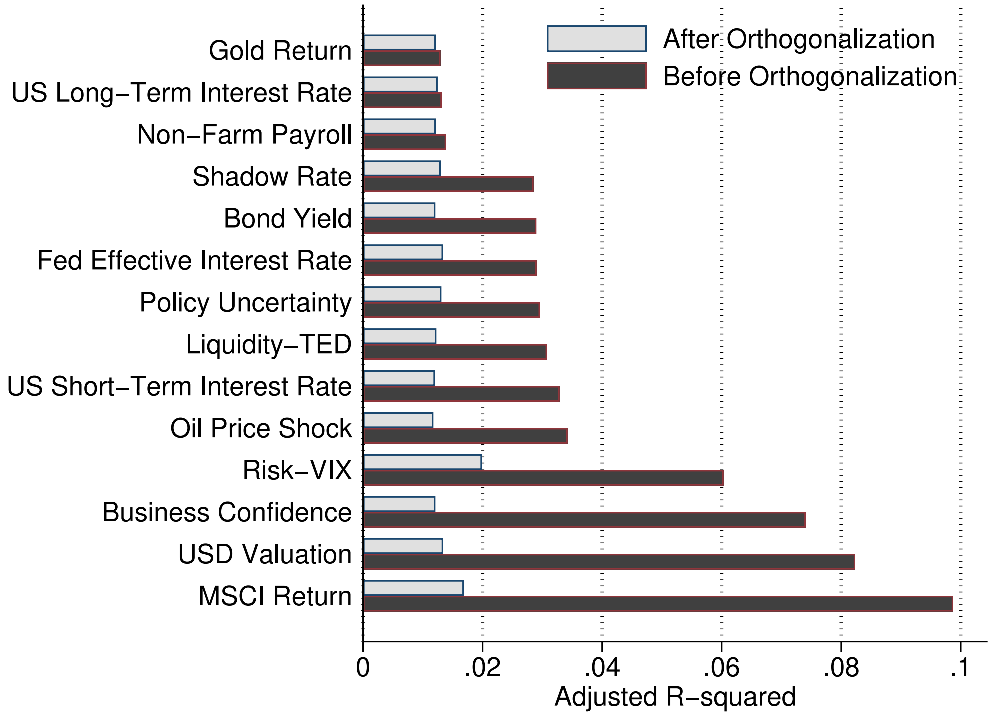
$$K_{i,t} = c_i + \tau^f f_{i,t} + e_{i,t} \quad (8)$$

For each push factor, the adjusted R-squared from both regressions above are reported in Figure 2. The explanatory power of the orthogonalized factor $f_{i,t}$ on equity flows is substantially

[8] For example, if rising global risk aversion reduces equity flows to half of the economies in the sample while increasing equity flows to the other half, the average impact of global risk aversion on global equity flows would be around zero. In this case, the impact of global risk aversion on economy-specific equity flows cannot be captured by ROW.

Figure 2. Explanatory power of push factors before and after orthogonalization

This figure plots the adjusted R^2 in the regressions of equity flows on each push factor before and after its orthogonalization with respect to the three elements in the baseline model Eq.(1). The detailed description of each push factor is in Appendix Table A1.



lower than that of the original factor F_t for each of the fourteen push factors that we explored. Even for global risk proxied by the return on VIX, the most commonly used push factor, its explanatory power on equity flows reduces from 6% to 2% after orthogonalization, which filters the component that is related to the three elements. More contrastingly, USD valuation alone explains 8% of the variation in equity flows, but after orthogonalization, this number drops to 1%. On average, the orthogonalized factor $f_{i,t}$ explains 1.5% of the variations in equity flows, which is significantly smaller than that of the original factor F_t at 3.6%. It suggests that most impacts of the push factors on equity flows have been incorporated in the three elements ROW, ROR and K_{t-1} in the baseline model.

After checking the individual push factors, we proceed to look at their total explanatory power. Figure 3 compares the explanatory power of all push factors with the baseline model as well as their combinations. Based on the pooled regression with economy fixed effects, we find that the fourteen push factors can explain 20% of the variations in equity flows to ASEAN+3 economies, which is less than half of the adjusted R-squared (47%) produced by the baseline model that includes only three elements. Across all economies in our sample, the explanatory power of the baseline model is consistently higher than that of the push-factor model. Moreover, adding all push factors to the baseline model in Eq.(1) increases the adjusted R-squared by 1% in the pooled regression and by 2% when averaging across economies. The marginal contribution to the goodness of fit is trivial especially when we consider the large number of push factors included. The result reinforces that the baseline model has well incorporated the effects of major push factors on equity flows.

Although the three elements do not directly account for the roles of pull factors, we find that most pull factors' explanatory power on equity flows also decline after orthogonalization (see Appendix Figure A3). This may be because some pull factors are highly correlated with push factors, rendering their impacts to be absorbed by the three elements. The result in Appendix Figure A4 show that (i) the baseline model yields higher explanatory power on equity flows than a large set of major pull factors; and (ii) adding pull factors to the baseline model increases the explanatory power only slightly. Similar results are found when we repeat the analysis for all push and pull factors, as illustrated in Appendix Figure A5.

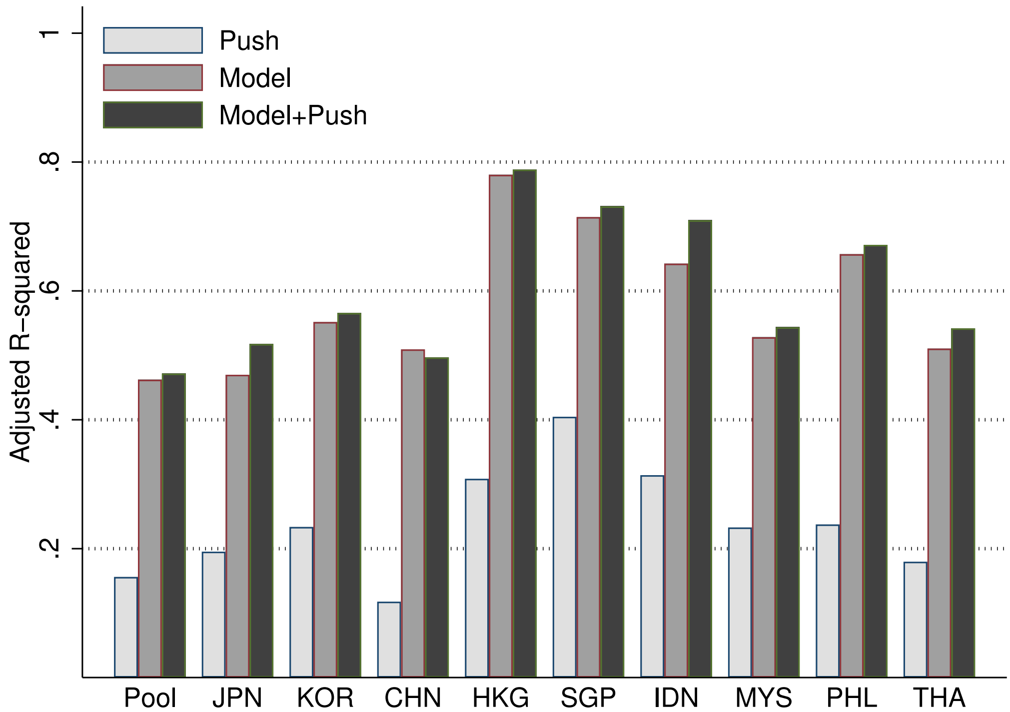
The findings so far suggest that, to a large extent, the baseline model has encompassed the push-pull framework and beyond. It exhibits additional explanatory power on top of push and pull factors, which may be ascribed to the unobserved common factors or linkages that are incorporated in the three elements. After all, unobserved common factors or linkages would affect equity flows to all economies, its impact on the equity flows to a particular economy will be captured by those to the rest of the world or region. Omitting important common external drivers may overestimate the shock transmission from one economy to another. Capital may flow out of two economies, i.e. economy A and B, after a significant shock to a common factor, failing to control for such a common factor may mislead us to the conclusion that there are spillover effects from economy A to economy B or vice versa. The baseline model in this paper mitigates such an issue by allowing us to better capture the common risk exposure of equity flows, which are important for identifying the origins of capital comovement.

