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# **Do Volatile Capital Flows Put ASEAN+3 Growth at Risk?**

Anne Oeking and Laura Grace Gabriella

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# Do Volatile Capital Flows Put ASEAN+3 Growth at Risk?<sup>1</sup>

Prepared by Anne Oeking<sup>2</sup> and Laura Grace Gabriella<sup>3 4</sup>

Authorized by Hoe Ee Khor (Chief Economist)

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## Abstract

Capital inflows help to develop financial markets and promote economic growth, but they also pose risks that may undermine financial stability. Consequently, policymakers have developed their policy toolkits to include capital flow management and macroprudential policy measures, and encourage international financial institutions to adopt more flexible positions vis-à-vis their application. This study investigates the impact of short-term capital flows, namely, portfolio and other investment flows, on selected ASEAN+3 economies. The empirical results show that capital flows matter for growth through the financial stability channel, that is, capital flow surges can put growth at risk. Moreover, the findings suggest that the effects of capital flow shocks are economy-specific. These findings could contribute to the policy debate on how capital flow management and macroprudential policy measures should be deployed.

JEL classification: F21, F32, F41, F43, G15, G28

Keywords: capital flows, capital flow management measures, emerging market economies, financial stability, growth-at-risk, quantile regression, vector autoregression

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<sup>2</sup> This paper was written while the author was on secondment at AMRO.

<sup>3</sup> Corresponding author: [Laura.Grace.Gabriella@amro-asia.org](mailto:Laura.Grace.Gabriella@amro-asia.org).

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**Abbreviations**

AFC	Asian financial crisis
ASEAN	Association of South-East Asian Nations
ASEAN+3	ASEAN plus China (including Hong Kong), Japan, Korea
ASEAN-5	Indonesia, Malaysia, Philippines, Singapore, and Thailand
BCLMV	Brunei Darussalam, Cambodia, Lao PDR, Myanmar, and Vietnam
BIS	Bank for International Settlements
BOP	balance of payments
BPM6	balance of payments and international investment position manual
CFM	capital flow management measures
FDI	foreign direct investment
GaR	growth-at-risk
GFC	global financial crisis
IMF	International Monetary Fund
MPM	macroprudential policy measures
VAR	vector autoregression

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## I. Introduction

The resumption of capital flows into the ASEAN+3 region, particularly the emerging market economies (EMEs), following the global financial crisis (GFC), has been both a boon and a bane. Although capital inflows are crucial for financial and economic development, they also pose risks to financial stability and, consequently, growth. Meanwhile, the increasing complexity of the international monetary system and network of financial linkages have raised concerns among regional policymakers about the effects of capital flow volatility and sudden stops. In response, they have sought to develop their policy toolkits to include capital flow management and macroprudential policy measures (CFMs and MPMs), and to encourage international financial institutions to adopt more flexible positions vis-à-vis their application.

There is a plethora of research literature on capital flows and their relationship to economic growth. A substantial amount of research on the Asian region was conducted in the wake of the Asian financial crisis (AFC), when many regional economies were severely damaged by the sudden stops in capital flows. The literature suggests that the relationship between capital flows and macroeconomic volatility in emerging market economies is ambiguous and may depend on certain factors. Examples include the nature of flows (Hegerty 2011), the level of financial development of an economy ([Kose, Prasad, and Terrones 2003](#)), or country characteristics (Milesi-Ferretti and Tille 2011; and Ahmed and Suardi 2009).

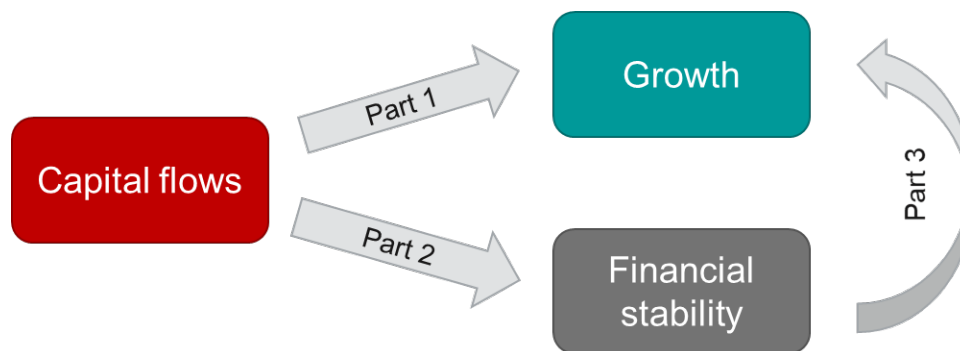
Over the past dozen years, researchers have found more evidence on the benefits of capital inflows beyond the typically-preferred foreign direct investment (FDI) flows, for economic growth. For example, [Aizenman and others \(2011\)](#) show a positive relationship between growth and equity flows, albeit smaller and less stable than with FDI flows. Acharya and Prakash (2013) examine the impact of capital inflows on economic growth of 11 Asian economies between 1991–2010 and similarly conclude that both FDI and portfolio inflows have a positive impact on growth. [Iqan, Kutan and Mirzaei \(2016\)](#) use industrial level data for 22 emerging markets (including four ASEAN+3 economies) and find that external finance-dependent industries grow disproportionately faster in countries that receive more capital inflows, albeit debt rather than equity. However, [Eichengreen and Gupta \(2016\)](#) find that huge capital inflows, particularly portfolio investment and bank lending, without appropriate macroeconomic and macroprudential policies in place, lead to a significant increase in sudden stop risks, corroborating lessons learned during the AFC.

Apart from the impact on growth and other aspects of the real economy, capital flows also have implications for financial stability. The existing literature suggests that capital account liberalization in developing economies is usually followed by financial instability and crises in the presence of underdeveloped financial systems and increased risk-taking, as the liberalization process evolves (Corsetti and others 1999; Daniel and Jones 2007). Furthermore, the work by Caballero (2016) shows that surges of capital inflows are associated with a higher probability of banking crises, but in some country-specific cases, portfolio and banking flows have a positive effect on financial stability when supported by appropriate macroeconomic policies ([Pruski and Szpunar 2008](#)). The mixed evidence across country experiences suggests that the impact of a particular type of capital flows on the financial stability of one country may not be the same as for another. [Baum, Pundit, and Ramayandi \(2017\)](#) argue that country-specific financial and macroeconomic characteristics help to explain some of these differences.