Equity Flows comovement

After demonstrating that the baseline model well captures the common exposure to external factors, we analyze how equity flows comove with the rest of the world and region in this section. Table 3 reports the estimation results. Based on the pooled regression with economy fixed effects, the sensitivity to global capital flows β^w is positive and statistically significant, which suggests that equity flows to ASEAN+3 economies comove with the rest of the world. The evidence of comovement with the rest of the world is consistent across different economies, although the degree of comovement varies. Based on the time-series regression for each economy, we find that Thailand has the highest sensitivity to the global equity flows in our sample. For every 10% drop in the equity flows to the rest of the world ROW, equity flows to Thailand fall by 8.6%, while those to Hong Kong only decline by 3% (the lowest). The estimated coefficient β^w is less than 1 in both pooled and time-series regression, which suggests that global shocks are mitigated as they transmit to ASEAN+3. If all investors invest in proportion to the total world market capitalization, the increment in equity flows in one economy and the the rest of the world will be one-to-one, that is $\beta^w = 1$. The result suggests that all ASEAN+3 economies are impor-

Figure 3. Explanatory power of push factors and baseline model

This figure plots the adjusted R^2 in the regressions of equity flows on (i) a set of 14 push factors specified in Figure 2 (left bar), (ii) the three elements in the baseline model (middle bar), and (iii) all push factors and three elements (right bar). These statistics are reported separately for the pool of ASEAN+3 (Pool), Japan (JPN), South Korea (KOR), China (CHN), Hong Kong, China (HKG), Singapore (SGP), Indonesia (IDN), Malaysia (MYS), Philippines (PHL) and Thailand (THA).



tant components of global portfolios, yet they are relatively underweighed. The result could also arise because (i) some capitals focus on selected markets outside ASEAN+3; or (ii) some equity flows are attracted to ASEAN+3 by their idiosyncratic characteristics, which are not correlated with the rest of the world.

The sensitivity to the regional equity flows β^R is also positive and statistically significant in the pooled regression with economy fixed effects, which provides evidence of capital comovement within ASEAN+3. Delving into each economy, we find that all markets except Japan exhibit strong comovement with the rest of the region. Japan, one of the largest advanced economies, is often classified into different groups and market indices with the other ASEAN+3 economies, which motivate international investors to treat Japan separately. The scant correlation between equity flows to Japan and the other ASEAN+3 economies justifies the exclusion of Japan in the calculation of ROW. China is the most sensitive to the rest of the region ($\beta^R = 1.21$). The equity flows to China rise by 12.1% for every 10% increment in equity flows to the rest of the region. The prospect of economic growth in China has been strong in the past few decades, which provides fundamental support for investment returns. This may motivate investors targeting ASEAN+3 economies to overweight China or even focus entirely on China, which leads China to expose more to the rest of the region than other ASEAN+3 economies. Such a high sensitivity to regional equity flows attract nonproportionally more equity flows to China but also exposes China to greater shock amplication.

The coefficient $\beta^k$is positive and statistically significant. It suggests that strong equity flows to ASEAN+3 economies are persistent, which is consistent with Froot et al. (2001) and Jinjarak et al. (2011b). A similar pattern is observed in equity flows to each economy except for Thailand. Equity flows are found to be the most persistent in Japan. The persistence in equity flows suggests that one can predict the future equity flows based on historical information. The more persistent the equity flows are, the higher the predictability. However, adding more lags of equity flows to the model does not increase the predictability. As shown in Appendix Table A3, the coefficients of additional lagged flows are generally insignificant, possibly because most indexed funds adjust their portfolio monthly to track the index. The findings of global and regional comovement remain robust when we include more lags of equity flows (see Appendix Table A3) or add the commonly used push and/or pull factors in the baseline model (see Appendix Table A4).

We now turn to further quantify the roles of global and regional shocks on equity flows. The impacts of a shock on an economy not only vary with its sensitivity to the global and regional equity flows but also the external shocks it faces. Note that both ROW and ROR vary across economies, to better understand the economic importance of each element across different economies, we calculate the change in equity flows with respect to one standard deviation (sd) shock in ROW and ROR respectively and show them in Figure 4. The response of equity flows to 1 sd positive shock in ROW ranges from 1.5% (Indonesia) to 4.1% (Thailand). For 1 sd unexpected increase in ROR, the equity flows to Japan decline by 0.3%, while those to other

Table 3. Capital Comovement

This table reports the OLS estimation results of $K_{i,t}$, the equity flows to economy i, on ROW and ROR, the equity flows to the rest of the world and region, and $K_{i,t-1}$, the one-month lagged equity flows:

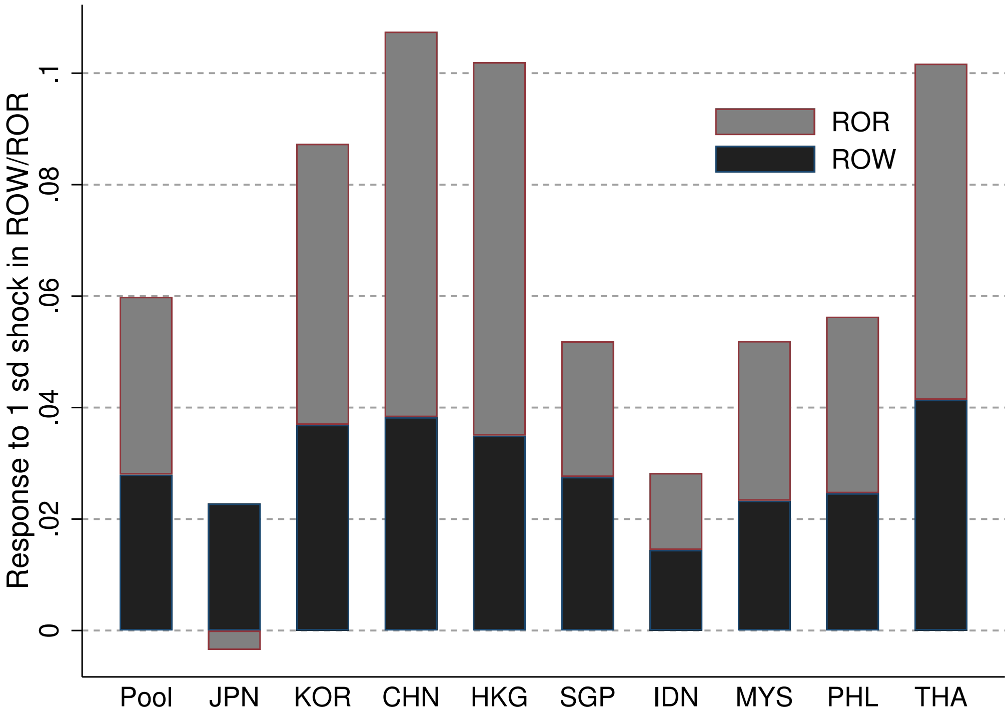
$$K_{i,t} = \beta^w ROW_{i,t} + \beta^R ROR_{i,t} + \beta^k K_{i,t-1} + c_i + \varepsilon_{i,t}.$$

The first row reports the result based on pooled regression with economy fixed effects (Pool), while the subsequent rows report results for Japan (JPN), South Korea (KOR), China (CHN), Hong Kong, China (HKG), Singapore (SGP), Indonesia (IDN), Malaysia (MYS), Philippines (PHL) and Thailand (THA) respectively. Heteroskedasticity robust standard errors are in parentheses next to the estimated coefficient. Symbol *, **, and *** corresponds to significance level at 10%, 5%, and 1% respectively.