This study investigates the impact of different types of short-term capital flows on ASEAN+3 economies, specifically portfolio and other investment flows. The empirical analysis sheds some light on how capital flows impact growth and financial stability in the region, as a first step in the discussion of whether capital flows should potentially be managed by policy measures. This paper comprises three parts (Figure 1): First, we consider the empirical relationship between different types of capital flows and growth, irrespective of the main underlying channels driving this relationship. Second, we test whether and how capital flows impact financial stability. Finally, we combine these two and assess whether capital flows put growth at risk via the financial stability channel. This exercise is mostly comparative static in nature and thus does not provide a causal interpretation.

The results show that capital flows matter for growth through the financial stability channel, that is, capital flow surges can put growth at risk. The findings also suggest that the effects of capital flows are economy-specific, thus suggesting that an array of policy measures—if any were to be used—would have to fit different circumstances. The paper is structured as follows. Section II describes the data used in the empirical analysis. Section III presents the methodologies used in each of the three parts described above, together with analyses of the respective findings. Section IV concludes.

**Figure 1. Impact of Capital Flow Shocks: Overview of Relationships Analyzed**



Source: Authors.

## II. Data

Our empirical analysis focuses on the ASEAN-5, Hong Kong, and Korea. Within the ASEAN+3 region, these economies have the characteristics of largely open capital accounts and receive sizeable, high-frequency flows. Japan and China are excluded given that the former has a fully open capital account with an international reserve currency, while the latter has a relatively closed capital account. The BCLMV economies are excluded given their relatively small to non-existent non-FDI private capital flows and lack of high frequency data.

Quarterly data are collected for the 1990–2020 period. However, the common start dates for all data series differ across our sample economies and not all capture tail events (Figure 2). For instance, data for Indonesia, Korea, and Singapore include the AFC period but data for Hong Kong, Malaysia, and Thailand are only available post-AFC. Separately, financial market data for the Philippines are too limited for some of the econometric analysis, while Singapore does not publish a breakdown of its portfolio flows into equities and bonds. The data are obtained from Haver Analytics, comprising:

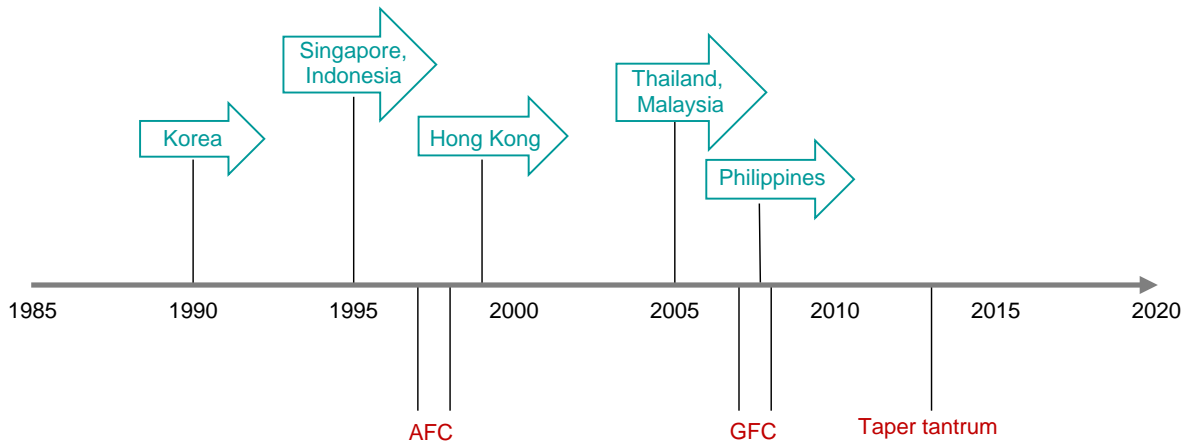
- Capital flow liabilities (non-resident flows) from the IMF's Balance of Payments (BoP) statistics database (BPM6), consisting of the main non-FDI private flow subgroups;



portfolio investment, comprising equity and bond flows, and other investment, which for many economies, is represented largely by bank lending.

- Credit and property price data from the Bank for International Settlements (BIS), which are used to derive the financial cycle, as a measure of financial stability. Financial stability is represented by a financial cycle variable, which averages over deviations or “gaps” from the historical norms of credit to GDP, real credit growth, and real property price growth.
- Other financial and macroeconomic data series from national authorities and private sector market sources for the quantile regressions.

**Figure 2. Selected ASEAN+3: Data Availability**



Sources: Bank for International Settlements, IMF, and national authorities, all via Haver Analytics; and authors' estimates.  
 Note: Data availability refers to the earliest period for which quantile regression results for at least one set of partition variables commence (see Section III). "Hong Kong" refers to Hong Kong, China. AFC = Asian financial crisis. GFC = global financial crisis.

### III. Methodology and Analysis

#### A. Part 1: Capital Flows and Future Growth

In a first step, we establish the relationship between future GDP growth and prevailing levels of capital flows. We follow some parts of the IMF's growth-at-risk (GaR) framework ([Prasad and others 2019](#); [Lafarquette, 2019](#)). The framework is not structural, so does not give causal links. It nevertheless helps to identify the historical relationship between capital flows and growth, and can help to identify risks. To link future GDP growth to current levels of capital flows, we estimate the following quantile regressions:

$$(1) \quad y_{t+h}^q = \alpha^q + \beta_C^q X_{C,t} + \varepsilon_{t+h}.$$

Here,  $y_{t+h}$  measures future growth  $h$  quarters ahead, with  $h \in \{4,12\}$ , thus focusing on both the short-term and medium-term relationships. The regression is estimated at different points of the distribution of  $y_{t+h}$  to show how results differ over the business cycle. We focus on quantiles  $q \in \{0.1, 0.25, 0.5, 0.75, 0.9\}$ .  $X_{C,t}$  measures capital flows, and refers to either portfolio investment flows (parsed by equity and bond flows, where available), or other investment flows.

Our findings suggest the main link between non-FDI private capital flows and growth is via portfolio investment, particularly equities. For most economies, we find a positive link between the different types of capital flows and growth four quarters ahead, particularly for equity flows (Table 1).<sup>5</sup> The findings are less significant over the medium-term. Most significant findings are at the outer quantiles, that is, they occur during either booms or busts. We interpret this finding as evidence that non-resident capital inflows in and of itself have a positive link with growth in the short-term, especially when the respective economy is in either a downturn or sharp upturn. We do not find such strong relationships over the medium-term, although here, the trends suggest a more negative relationship between capital flows and growth during periods of weak growth.