	β^w		β^R		β^k		Constant		Observations	R-squared	Adjusted R-squared
Pool	0.577***	(0.035)	0.471***	(0.032)	0.403***	(0.062)	0.020**	(0.009)	1,611	0.466	0.462
JPN	0.466***	(0.094)	-0.055	(0.074)	0.594***	(0.077)	0.016***	(0.005)	179	0.479	0.470
KOR	0.767***	(0.112)	0.742***	(0.128)	0.257***	(0.051)	0.026***	(0.005)	179	0.559	0.552
CHN	0.765***	(0.150)	1.206***	(0.177)	0.437***	(0.146)	0.018**	(0.008)	179	0.518	0.509
HKG	0.300***	(0.020)	0.212***	(0.017)	0.164***	(0.049)	0.006***	(0.001)	179	0.784	0.780
SGP	0.571***	(0.042)	0.359***	(0.034)	0.348***	(0.060)	0.007***	(0.002)	179	0.719	0.715
IDN	0.704***	(0.077)	0.761***	(0.077)	0.259***	(0.054)	0.017***	(0.004)	179	0.648	0.642
MYS	0.483***	(0.051)	0.429***	(0.051)	0.174***	(0.066)	0.006**	(0.003)	179	0.536	0.528
PHL	0.512***	(0.050)	0.487***	(0.049)	0.191***	(0.048)	0.010***	(0.002)	179	0.663	0.657
THA	0.861***	(0.112)	0.928***	(0.139)	0.110	(0.067)	0.019***	(0.005)	179	0.519	0.510

Figure 4. Economic significance in the response to global and regional shocks

This figure plots the response of equity flows to one standard deviation shock in ROW and ROR, the equity flows to the rest of the world and region, respectively, for the pool of ASEAN+3 (Pool), Japan (JPN), South Korea (KOR), China (CHN), Hong Kong, China (HKG), Singapore (SGP), Indonesia (IDN), Malaysia (MYS), Philippines (PHL) and Thailand (THA). It is calculated as the coefficient of each element in the regression of Eq.(1) multiplied by the standard deviation of the corresponding element.



economies rise by 1.4% (Indonesia) to 6.9% (China).

Interdependence or Contagion?So far we have documented robust evidence of global and regional comovement in equity flows. In this section, we differentiate comovement into interdependence, the component of comovement that prevails at all times, and contagion, the additional jump in the magnitude of comovement triggered by shocks. To understand how capital comovement evolve with global financial cycles, we explore four major episodes of stress since the Global Financial Crisis (GFC): (i) GFC from 2007M12 to 2009M6, which is the contraction period identified by NBER business cycles; (ii) the European Debt Crisis from 2009M12, when some EU members such as GIPS (Greece, Ireland, Portugal and Spain) first revealed problems of refinancing their debt, to 2012M9, when the European Central Bank (ECB) calmed the market by committing free and unlimited support for a sovereign bailout; (iii) the US taper tantrum from 2013M5, when the Fed indicated the possibility of tapering bond purchases, to 2014M10, when the taper tantrum was halted; and (iv) the Chinese stock market crash from 2015M6, when its major stock index crashed from its peak, to 2016M10, when the market started to stabilize.

We explore whether the documented comovement are driven by interdependence or contagion for each episode of turbulence individually and report the pooled estimation results based on Eq.(2) in Panel A of Table 4. When examining each episode of stress separately, we essentially compare the degree of comovement during the particular episode of stress with the rest of the sample period, which contains other stress episodes that may reshape the comovement patterns and contaminate the estimation results. To address this issue, we also examine all five episodes of stress simultaneously and show how they change the comovement patterns relative to the benchmark period before the GFC and report the result in Panel B of Table 4. However, this approach costs many degree of freedoms by including a large number of variables. We report both sets of results and focus on those that are common across both approaches. While we find strong evidence of interdependence using both approaches, the evidence of contagion, or additional sensitivity to global or regional equity flows, varies substantially. We now turn to a discussion of the role of contagion in each episode of stress.

Table 4. Capital Interdependence and Contagion

This table reports estimation results based on the pooled regression with economy fixed effects based on the following specification,

$$K_{i,t} = \beta_t^w ROW_{i,t} + \beta_t^R ROR_{i,t} + \beta_t^K K_{i,t-1} + \eta CR_t + \varepsilon_{i,t},$$
$$\beta_t^w = \beta_0^w + \gamma^w CR_t,$$
$$\beta_t^R = \beta_0^R + \gamma^R CR_t,$$
$$\beta_t^K = \beta_0^K + \gamma^K CR_t,$$

where $K_{i,t}$ is the equity flows to economy i, ROW and ROR are equity flows to the rest of the world and region, $K_{i,t-1}$ is the one-month lagged equity flows, and CR_t is a stress dummy that equals 1 during a specific (any) episode of financial crisis specified in the first column and 0 otherwise in panel A (B). Panel A evaluates each episode of financial crisis separately while Panel B studied all five episodes of financial crisis simultaneously. We report the estimated sensitivity to global (regional) equity flows β_t^w (β_t^R), which is decomposed into global (regional) interdependence β_0^w (β_0^R) and global (regional) contagion γ^w (γ^R), and the episode-specific equity outflows (non-fundamental contagion) η. The estimated β_0^K and γ^K that capture the momentum and heteroskedasticity robust standard errors, abbreviated to save space, are available upon request. Symbol *, **, and *** corresponds to significance level at 10%, 5%, and 1% respectively.

Panel A: Individual stress episode					
	Contagion			Interdependence	
	γ^w	γ^R	η	β_0^w	β_0^R
Global Financial Crisis	0.087	0.239**	-0.007	0.556***	0.456***
European Debt Crisis	0.024	0.285***	0.004	0.587***	0.449***
US Taper Tantrum	0.277**	0.034	-0.013**	0.563***	0.465***
Chinese Stock Market Crash	-0.279	0.034	0.009	0.586***	0.476***
Panel B: All stress episodes					
	Contagion			Interdependence	
	γ^w	γ^R	η	β_0^w	β_0^R
Global Financial Crisis	0.092	0.272***	-0.007	0.551***	0.423***
European Debt Crisis	0.061	0.311***	0.004		
US Taper Tantrum	0.291**	0.074	-0.013*		
Chinese Stock Market Crash	-0.244	0.086	0.010		

The Global Financial Crisis The GFC started with a series of short-term funding liquidity constraints in financial sectors, which triggered the Fed to institute the Term Auction Facility to supply short-term credit to banks with sub-prime mortgages on December 12, 2007. The crisis escalated as more and more financial institutions fell into liquidity trouble, and skyrocketed after Lehman Brothers declared bankruptcy on September 15, 2008, which shook the global market. The US market showed signs of stabilization and recovery in 2009M6. When discussing GFC, we refer to the period from 2007M12 to 2009M6, which corresponds to the contraction period identified by NBER business cycles. We observe from Figure A1 that equity flows to ASEAN+3 fall sharply after 2007M12 before reversing the downward trend in early 2009.