**Table 1. Selected ASEAN+3: Quantile Regression Results, with Capital Flows as Only Regressor**

Portfolio investment											
Quantile						Quantile					
<i>h=4</i>	0.1	0.25	0.5	0.75	0.9	<i>h=12</i>	0.1	0.25	0.5	0.75	0.9
Hong Kong	+	-	+	+	-	Hong Kong	---	-	-	-	-
Indonesia	+++	+	+	+	+++	Indonesia	-	+	+	-	+
Korea	+	+	+	+	-	Korea	+	+	+	+	+++
Malaysia	+++	+	+	+	+++	Malaysia	-	+	+	+	+
Singapore	+++	+++	+	+++	+++	Singapore	---	-	+	+	+++
Thailand	+	+++	+	+	+	Thailand	-	-	-	+	+

Other investment											
Quantile						Quantile					
<i>h=4</i>	0.1	0.25	0.5	0.75	0.9	<i>h=12</i>	0.1	0.25	0.5	0.75	0.9
Hong Kong	+++	+	-	-	-	Hong Kong	-	+	-	-	-
Indonesia	+++	+++	+	+	+	Indonesia	-	+	+	+	+
Korea	-	-	+	+	+	Korea	---	+	+	+	+++
Malaysia	-	+	+	-	-	Malaysia	+	+	+	+	+
Singapore	-	-	-	-	-	Singapore	-	+	+	+	+
Thailand	-	-	-	-	---	Thailand	-	-	+	+	-

Equity flows											
Quantile						Quantile					
<i>h=4</i>	0.1	0.25	0.5	0.75	0.9	<i>h=12</i>	0.1	0.25	0.5	0.75	0.9
Hong Kong	+	-	+	+	-	Hong Kong	+	-	-	-	-
Indonesia	+++	+++	+	+	+++	Indonesia	-	+	+	-	+
Korea	+++	+++	+	+	+++	Korea	+	-	+	+	-
Malaysia	+++	+++	+	+	+++	Malaysia	-	-	-	+	+
Thailand	+++	+++	+	+	+	Thailand	-	-	-	+	+++

Bond flows											
Quantile						Quantile					
<i>h=4</i>	0.1	0.25	0.5	0.75	0.9	<i>h=12</i>	0.1	0.25	0.5	0.75	0.9
Hong Kong	+++	-	-	-	---	Hong Kong	---	-	-	-	-
Indonesia	+	+	+	+	-	Indonesia	---	+	+	-	+
Korea	---	-	-	-	---	Korea	-	+	+	+	+++
Malaysia	+	+	+	+	+	Malaysia	-	+	+	+	+
Thailand	+	+	-	+	-	Thailand	-	-	-	-	-

Sources: Bank for International Settlements, IMF, and national authorities, all via Haver Analytics; and authors' estimates.

Note: Shows sign of coefficient  $\beta_C^q$  from the quantile regression  $y_{t+h}^q = \alpha^q + \beta_C^q X_{C,t} + \varepsilon_{t+h}$ . Green "+++" and orange "---" show statistically significant findings at the 90 percent confidence level.

<sup>5</sup> The full results are available upon request.

To control for other factors, we expand our quantile regression, taking into account financial stability as measured by the financial cycle variable and several other control variables capturing macro-financial conditions. To include macro-financial conditions, we rely on partitions, that is, groupings of related variables. Partitions help to set up parsimonious models with a reduced number of parameters estimated. This feature is particularly important, given that we are using quarterly macroeconomic data and thus have a limited number of observations to work with. It also helps to extract common information about co-movements between the variables, while ignoring idiosyncratic noise (see [Prasad and others 2019](#)). Finally, the partitions can also be used to mitigate attrition issues in the case of variables with missing data points ([Lafarquette, 2019](#)).

We set up two partitions, one capturing financial conditions, the other capturing external factors. For the financial conditions partition, we mainly rely on price-based financial market indicators, similar to financial condition indices in the literature (for example, [Hatzius and others 2010](#); [Debuque-Gonzales and Gochoco-Bautista 2013](#); [Brave and Kelley 2017](#)); for the external factors partition, we include main trading partner growth, commodity prices, as well as the VIX to capture market risks and investor sentiment (Table 2).

**Table 2. Quantile Regression: Partition Variables**

Financial conditions	External factors
Term premia	US growth
Sovereign spread	China's growth
Bond returns	Euro area growth
Bond historical volatility	Commodity prices, energy
Equity returns	Commodity prices, non-energy
Equity historical volatility	VIX
CDS spreads	
Government bond yields	
Prime business lending rates	

Source: Authors.

We aggregate variables in each partition by using principal component analysis. The first component of the principal component analysis is calculated as the respective index. The partitions may include different sets of variables for each economy—we define partitions to ensure that the main economic trends are adequately captured, and to provide a high variance ratio by including those variables that are most informative, as indicated by the loadings. Also, different economies may have different data series available (Appendix I). Finally, we confirm that the partitions can be interpreted consistently across all economies by switching the signs of the index as necessary.<sup>6</sup> A higher (lower) indicator for the financial conditions partition implies tighter (easier) financial conditions; a higher (lower) external factors partition implies weaker (stronger) external conditions.

<sup>6</sup> The signs of the loadings in the first component of the principal component analysis are arbitrary, so our manual reversion ensures consistency across economies without changing the variance within the first component (Jolliffe 2002).

We estimate the following quantile regression:

$$(2) \quad y_{t+h}^q = \alpha^q + \beta_C^q X_{C,t} + \beta_{FS}^q X_{FS,t} + \beta_F^q X_{F,t} + \beta_E^q X_{E,t} + \beta_G^q X_{G,t} + \varepsilon_{t+h}.$$

In addition to equation (1), we include our financial stability indicator,  $X_{FS,t}$  and our partitions for financial conditions,  $X_{F,t}$  and external factors,  $X_{E,t}$ , in equation (2).<sup>7</sup> Finally, we add contemporaneous GDP growth  $X_{G,t}$  to capture persistence. As before, we estimate the quantile regressions separately for each economy.

Our results show that when controlling for additional factors impacting growth, many of the earlier results disappear, likely because other variables already capture the main trends. In the short-term, the main finding is still that equity inflows during periods of weak growth are associated with higher growth four quarters ahead (short term) for many economies (Table 3). In the medium-term (12 quarters ahead), capital inflows seem to be negatively correlated with growth during periods of weak growth and across different types of capital flows for several economies; the opposite finding holds for periods of strong growth. However, these findings do not suggest any causation and do not specify any channel through which capital flows would impact growth outcomes. The analysis also disregards any other general equilibrium effects.

## B. Part 2: Capital Flows and Financial Stability

Importantly, what impact do capital flows have on financial stability? In the second step, we explore the potential impact of capital flow surges on the financial stability of individual economies. Here, financial stability is again represented by the financial cycle variable and by its components, comprising deviations or “gaps” from the historical norms of credit to GDP, real credit growth, and real property price growth, which have been found to be the most promising leading indicator of financial crises ([Drehmann, Borio, and Tsatsaronis 2012](#); [Borio and Drehmann 2009](#); [Alessi and Detken 2009](#)).

The impact of capital flows is differentiated based on the type of flow and the financial stability indicator, using a vector autoregression (VAR) model:

$$(3) \quad \begin{cases} X_{FS,t} = \alpha_1 + \beta_{11}X_{FS,t-1} + \beta_{12}X_{C,t} + \beta_{13}X_{C,t-1} + e_{1t} \\ X_{C,t} = \alpha_2 + \beta_{21}X_{C,t-1} + \beta_{22}X_{FS,t} + \beta_{23}X_{FS,t-1} + e_{2t} \end{cases}$$

where,  $X_{FS,t}$  is the financial stability component,  $X_{C,t}$  is the capital flow type—portfolio investment, equity or bond flows, or other investment—and  $e_t$  is the random error term. The impulse response estimates the impact of a one standard deviation shock to each type of capital flow on financial stability.<sup>8</sup> The maximum impulse responses of financial stability to each type of flow for each economy in each of the first two years (8 quarters) is summarized in Table 4.

The evidence on the impact of capital flows on financial stability is mixed, underscoring the economy-specific nature of capital flow shocks. Historically, shocks to capital flows affect the financial stability indicators similarly in both the first and second year of the risk horizon, for Korea, Philippines, and Thailand; in particular, increases in other investment flows appear to

<sup>7</sup> In line with the findings in later parts, we assume that our variables for financial stability and for capital flows are not contemporaneously correlated.

<sup>8</sup> Individual results are available upon request.

have the most negative impact. In contrast, capital flow surges tend to impact Hong Kong's financial stability indicators negatively within 12 months, and then recede for a few indicators, but take time to build up in Indonesia and manifest in the second year. Shocks to portfolio inflows appear to widen the real property price gap in almost all regional economies in the short-term, with lingering effects on the property sectors in Malaysia, Philippines, and Singapore.

**Table 3. Selected ASEAN+3: Quantile Regression Results, Including Partitions**

Portfolio investment											
Quantile						Quantile					
<i>h=4</i>	0.1	0.25	0.5	0.75	0.9	<i>h=12</i>	0.1	0.25	0.5	0.75	0.9
Hong Kong	-	-	+	+	+	Hong Kong	---	---	-	-	-
Indonesia	+++	+++	+	+	+	Indonesia	-	+	+	+	+
Korea	-	-	-	+	+	Korea	-	-	+	+	-
Malaysia	+	+	+	+	+	Malaysia	+	+	+	+	+
Singapore	+	+	+	+	+	Singapore	-	-	+	-	+++
Thailand	+	+	+	+	+	Thailand	-	-	-	-	-

Other investment											
Quantile						Quantile					
<i>h=4</i>	0.1	0.25	0.5	0.75	0.9	<i>h=12</i>	0.1	0.25	0.5	0.75	0.9
Hong Kong	+	-	+	+	-	Hong Kong	-	+	+	-	-
Indonesia	+	+	+	+	+++	Indonesia	---	-	-	-	-
Korea	-	-	-	-	+	Korea	-	-	-	+	+
Malaysia	+	+	+	-	-	Malaysia	+	+	+	-	-
Singapore	---	-	-	-	+	Singapore	-	+	+	+++	+++
Thailand	-	-	-	+	+	Thailand	-	-	-	-	-

Equity flows											
Quantile						Quantile					
<i>h=4</i>	0.1	0.25	0.5	0.75	0.9	<i>h=12</i>	0.1	0.25	0.5	0.75	0.9
Hong Kong	-	-	-	-	-	Hong Kong	-	---	-	-	-
Indonesia	+++	+++	+	+	+	Indonesia	-	+	+	-	+
Korea	+++	+	+	+	+++	Korea	-	-	-	-	-
Malaysia	+++	+++	+	+	+	Malaysia	+	-	-	+	+
Thailand	+	+++	+	+	+	Thailand	-	+	+	+	+++

Bond flows											
Quantile						Quantile					
<i>h=4</i>	0.1	0.25	0.5	0.75	0.9	<i>h=12</i>	0.1	0.25	0.5	0.75	0.9
Hong Kong	+	-	+	+	+	Hong Kong	-	-	-	-	-
Indonesia	+	+	-	+	+	Indonesia	---	+	+	+	+
Korea	-	-	-	---	-	Korea	-	-	+	+	+
Malaysia	+	+	+	+	-	Malaysia	+	+	+	+	-
Thailand	-	-	+	+	+	Thailand	-	-	-	-	-

Sources: Bank for International Settlements, IMF, and national authorities, all via Haver Analytics; and authors' estimates.

Note: Shows sign of coefficient  $\beta_C^q$  from the quantile regression  $y_{t+h}^q = \alpha^q + \beta_C^q X_{C,t} + \beta_{FS}^q X_{FS,t} + \beta_F^q X_{F,t} + \beta_E^q X_{E,t} + \beta_G^q X_{G,t} + \varepsilon_{t+h}$ . Green "+++" and orange "---" show statistically significant findings at the 90 percent confidence level.

**Table 4. Selected ASEAN+3: Impact of Capital Flow Shocks on Financial Stability Indicators**

Year = 1		Hong Kong	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
Credit Gap	Portfolio investment	○	●	○	○	●	○	●
	Equity flows	●	●	●	○	●	○	●
	Bond flows	○	●	●	●	○	○	○
	Other investment	●	●	●	○	○	○	●
Credit Growth Gap	Portfolio investment	●	●	○	○	●	○	○
	Equity flows	●	●	●	○	○	○	●
	Bond flows	●	●	●	○	●	○	●
	Other investment	○	●	●	○	●	○	●
Real Property Price Gap	Portfolio investment	●	○	●	●	○	●	○
	Equity flows	○	○	○	●	●	○	○
	Bond flows	●	○	●	○	○	○	○
	Other investment	○	○	●	○	○	○	○
Financial Cycle	Portfolio investment	○	●	○	○	●	○	●
	Equity flows	●	●	●	○	○	○	●
	Bond flows	○	●	●	●	●	○	●
	Other investment	○	●	●	●	○	○	●
Year = 2								
Credit Gap	Portfolio investment	○	●	○	○	○	○	○
	Equity flows	○	●	●	●	○	○	○
	Bond flows	●	○	●	○	○	○	○
	Other investment	○	●	●	●	○	○	●
Credit Growth Gap	Portfolio investment	○	●	○	○	●	●	○
	Equity flows	○	●	○	○	○	○	●
	Bond flows	●	○	●	○	●	○	○
	Other investment	●	●	●	●	●	○	●
Real Property Price Gap	Portfolio investment	●	●	○	○	○	●	○
	Equity flows	●	○	○	●	●	○	●
	Bond flows	●	○	○	○	○	○	○
	Other investment	○	○	○	○	○	●	○
Financial Cycle	Portfolio investment	○	●	○	○	○	○	○
	Equity flows	○	●	●	●	○	○	○
	Bond flows	●	○	●	○	○	○	○
	Other investment	○	●	●	●	○	●	●

Sources: Bank for International Settlements, IMF, and national authorities, all via Haver Analytics; and authors' estimates.