The result on how equity flow comovement interact with the GFC is reported in Panel A of Table 4. The stress dummy CR_t equals to one during GFC from 2007M12 to 2009M6 and zero otherwise. The result shows that γ^w is economically small and statistically insignificant, which means no additional sensitivity to the global equity flows during the GFC and therefore provides no evidence of global contagion. However, we do find evidence of regional contagion: the additional sensitivity to the regional equity flows during the GFC, γ^R, is positive and statistically significant. The result remains robust when we control for the impact of other stress episodes as shown in Panel B of Table 4. The sensitivity to the regional equity flows during the stress period equals the sum of the sensitivity to regional equity flows during normal times (regional interdependence) and the additional sensitivity during the stress period (regional contagion). It increases to $\beta^R = \beta_0^R + \gamma^R = 0.42 + 0.27 = 0.69$, which is more than 50% larger than that before the GFC ($\beta^R = \beta_0^R = 0.42$). The coefficient η is economically indistinguishable from zero and statistically insignificant, which provides no evidence of episode-specific equity outflows (non-fundamental contagion). Our estimation results suggest that the equity outflows from ASEAN+3 during the GFC (see Figure A1) were mainly driven by global and regional interdependence, the sensitivity to global and regional equity flows during normal times, and regional contagion, the additional sensitivity to regional eqiuty flows during stress period.

Repeating the analysis for each economy to account for the heterogeneous sensitivity, we find similar evidence of regional contagion characterized by additional sensitivity to regional equity flows, as shown in Panel A of Table 5. Focusing on the results that are common for both approaches, we find that the additional sensitivity to regional equity flows (regional contagion) is particularly pronounced in Indonesia and Thailand, which almost doubled the sensitivity to the regional equity flows of the two economies during the GFC. As with the pooled regression with economy fixed effects, there is little evidence of additional sensitivity to the global equity flows (global contagion) across economies. However we do find some evidence of episode-specific equity outflows (non-fundamental contagion) in Japan and Hong Kong during the GFC. The financial markets in Japan and Hong Kong are more developed and share more similar characteristics with the US, the origin of the GFC, which may motivate international investors to downgrade them like the US according to the wake-up call hypothesis and therefore trigger additional capital outflows. On the other hand, the GFC moved additional equity flows to China

($\eta = 0.05$), whose economic fundamentals remained resilient, perhaps in seeking for risk hedging and diversification. Such diversified effects cancel each other out and lead to an insignificant episode-specific equity outflows (non-fundamental contagion) in the pooled regression.

The European Debt Crisis Ratings agencies started to downgrade Greece and other GIPS that revealed unprecedented sovereign debts in 2009M12, which triggered a series of bailouts and financial support. The concern over sovereign solvency only started to ease when the ECB committed free unlimited support for sovereign bailouts. We refer to the period from 2009M12 to 2012M9 as the European Debt Crisis (EDC). Panels A and B of Table 4 both show evidence of additional sensitivity to regional equity flows (regional contagion) during EDC. The sensitivity to the regional equity flows increases by more than 50% during the EDC, either relative to the non-EDC period (see Panel A) or the non-stress period (see Panel B). As in the GFC, we find no evidence of additional sensitivity to global equity flows (global contagion), or episode-specific equity outflows (non-fundamental contagion) amid the EDC.

To explore the heterogeneous roles of the EDC across economies, we perform similar analysis for each economy and report the results in Panel B of 5. The previous evidence of additional sensitivity to regional equity flows (regional contagion) is mainly driven by ASEAN economies (except for Singapore) and Korea, whose sensitivity to the regional equity flows increases substantially during the EDC as revealed by the positive and statistically significant estimation of γ^R. In particular, the additional sensitivity to regional equity flows (regional contagion), triples the sensitivity to the regional equity flows of Indonesia, and more than doubles that of Korea, Thailand and Malaysia. We find evidence of additional sensitivity to global equity flows (global contagion) in Indonesia but not other markets. Indonesia's sensitivity to the global equity flows during the EDC is doubled, increasing from 0.63 in the non-EDC period to 1.26 ($\beta^w = \beta_0^w + \gamma^w = 0.63 + 0.63$) during EDC. The coefficient η is positive and statistically significant for Korea, Indonesia and Thailand, which suggests that the EDC triggers additional capital inflows to these markets that cannot be explained by their sensitivity to the global or regional equity flows.

Note from Figure A1 that ASEAN+3 economies experience net equity inflows during the EDC, although they witnessed outflows in the second half of this period. While the outlook of Euro Zone appeared doomed during the EDC, both financial markets and economic fundamentals in ASEAN+3 had recovered from the GFC and remained robust during the EDC, which might induce new capital to target this region in the first half of this period. As more and more capital concentrate on the regional market of ASEAN+3, relative to the global or economy-specific markets, the regional comovement would be strengthened. The additional sensitivity to regional equity flows (regional contagion) during the first half of the EDC indeed accelerated capital inflows to ASEAN+3, especially ASEAN and Korea.

The US Taper Tantrum In May 22, 2013, then Fed chairman, Ben Bernanke, testified before the Joint Economic Committee of Congress that the Fed might taper or reduce the amount of bond purchases. The indication of taper tantrum that would slow down the speed of quantitative easing (QE) surprised the market and led to substantial disruption. The official taper tantrum was announced in 2013M12, implemented in 2014M1 and ceased in 2014M10. We define the period from 2013M5 to 2014M10 as US taper tantrum and explore its impact on equity flows comovement.

Panel A of Table 4 presents evidence of additional sensitivity to global equity flows (global contagion) and episode-specific equity outflows (non-fundamental contagion) but not additional sensitivity to regional equity flows (regional contagion) during taper tantrum. The coefficient γ^w is positive and statistically significant, which means that the sensitivity to the global equity flows increased during taper tantrum. The results in Panel B of Table 4 show that such evidence of additional sensitivity to global equity flows (global contagion), remain robust when all stress episodes are considered. The coefficient η is negative in both Panel A and B of Table 4, but only statistically significant in Panel A. The evidence of episode-specific equity outflows (non-fundamental contagion) is weaker when we compare the idiosyncratic equity flows during taper tantrum with that before the GFC. There is no evidence of additional sensitivity to regional equity flows (regional contagion) whether taper tantrum is studied individually or together with other stress episodes.

Delving into each economy, Panel C of Table 5 shows additional sensitivity to global equity flows (global contagion) during US taper tantrum for the case of the Philippines and Thailand. We find evidence of episode-specific equity outflows (non-fundamental contagion) in Thailand but not other economies. The sensitivity to the regional equity flows increases for several economies including Korea, Malaysia, the Philippines and Thailand, but declines for China. Overall, our estimation results imply that contagion contributes to the substantial capital outflows from ASEAN during the US taper tantrum (Figure A1).

The Chinese Stock Market Crash In 2014, as China's growth continued to slow down, the profitability of China's corporate sector worsened and non-performing loans increased in the banking system. Despite weak fundamentals, Chinese stock market started a major rally in 2014, fed by credit expansion and widespread expectations that the state would commit to promote the rise of a "national bull market" to facilitate economic restructuring. This "national bull market" eventually crashed on June 12, 2015, with the Shanghai Stock Exchange Composite Index (SSE) plungingover 30% from its peak value of 5166 within three weeks. As the crash deepened, the government coordinated bailout actions from various state agencies to intervene and stabilize the market. Despite the bailout efforts, SSE experienced several rounds of meltdowns before it bounced back in late January 2016 and stabilized for the rest of the year. We refer to the period from 2015M6 to 2016M1 as the Chinese stock market crash (CSMC) and evaluate its impact on capital comovement. Panel A and B of Table 4 yield no evidence of additional sensitivity to global and regional market, or episode-specific equity outflows (non-fundamental contagion) during the CSMC. It suggests that capital outflows during the CSMC are mainly driven by interdependence.

Panel D of 5 shows that the finding of no additional sensitivity to global and regional equity flows during the CSMC holds for most economies, with some exceptions. The sensitivity to the regional equity flows of Korea and Philippines increased during the CSMC, possibly due to their high exposure to regional portfolios that pulled out of ASEAN+3. China had experienced substantial capital outflows during CSMC (see Figure A1). Although the other economies also suffer from capital outflows, the magnitude is not comparable with that of China.

VII. Conclusion and Policy Implications

With only three factors, including global comovement, regional comovement and capital flow momentum, the factor model that captures how economy-level equity flows comove with the global and regional market explains 46% to 78% of the variations in equity flows to ASEAN+3. We show that the model incorporates the effects of not only observable push factors but also of other potentially unobservable factors and omitted linkages to international equity flows. It therefore mitigates the issue of under-estimating the international capital comovement driven by unobservable or omitted common factors. Based on such a model, we document significant evidence of global and regional capital comovement, which exhibits substantial variations between Japan and other ASEAN+3 economies but similar patterns among emerging economies in the region. In ASEAN+3 excluding Japan, global comovement rose during US taper tantrum period. Regional comovement escalated substantially during the Global Financial Crisis and European Debt Crisis for many regional economies. These findings highlight the potential usefulness of enhancing policy coordination, especially within the region, to mitigate shock transmission.

Table 5. Capital Interdependence and Contagion for individual economies

This table reports estimation results for each economy based on the following specification,

$$K_{i,t} = \beta_t^w ROW_{i,t} + \beta_t^R ROR_{i,t} + \beta_t^K K_{i,t-1} + \eta CR_t + \varepsilon_{i,t},$$
$$\beta_t^w = \beta_0^w + \gamma^w CR_t, \beta_t^R = \beta_0^R + \gamma^R CR_t,$$
$$\beta_t^K = \beta_0^K + \gamma^K CR_t,$$

where $K_{i,t}$ is the equity flows to economy i, ROW and ROR are equity flows to the rest of the world and region, $K_{i,t-1}$ is the one-month lagged equity flows, and CR_t is a stress dummy that equals 1 during a specific (any) episode of financial crisis specified in each panel and 0 otherwise. The left panel reports estimation results for each episode of financial crisis separately while the right panel reports those for all episodes of financial crisis simultaneously. We report the estimated the sensitivity to global (regional) equity flows β_t^w (β_t^R), which is decomposed into global (regional) interdependence β_0^w (β_0^R) and global (regional) contagion γ^w (γ^R), and the episode-specific equity outflows (non-fundamental contagion) η. The estimated β_0^K and γ^K that capture the momentum and heteroskedasticity robust standard errors, abbreviated to save space, are available upon request. Symbol *, **, and *** corresponds to significance level at 10%, 5%, and 1% respectively.

	Individual Stress Episode					All Stress Episodes				
	Contagion			Interdependence		Interdependence			Interdependence	
	γ^w	γ^R	η	β_0^w	β_0^R	γ^w	γ^R	η	β_0^w	β_0^R
Panel A. Global Financial Crisis										
JPN	0.104	0.045	-0.042***	0.420***	-0.066	0.033	0.051	-0.045***	0.491**	-0.072
KOR	0.359*	0.511**	-0.020**	0.664***	0.717***	0.526**	0.619***	-0.019*	0.497***	0.610***
CHN	-0.173	-0.378	0.045***	0.908***	1.292***	-0.352	-0.732**	0.056***	1.087***	1.646***
HKG	0.036	0.065**	-0.012***	0.279***	0.213***	0.028	0.077**	-0.015***	0.287***	0.201***
SGP	0.199**	0.165	-0.011	0.516***	0.352***	0.170	0.173	-0.015	0.545***	0.344***
IDN	0.185	0.607***	0.001	0.668***	0.718***	0.231	0.713***	0.002	0.622***	0.613***
MYS	-0.251**	0.454**	-0.029**	0.494***	0.407***	-0.304**	0.547***	-0.030**	0.547***	0.314***
PHL	0.010	0.131*	-0.009**	0.502***	0.480***	-0.016	0.241***	-0.014**	0.527***	0.370***
THA	0.179	0.694**	-0.024	0.790***	0.886***	0.265	0.826**	-0.027	0.704***	0.754***
Panel B. European Debt Crisis										
JPN	-0.257	-0.188	-0.014*	0.504***	-0.057	-0.244	-0.174	-0.018	0.491**	-0.072
KOR	0.611***	0.906***	0.021**	0.709***	0.690***	0.822***	0.986***	0.017	0.497***	0.610***
CHN	-0.275	-0.444**	-0.006	0.825***	1.286***	-0.537	-0.804***	0.013	1.087***	1.646***
HKG	-0.034	-0.025	-0.002	0.307***	0.213***	-0.014	-0.012	-0.005**	0.287***	0.201***
SGP	-0.119	0.135	-0.010**	0.593***	0.350***	-0.072	0.141	-0.015***	0.545***	0.344***
IDN	0.571***	1.307***	0.035***	0.693***	0.703***	0.642***	1.397***	0.034***	0.622***	0.613***
MYS	0.041	0.447***	0.011**	0.506***	0.397***	-0.000	0.530***	0.007	0.547***	0.314***
PHL	-0.041	0.186*	0.012***	0.544***	0.471***	-0.024	0.288***	0.004	0.527***	0.370***
THA	0.505*	1.136***	0.023**	0.838***	0.869***	0.639*	1.251***	0.014	0.704***	0.754***

Table 5. Capital Interdependence and Contagion for individual economy. (continued)

	Individual Stress Episode					All Stress Episodes				
	Contagion			Interdependence		Contagion			Interdependence	
	γ^w	γ^R	η	β_0^w	β_0^R	γ^w	γ^R	η	β_0^w	β_0^R
Panel C. US Taper Tantrum										
JPN	0.244	0.056	0.010	0.442***	-0.065	0.195	0.062	0.003	0.491**	-0.072
KOR	0.157	0.646*	0.034	0.751***	0.712***	0.411	0.748*	0.032	0.497***	0.610***
CHN	-0.057	-0.504*	-0.020	0.750***	1.259***	-0.394	-0.891**	-0.003	1.087***	1.646***
HKG	-0.002	0.100*	0.004	0.308***	0.204***	0.018	0.104*	0.001	0.287***	0.201***
SGP	-0.277***	-0.051	0.006	0.585***	0.363***	-0.237**	-0.032	0.000	0.545***	0.344***
IDN	0.186	0.170	-0.007	0.689***	0.748***	0.254	0.305	-0.004	0.622***	0.613***
MYS	0.173	0.315***	-0.003	0.483***	0.403***	0.109	0.404***	-0.003	0.547***	0.314***
PHL	0.340***	0.480***	-0.001	0.506***	0.441***	0.318**	0.552***	-0.005	0.527***	0.370***
THA	0.645***	0.368*	-0.038***	0.842***	0.881***	0.783***	0.495**	-0.041***	0.704***	0.754***
Panel D: Chinese Stock Market Crash										
JPN	-1.227	0.801	0.064*	0.513***	-0.046	-1.205	0.826	0.056	0.491**	-0.072
KOR	-1.065**	0.651*	0.016	0.780***	0.735***	-0.782	0.776**	0.015	0.497***	0.610***
CHN	0.514	-0.806***	-0.032*	0.754***	1.241***	0.181	-1.211***	-0.017	1.087***	1.646***
HKG	-0.092	0.087	-0.003	0.302***	0.210***	-0.077	0.096	-0.007	0.287***	0.201***
SGP	-0.250***	-0.069	0.006	0.576***	0.364***	-0.219**	-0.049	-0.001	0.545***	0.344***
IDN	-0.210	-0.046	-0.026	0.706***	0.757***	-0.126	0.098	-0.023	0.622***	0.613***
MYS	-0.080	0.110	-0.010	0.484***	0.424***	-0.144	0.220	-0.011	0.547***	0.314***
PHL	0.141	0.976**	-0.011	0.509***	0.467***	0.122	1.073**	-0.014	0.527***	0.370***
THA	-2.235*	1.263	0.081	0.878***	0.941***	-2.061	1.450	0.075	0.704***	0.754***