Note: Dots show the results from the impulse responses as described in equation (3). Red dot means that financial stability is weakened (higher financial gap); green dot means financial stability is strengthened (lower financial gap), and white dot means the result is not significant.

### C. Part 3: Capital Flows and Future Growth via Financial Stability

In the final step, we incorporate the link between capital flows and financial stability into our quantile regressions and expand our analysis to show whether capital flows put growth at risk. Even if capital flows by themselves do not show a direct negative association with growth in the medium-term, their impact on financial stability warrants a closer look. We estimate two different sets of quantile regressions, both modelling a relatively ad-hoc inclusion of our modelling of the linkage between capital flows and financial stability—one more generalized, one taking into account more economy-specific features.

Based on the quantile regression results, we proceed to estimate the GaR at certain points in time. The GaR ([Prasad and others 2019](#); [Lafarquette 2019](#)) links macro-financial conditions to the probability distribution of future real GDP growth. Specifically, we develop a full distribution of future growth based on the conditional quantiles from the regression. The GaR tool first derives the conditional cumulative distribution function, and then derives the

probability distribution function with a parametric t-skew fit, following Adrian, Boyarchenko, and Giannone (2019). We use these functions to derive our GaR at specific points in time—we define the 5<sup>th</sup> percentile of the growth distribution as a severe adverse outcome.

Finally, we run a counterfactual scenario analysis. Here, we simulate the impact of a shock to capital flows, via its effect on financial stability, on the future growth distribution. As with the growth distribution derived in the previous step, this result relates to one point in time. It is important to note that the GaR framework is not a structural model, but a parsimonious reduced-form forecasting system. It thus does not establish causal links. It considers uncorrelated shocks without taking into account feedback loops, that is, it reflects comparative static analysis by assuming that other variables remain unchanged if one or more variables are shocked.

First, we estimate quantile regressions by taking into account our findings from the previous section.

$$(4) \quad y_{t+h}^q = \alpha^q + \beta_{FS,t}^q X_{FS,t} + \beta_F^q X_{F,t} + \beta_E^q X_{E,t} + \beta_G^q X_{G,t} + \varepsilon_{t+h}.$$

We use the same quantiles as previously,  $q \in \{0.1, 0.25, 0.5, 0.75, 0.9\}$ . Regressors include the partitions for financial conditions,  $X_{F,t}$ , and external factors,  $X_{E,t}$ , as well as contemporaneous GDP growth,  $X_{G,t}$ , to capture persistence. As before, we estimate the quantile regressions separately for each economy.

Equation (4) excludes capital flows as an explicit regressor and focuses instead only on the financial stability,  $X_{FS,t}$ , variable (“basic model”). Given that any impact from capital flows on financial stability takes at least 2 quarters to build up, we focus on a future growth horizon of  $h \in \{2,6,8,10\}$  for our dependent variable  $y_{t+h}$ . This avenue assumes the same time frame and shock size from capital flows to financial stability for each economy, thus allowing simplification amid different lengths of time series and considerable estimation uncertainty (Appendix II).

We proceed to derive the probability distribution of future real GDP growth, under both the baseline and shock scenarios. The shock scenario assumes a shock to financial stability broadly corresponding to a one standard deviation shock to capital flows as shown in the previous part:

$$(5) \quad \tilde{X}_{FS,t} = X_{FS,t} * (1 + shock).$$

Under the basic model, we assume a uniform shock across economies of 0.2 standard deviation—which is based on the estimated maximum range of impulse responses of financial stability to inflow shocks—on our financial stability indicator (Table 5). We show the results of a positive and a negative shock, based on Q4 2020, the last available quarter in our data set.

Our analysis reveals a multitude of information, including the entire growth distribution, but our discussion focuses on the 5 percent GaR. The 5 percent GaR corresponds to the probability of future real GDP growth falling below a certain threshold. We are particularly interested in this GaR value and how it changes under our shock scenarios, given that it focuses on the left tail of the distribution and helps to quantify the impact of severe downside

(tail) risks for future GDP growth. Per [Prasad and others \(2019\)](#), it can assist in guiding policy by focusing on risk minimization rather than optimizing average forecast outcomes.

**Table 5. Selected ASEAN+3: Estimated Size of Shock to Financial Stability**  
(Number of standard deviations)

Capital Flow Type	Hong Kong	Indonesia	Korea	Malaysia	Singapore	Thailand
Portfolio investment	–	0.16	–	–	–	-0.04
Equity flows	0.06	0.22	-0.21	-0.05		-0.04
Bond flows	-0.10	-0.08	0.15	-0.03		0.03
Other investment	-0.04	0.08	0.16	0.04	-0.09	0.04

Sources: Bank for International Settlements, IMF, and national authorities, all via Haver Analytics; and authors' estimates.  
Note: Financial stability is represented by the financial cycle in Table 4. Derived from the impulse response functions estimated in part 2. Shows the maximum statistically significant impulse responses as measured in standard deviations.

The respective shocks model the resulting impact on growth from a shock to financial stability, which we assume—but not explicitly model—to follow a capital flow shock. In our impulse responses, discussed in sub-section B (Part 2) above, we show that financial stability mostly, though not exclusively, worsens following a shock to capital inflows (and, in the absence of a structural model, we assume a symmetric shock for capital outflows, that is, improving financial stability). Hence, when our 5 percent GaR value for growth is lower (that is, tail risk growth in the severely adverse outcome is even worse) after a weakening in financial stability (that is, a +0.2sd shock) compared to the baseline, we interpret it as implying that any deterioration in financial stability from a shock to capital flows could exacerbate risks to growth, and vice versa. When tail risk growth under the 5 percent GaR is higher after a strengthening in financial stability (that is, a –0.2 sd shock) compared to the baseline, we interpret it as implying that capital outflows and their bearing on financial stability have a positive impact on tail growth.

With our basic model, we note that the results differ by economy and forecast horizon (Table 6). For some, weakening (strengthening) financial stability—which we assume to be driven by capital flow shocks—is correlated with the probability of lower (higher) tail growth (Indonesia throughout the entire forecast horizon; Singapore after at least six quarters). For others, the probability of higher tail growth is greatest at six quarters before worsening subsequently (Hong Kong, Malaysia, Thailand); for yet others, tail risk growth under the 5 percent GaR is only marginally affected (Korea).

In our extended model, we estimate the following quantile regression, with the same quantiles  $q \in \{0.1, 0.25, 0.5, 0.75, 0.9\}$  and regressors as before:

$$(6) \quad y_{t+12}^q = \alpha^q + \beta_C^q X_{C,t} + \beta_{FS}^q X_{FS,t+r} + \beta_F^q X_{F,t} + \beta_E^q X_{E,t} + \beta_G^q X_{G,t} + \varepsilon_{t+h}.$$

In equation (6), we include both capital flows and financial stability, as macro-financial vulnerabilities develop endogenously and can amplify financial shocks (“extended model”). Since the impact from capital flows on financial stability takes time to build, we focus on the growth outcome over the medium-term (that is, 12 quarters ahead), and use a leading value for our financial stability regressor,  $X_{FS,t+r}$ , with  $r \in \{2,3,4,6,8,9\}$ . The respective values for  $r$  are economy-specific, and derived from the impulse response results in subsection B (Part 2) by focusing on the quarters with the largest statistically significant impulse response (Table 7).



**Table 6. Selected ASEAN+3: Change in Growth-at-Risk after Shock to Financial Stability, Basic Model**  
(Relative to baseline 5 percent GaR, in percentage points)

<b><i>h = 2</i></b>				<b><i>h = 6</i></b>			
	+ve shock		-ve shock		+ve shock		-ve shock
Hong Kong	↑ 0.3		↓ -0.1	Hong Kong	↑ 1.0		↓ -1.0
Indonesia	↓ -0.5		↑ 0.6	Indonesia	↓ -0.2		↑ 0.2
Korea	↓ -0.2		↑ 0.2	Korea	↑ 0.1		↓ -0.2
Malaysia	↑ 0.7		↓ -0.7	Malaysia	↑ 1.3		↓ -1.3
Singapore	↑ 0.2		↓ -0.2	Singapore	↓ -0.3		↑ 0.3
Thailand	↑ 0.4		↓ -0.4	Thailand	↑ 0.6		↓ -0.6

<b><i>h = 8</i></b>				<b><i>h = 10</i></b>			
	+ve shock		-ve shock		+ve shock		-ve shock
Hong Kong	↑ 0.1		↓ -0.1	Hong Kong	↑ 0.2		↓ -0.3
Indonesia	↓ -0.2		↑ 0.2	Indonesia	↓ -0.2		↑ 0.1
Korea	↑ 0.1		↑ 0.0	Korea	↑ 0.1		↓ -0.1
Malaysia	↑ 0.0		↓ -0.2	Malaysia	↓ -0.1		↑ 0.2
Singapore	↓ -0.1		↑ 0.1	Singapore	↓ -0.3		↑ 0.3
Thailand	↑ 0.5		↓ -0.5	Thailand	↑ 0.0		↓ -0.3

Sources: Bank for International Settlements, IMF, and national authorities, all via Haver Analytics; and authors' estimates.

Note: Based on results from quantile regression  $y_{t+h}^q = \alpha^q + \beta_{FS,t}^q X_{FS,t} + \beta_F^q X_{F,t} + \beta_E^q X_{E,t} + \beta_G^q X_{G,t} + \varepsilon_{t+h}$ . Assuming  $\tilde{X}_{FS,t} = X_{FS,t} * (1 + shock)$  with  $shock = 0.2$  s.d. in Q4 2020. Growth-at-risk calculated as described in [Prasad and others, 2019](#) and [Lafarguette, 2019](#); following Adrian and others, 2018.

**Table 7. Selected ASEAN+3: Lead Time for Financial Stability Regressor**  
(Number of quarters)

Capital Flow Type	Hong Kong	Indonesia	Korea	Malaysia	Singapore	Thailand
Portfolio investment	–	4	–	–	–	3
Equity flows	2	4	8	6		3
Bond flows	6	2	8	4		2
Other investment	9	4	8	6	6	6

Sources: Bank for International Settlements, IMF, and national authorities, all via Haver Analytics; and authors' estimates.

Note: Derived from the impulse response functions estimated in Part 2. Shows the quarters with the largest statistically significant impulse response.

Next, we derive the probability distribution of future real GDP growth, under both the baseline and shock scenarios. Under the extended model, we shock both capital flows and the lead financial stability variable:

$$(7) \quad \tilde{X}_{C,t} = X_{C,t} * (1 + shock), \tilde{X}_{FS,t+r} = X_{FS,t+r} * (1 + shock_C).$$

We distinguish the shock size by type of capital flow and by economy, and estimate the baseline and shock scenarios in quarters Q4 2020 –  $r$ , the number of lead quarters for our financial stability variable.















For the extended model, we focus on the impact on medium-term growth after capital inflows have built up over time. For all economies, we find that tail risk growth 12 quarters ahead is

weaker following a bond inflow shock, and stronger following a bond outflow shock (Table 8). In Indonesia and Thailand, surges in the various types of capital inflows consistently increase the tail risks to growth. Economic growth in Korea and Malaysia is most vulnerable to equity outflows, and Malaysia is also exposed to other investment outflows. We provide some examples of the full distribution of future growth and corresponding 5 percent GaR (Figure 3), which clearly show that the full distribution can look quite different across economies, and change in distinct ways after a shock. Although the 5 percent GaR trends at the tail are mostly similar across the charts, several other distribution parameters, such as the mode (local maximum), skewness (measuring asymmetry) and kurtosis (capturing the heaviness of the tails) show distinct findings across economies.























The extended model shows that capital inflows—including via their impact on financial stability—are negatively correlated with medium-growth during the weaker parts of the business cycle (Appendix Table 3). This finding, compared to the models in subsection A (Part 1), takes into account that vulnerabilities can build up over time, and any effect from capital flows on growth will likely take place via indirect channels. Importantly, these findings do not provide any causation, but rather, should be interpreted as historical correlations. Economy-specific findings and unique future growth distributions are one example of how the characteristics of individual economies considerations might matter.