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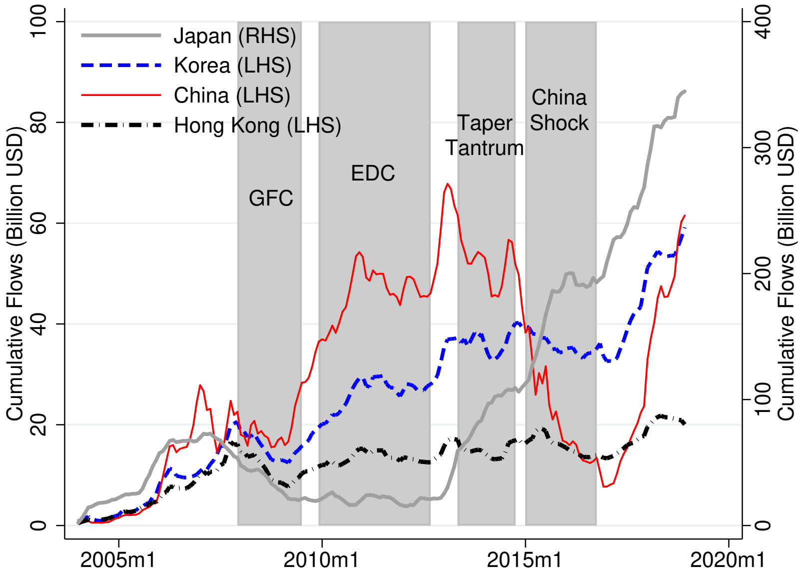
Appendix

Figure A1. Cumulative equity flows.

This figure plots the cumulative equity flows in billion USD to Japan, Korea, China and Hong Kong (panel A) and ASEAN (Panel B). The grey-shadded areas mark five episodes of shocks. (i) Global Financial Crisis (GFC) from 2007M12 to 2009M7; (ii) European Debt Crisis (EDC) from 2009M12 to 2012M9; (iii) the US Federal taper tantrum (Tapper) from 2013M5 to 2004M10; and (iv) Chinese stock market shock from 2015M1 to 2016M10 (China Shock).

Panel A: Japan, Korea, China and Hong Kong



Panel B: ASEAN

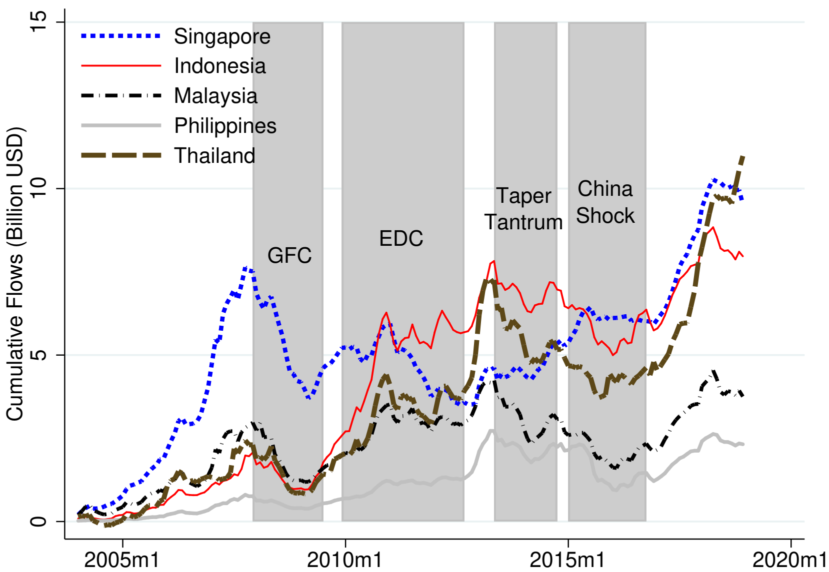


Figure A2. Summary statistics of equity flows.

This figure demonstrates the range and the mean of equity flows weighted by market capitalization in each ASEAN+3 economies.

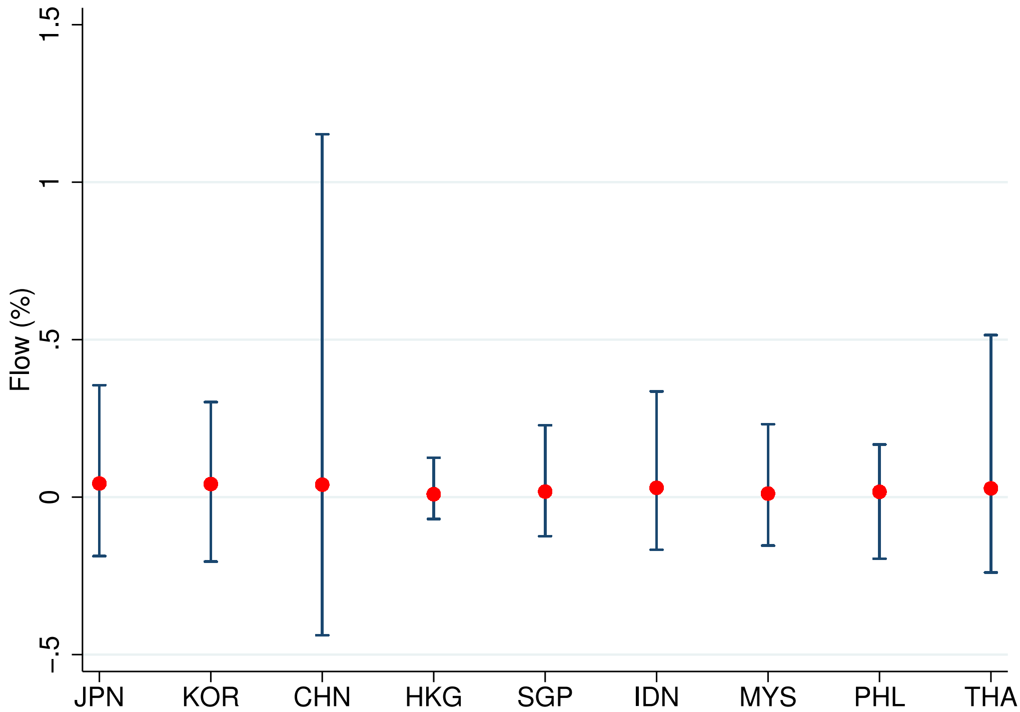


Figure A3. Explanatory power of pull factors before and after orthogonalization.