**Table 8. Selected ASEAN+3: Change in Growth-at-Risk after Shock to Capital Flows and Financial Stability, Extended Model**

(Relative to baseline 5 percent GaR, in percentage points)

Portfolio investment				Equity flows					
	+ve shock		-ve shock			+ve shock		-ve shock	
Indonesia		-0.5		0.3	Hong Kong		-0.9		0.3
Thailand		-1.3		1.7	Indonesia		-0.1		0.1
					Korea		1.1		-1.1
					Malaysia		1.5		-7.2
					Thailand		-1.6		1.8

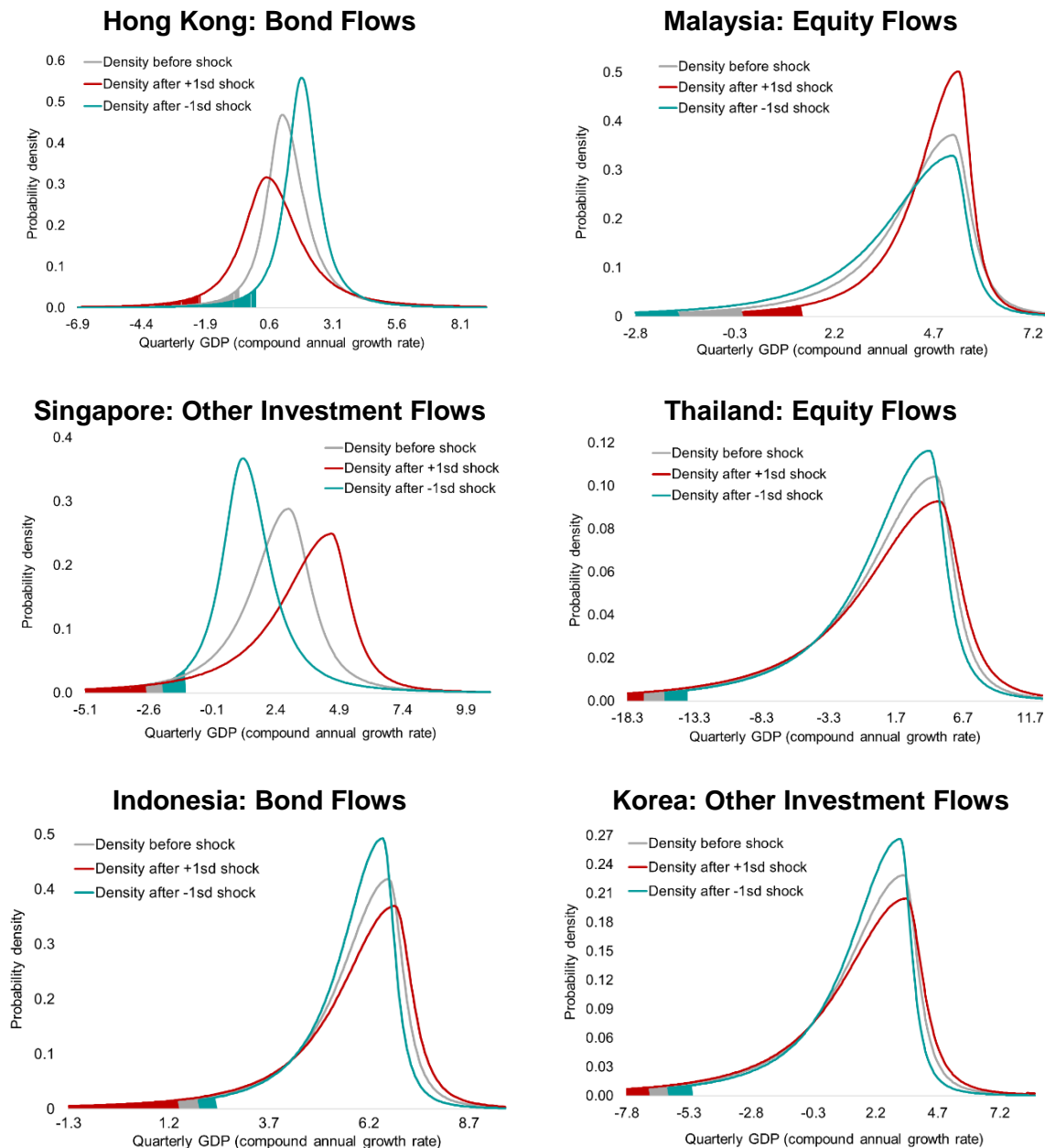
  

Other investment				Bond flows					
	+ve shock		-ve shock			+ve shock		-ve shock	
Hong Kong		0.7		-0.6	Hong Kong		-1.5		0.6
Indonesia		0.0		0.1	Indonesia		-0.5		0.5
Korea		-0.8		1.1	Korea		-0.1		0.1
Malaysia		2.7		-2.6	Malaysia		-0.3		0.3
Singapore		-0.6		0.9	Thailand		-1.6		1.1
Thailand		-1.3		1.3					

Sources: Bank for International Settlements, IMF, and national authorities, all via Haver Analytics; and authors' estimates.

Note: Based on results from quantile regression  $y_{t+12}^q = \alpha^q + \beta_C^q X_{C,t} + \beta_{FS}^q X_{FS,t+r} + \beta_F^q X_{F,t} + \beta_E^q X_{E,t} + \beta_G^q X_{G,t} + \varepsilon_{t+h}$ . Assuming  $\bar{X}_{C,t} = X_{C,t} * (1 + shock)$  and  $\bar{X}_{FS,t+r} = X_{FS,t+r} * (1 + shock_C)$  with  $shock = 1$  s. d. and  $shock_C$  economy-specific, based in Q4 2020 - r. Growth-at-risk calculated as described in [Prasad and others 2019](#) and [Lafarquette 2019](#); following Adrian and others, 2018.

**Figure 3. Selected ASEAN+3: Future Growth Distributions and Growth-at-Risk, Extended Model**



Sources: Bank for International Settlements, IMF, and national authorities, all via Haver Analytics; and authors' estimates.

Note: Shaded parts represent 5 percent GaR. Time periods considered are Q1 2020 for Hong Kong; Q2 2019 for Malaysia; Q2 2019 for Singapore; Q2 2019 for Thailand; Q2 2020 for Indonesia; and Q2 2019 for Korea. sd = standard deviation.

#### IV. Conclusion

This paper studies the impact of shocks to different types of capital flows on economies in the ASEAN+3 region. We consider three relationships: first, between capital flows and growth; second, between capital flows and financial stability; and finally, GaR under the simultaneous presence of capital flows and their impact on financial stability. Our empirical results show that capital flows matter for financial stability and future growth, and that capital flow surges can put growth at risk via the financial stability channel. Moreover, the effects can be quite economy-specific. These findings could contribute to the policy debate on how CFMs/MPMs should be deployed.