This figure plots the adjusted R^2 in the regressions of equity flows on each pull factor before and after its orthogonalization with respect to the three elements in the baseline model in Eq.(1). The detailed description of each push factor is in Appendix Table A1.

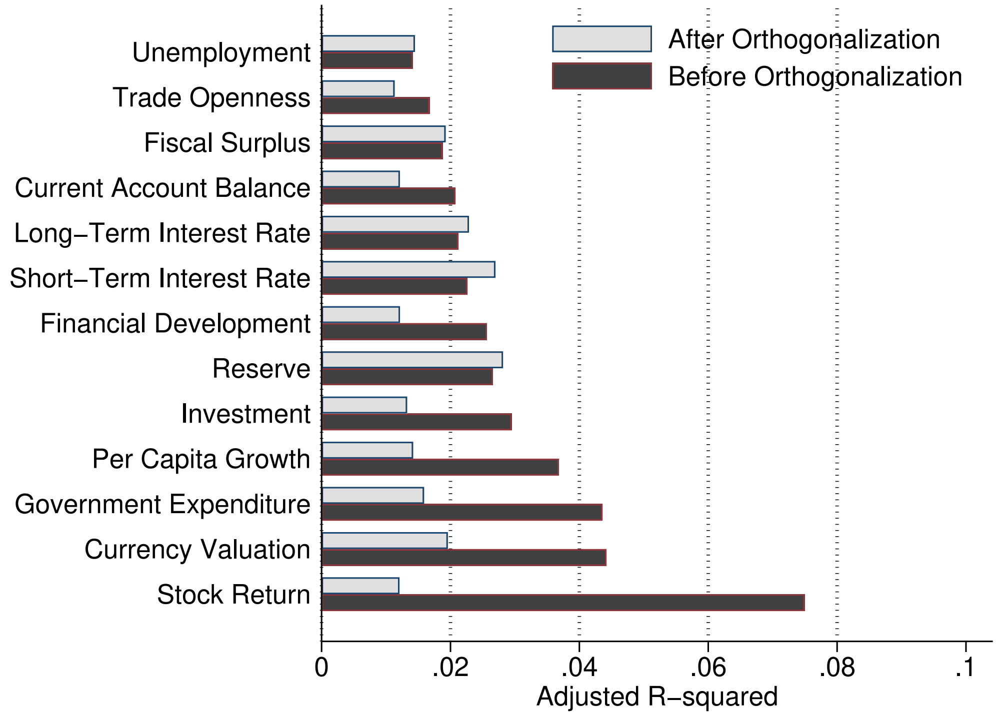


Figure A4. Explanatory power of pull factors and baseline model.

This figure plots the adjusted R^2 in the regressions of equity flows on (i) a rich set of pull factors reported in Figure A3 (left bar), (ii) the three elements in the baseline model (middle bar), and (iii) both pull and market factors (right bar) for each and the pool of ASEAN+3 economies.

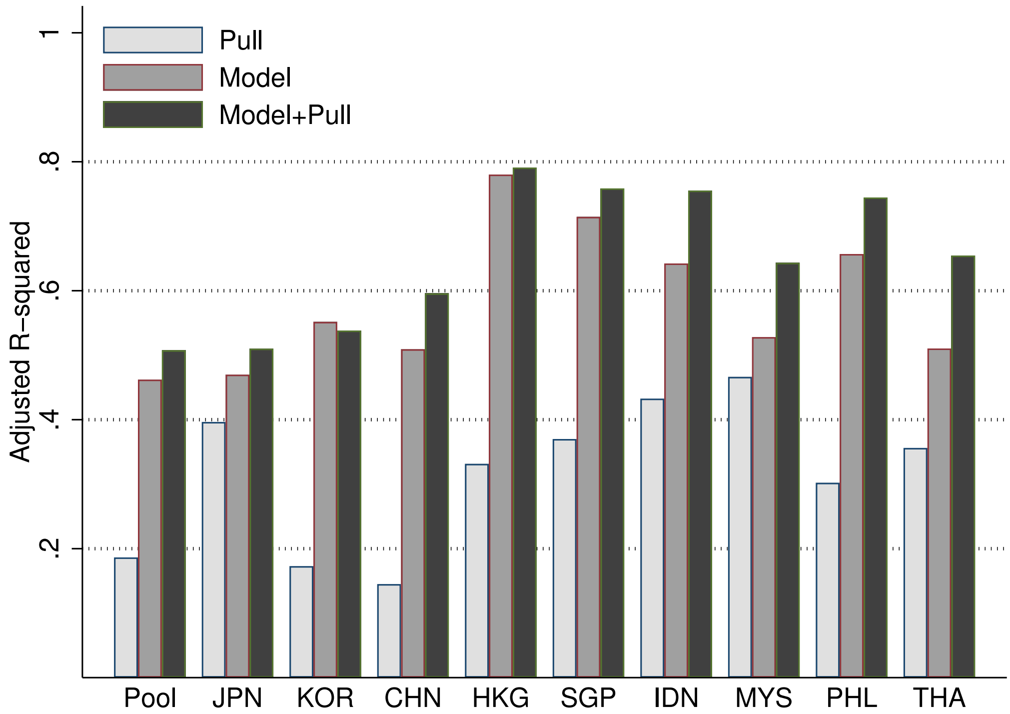


Figure A5. Explanatory power of push and pull factors versus baseline model.

This figure plots the adjusted R^2 in the regressions of equity flows on (i) a rich set of push and pull factors described in Figure 2 and A3 (left bar), (ii) the three elements in the baseline model (middle bar), and (iii) all push and pull factors plus and the three elements (right bar) for each and the pool of ASEAN+3 economies.

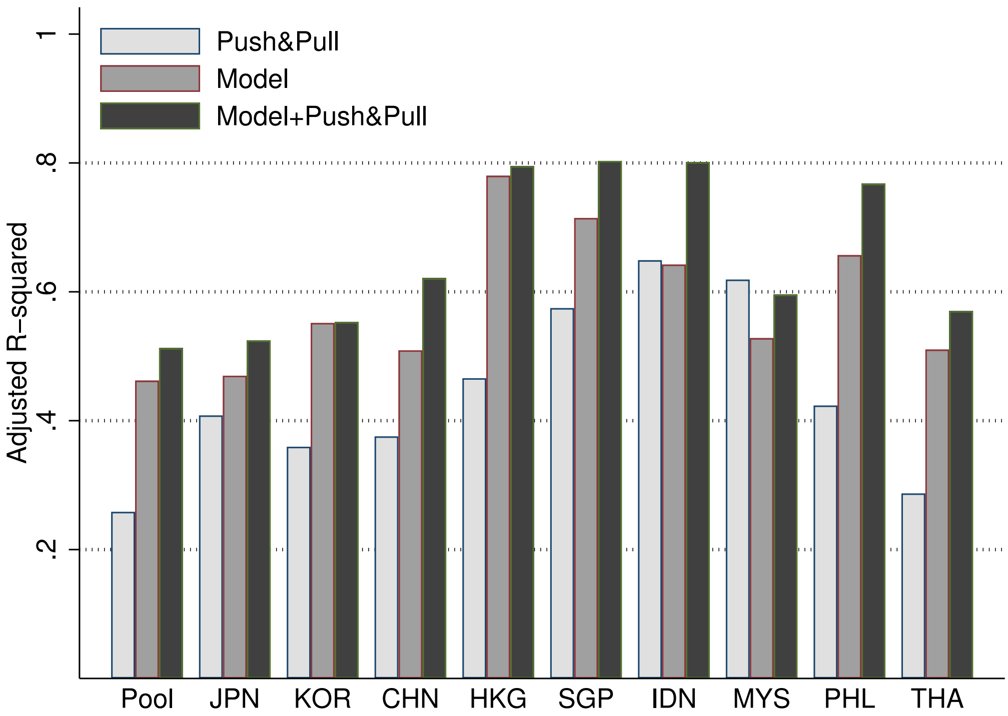


Table A1. Variable definition.

Variable Name	Definition	Frequency	Source
Key variables			
K_{it}	Market-capitalization weighted equity flows to economy i	M	EPFR/WDI
ROW_i	Market-capitalization weighted equity flows to the world except economy i	M	EPFR/WDI
ROR_i	Market-capitalization weighted equity flows to the rest of the region except economy i	M	EPFR/WDI
Push Factors			
Risk - VIX	monthly return on the Chicago Board Options Exchange (CBOE) volatility index	M	Bloomberg
Liquidity - TED	Interest difference between 3-M LIBOR based on US dollars and 3-M US Treasury bill	M	GFD
US short-term interest rates	Monthly return in the 3-M US treasury bond	M	GFD
US long-term interest rates	Monthly return in the 10-Y US government bond	M	GFD
Fed effective interst rate	Fed fund effective interst rate	M	FRED
Shadow rate	The Fed fund effective interst rate adjusted for the macroeconomic impact of monetary policy at the zero lower bound following Wu and Xia (2016)	M	FRED
Bond Yield	US bond yields	M	GFD
USD valuation	The monthly return on real effective exchange rate of USD	M	GFD
MSCI return	Monthly return of MSCI world index	M	Bloomberg
Business confidence	Monthly return in OECD's business confidence index	M	Datastream
Oil price shock	Monthly return in the crude oil price	M	GFD
Policy uncertainty	Monthly return in Global Economic Policy Uncertainty Index	M	GFD
Gold return	Monthly return in gold price.	M	GFD
Non-farm payroll	log difference of monthly number of paid workders in non-farm sector	M	GFD
Pull Factors			
Trade openess	To sum of total export and import divided by GDP	Q	UNCTAD
Trade with the rest of the world	To sum of total export and import divided by GDP	Q	UNCTAD
Trade with the rest of the region	To sum of export to and import from the rest of the region divided by GDP	Q	UNCTAD
Current account balance	The difference between export and import divided by GDP	Q	Datastream
International bank lending	The total claims of international banks on that economy divided by its GDP	M	BIS/WDI
Total external debt	The total debt outstanding divided by GDP	Q	BIS/Datastream
International Reserve	Total international reserve as a ratio of GDP	M	Datastream
Capital account openness	Chinn-Ito capital account openess index	A	Chin and Ito (2006)

Table A2. Variable definition (continued).

Variable Name	Definition	Frequency	Source
Nominal FX return	The monthly return of foreign exchange rate relative to USD	M	GFD
Trade-weighted FX return	The monthly return in the trade-weighted foreign exchange rates	Q	Datastream
Stock market return	The monthly return in the major stock index	M	GFD
Short-term interest rate	3-M interbank interest rate	M	GFD
Long-term interest rate	Monthly change in the yield of 10-year bond	M	GFD
Fiscal surplus	The government budget surplus divided by GDP	Q	Datastream
Government expenditure	Total government expenditure as a ratio of GDP	Q	Datastream
Market capitalization	The log of total market capitalization of all listed firms	A	WDI
Market capitalization/GDP	Total market capitalization of all listed firms as a ratio of GDP	A	WDI
Bank Credit/GDP	domestic credit to private sector by banks as a ratio of GDP	A	WDI
Per Capita growth	Annual growth in GDP per capita	A	WDI
Investment	Total investment as a ratio of GDP	A	WDI
Unemployment	The monthly change in unemployment rate	M	Datastream

Table A3. Capital Comovement - additional lag of equity flows.

This table reports the OLS estimation results of economy-level equity flows $K_{i,t}$ on equity flows to the rest of the world and region, ROW and ROR, and the lagged equity flows $K_{i,t-1}$ and $K_{i,t-2}$:

$$K_{i,t} = \beta^w ROW_{i,t} + \beta^R ROR_{i,t} + \beta^k_{-1} K_{i,t-1} + \beta^k_{-2} K_{i,t-2} + c_i + \varepsilon_{i,t}.$$

The first row reports the result based on pooled regression with economy fixed effects, while the subsequent rows report results for Japan (JPN), South Korea (KOR), China (CHN), Hong Kong, China (HKG), Singapore (SGP), Indonesia (IDN), Malaysia (MYS), Philippines (PHL) and Thailand (THA) respectively. Symbol *, **, and *** corresponds to significance level at 10%, 5%, and 1% respectively.

	β^w	β^R	β^k_{-1}	β^k_{-2}	Observations	Adjusted R-squared
Pool	0.577***	0.471***	0.393***	0.024	1,602	0.463
JPN	0.438***	-0.035	0.528***	0.111	178	0.473
KOR	0.763***	0.738***	0.242***	0.041	178	0.550
CHN	0.795***	1.191***	0.507***	-0.118	178	0.517
HKG	0.294***	0.212***	0.129**	0.075	178	0.782
SGP	0.558***	0.366***	0.279***	0.135	178	0.725
IDN	0.699***	0.759***	0.237***	0.053	178	0.643
MYS	0.468***	0.426***	0.122	0.150*	178	0.544
PHL	0.507***	0.488***	0.158***	0.077	178	0.660
THA	0.875***	0.932***	0.118*	-0.021	178	0.509

Table A4. Capital Comovement - controlling for push and pull factors.

This table reports the OLS estimation results of economy-level equity flows $K_{i,t}$ on equity flows to the rest of the world and region, ROW and ROR, and the lagged equity flows $K_{i,t-1}$, controlling for a set of push factors, pull factors, and both in the left, middle and right panel:

$$K_{i,t} = \beta^w ROW_{i,t} + \beta^R ROR_{i,t} + \beta^k K_{i,t-1} + \beta F_t + c_i + \varepsilon_{i,t}.$$

The set of of push and pull factors are described in Figure 2 and A3 respectively and their coefficients are abbreviated to save space. The first row reports the result based on pooled interquantile regression with economy fixed effects, while the subsequent rows report results for Japan (JPN), South Korea (KOR), China (CHN), Hong Kong, China (HKG), Singapore (SGP), Indonesia (IDN), Malaysia (MYS), Philippines (PHL) and Thailand (THA) respectively. Symbol *, **, and *** corresponds to significance level at 10%, 5%, and 1% respectively.

	Add push factors		Add pull factors		Add push and pull factors	
	β^w	β^R	β^w	β^R	β^w	β^R
Pool	0.477***	0.444***	0.555***	0.445***	0.474***	0.429***
JPN	0.658***	-0.007	0.350***	-0.042	0.554***	0.012
KOR	0.575***	0.672***	0.725***	0.715***	0.575***	0.672***
CHN	0.880***	1.245***	0.830***	1.342***	0.924***	1.367***
HKG	0.270***	0.212***	0.292***	0.208***	0.261***	0.210***
SGP	0.509***	0.356***	0.564***	0.347***	0.500***	0.347***
IDN	0.450***	0.676***	0.828***	0.958***	0.598***	0.822***
MYS	0.378***	0.406***	0.547***	0.634***	0.499***	0.583***
PHL	0.407***	0.454***	0.490***	0.485***	0.405***	0.468***
THA	0.687***	0.880***	0.735***	0.826***	0.615***	0.803***