Finally, we offer a couple of caveats to our analysis. First, the findings do not explicitly model any measure that has already been implemented. Thus, they would also capture any CFM/MPM in place during the period analyzed. For example, an economy that explicitly relies on policy measures to address financial stability concerns from capital flows could show up in the results as having a relatively weaker link between the two, not because capital flows do not have a strong impact on financial stability, but because any link may have already been reduced, in part, with policy. Consequently, the analysis does not provide any assessment on the effectiveness of any specific CFM or MPM measure in place. Second, the analysis shows the varying impact of the different types of capital flows across individual economies over the full time period for which data are available. Their significance and signs may change depending on sub-periods selected, which would again underscore the importance of economy- and situation-specific considerations in determining how shocks or potential shocks to capital flows should be managed.

## Appendix I. Partition Variables

**Appendix Table 1. Selected ASEAN+3: List of Partition Variables by Economy**

<b>Financial conditions</b>	Hong Kong	Indonesia	Korea	Malaysia	Singapore	Thailand
Term premia			X	X	X	X
Sovereign spread		X	X	X	X	X
Bond returns	X	X	X	X	X	X
Bond historical volatility	X		X	X	X	X
Equity returns	X	X		X	X	X
Equity historical volatility	X	X	X	X	X	X
CDS spreads	X		X			X
Government bond yields	X	X	X	X	X	X
Prime business lending rates	X		X		X	X

<b>External factors</b>	Hong Kong	Indonesia	Korea	Malaysia	Singapore	Thailand
US growth	X	X	X	X	X	X
China's growth	X	X	X	X	X	X
Euro area growth	X	X	X	X	X	X
Commodity prices, energy	X	X	X	X		X
Commodity prices, non-energy			X		X	
VIX	X	X	X	X	X	X

Source: Refinitiv, Tullett Prebon Information, CMA, and national authorities, all via Haver Analytics; and authors' calculations.

Note: The partitions include a different sets of variables for each economy as we review partitions to adequately capture the main economic trends, and to provide a high variance ratio by including those variables most informative as shown by the loadings. Also, different economies have different data series available.

## Appendix II. Quantile Regression Results

### Appendix Table 2. Quantile Regression Results: Basic Model

<b>Financial Stability</b>											
Quantile						Quantile					
<i>h=2</i>	0.1	0.25	0.5	0.75	0.9	<i>h=6</i>	0.1	0.25	0.5	0.75	0.9
Hong Kong	+	+	+	-	---	Hong Kong	+	+	-	-	-
Indonesia	---	---	-	-	+	Indonesia	---	-	+	+	+
Korea	---	+	+	+	+	Korea	---	+	+	+++	+++
Malaysia	+++	+	+	+	+	Malaysia	+++	+++	+	-	-
Singapore	+++	---	-	-	+++	Singapore	+	+	---	---	-
Thailand	+	-	-	-	-	Thailand	+	+	-	-	-

Quantile						Quantile					
<i>h=8</i>	0.1	0.25	0.5	0.75	0.9	<i>h=10</i>	0.1	0.25	0.5	0.75	0.9
Hong Kong	+	+	-	-	-	Hong Kong	+	+	+	+	+
Indonesia	-	-	-	-	-	Indonesia	-	-	-	-	+
Korea	-	+	+	+++	+++	Korea	+	+++	+++	+++	+++
Malaysia	-	+	+	-	-	Malaysia	-	+	-	-	-
Singapore	+++	+	+	-	-	Singapore	+	+	-	-	-
Thailand	+	+	-	-	---	Thailand	+	+	+	+	-

Sources: Bank for International Settlements, IMF, and national authorities, all via Haver Analytics; and authors' estimates.

Note: Shows sign of coefficient  $\beta_C^q$  from the quantile regression  $y_{t+h}^q = \alpha^q + \beta_{FS,t}^q X_{FS,t} + \beta_F^q X_{F,t} + \beta_E^q X_{E,t} + \beta_G^q X_{G,t} + \varepsilon_{t+h}$ . Green "+++" and orange "---" show statistically significant findings at the 90 percent confidence level.

Appendix Table 3. Quantile Regression Results: Extended Model

Portfolio investment						Financial stability						
Quantile						Quantile						
<i>h</i> =12	0.1	0.25	0.5	0.75	0.9	<i>h</i> =12	0.1	0.25	0.5	0.75	0.9	Lead length
Hong Kong	---	---	-	-	-	Hong Kong	-	+	-	-	-	4
Indonesia	+	-	+	+++	+++	Indonesia	---	---	---	---	---	
Korea	+	-	+	-	+	Korea	-	-	-	-	-	
Malaysia	-	+	-	+	+	Malaysia	---	-	-	+	-	
Singapore	---	-	+	+	+++	Singapore	-	-	-	-	-	
Thailand	-	-	-	-	-	Thailand	-	-	-	-	-	
Other investment						Financial stability						
Quantile						Quantile						
<i>h</i> =12	0.1	0.25	0.5	0.75	0.9	<i>h</i> =12	0.1	0.25	0.5	0.75	0.9	Lead length
Hong Kong	-	+	+	+	-	Hong Kong	-	-	-	-	-	9
Indonesia	-	+	-	-	+	Indonesia	---	-	-	-	-	4
Korea	-	-	-	+	+	Korea	---	+	+	+++	+++	8
Malaysia	+	+	+	+	-	Malaysia	-	-	-	+	-	6
Singapore	+	+	+	+	+++	Singapore	-	---	---	---	---	6
Thailand	-	-	-	-	-	Thailand	+	+	+	-	-	6
Equity flows						Financial stability						
Quantile						Quantile						
<i>h</i> =12	0.1	0.25	0.5	0.75	0.9	<i>h</i> =12	0.1	0.25	0.5	0.75	0.9	Lead length
Hong Kong	+	-	-	-	-	Hong Kong	+++	+	+	+	+	2
Indonesia	+	-	+	+	+	Indonesia	---	---	-	---	---	4
Korea	-	-	-	-	-	Korea	---	+	+	+++	+++	8
Malaysia	+	-	-	+	+	Malaysia	-	-	-	-	-	3
Thailand	-	-	+	+	+	Thailand	+	+	+	+	-	
Bond flows						Financial stability						
Quantile						Quantile						
<i>h</i> =12	0.1	0.25	0.5	0.75	0.9	<i>h</i> =12	0.1	0.25	0.5	0.75	0.9	Lead length
Hong Kong	-	-	-	+	-	Hong Kong	-	-	-	-	-	6
Indonesia	-	+	+	+	+	Indonesia	-	-	-	+	-	2
Korea	-	+	+	+	+	Korea	---	+	+	+	+++	8
Malaysia	+	+	+	+	+	Malaysia	+	+	+	+	-	4
Thailand	-	-	-	-	---	Thailand	+++	+	+	-	-	2

Sources: Bank for International Settlements, IMF, and national authorities, all via Haver Analytics; and authors' estimates.

Note: Shows sign of coefficient  $\beta_C^q$  from the quantile regression  $y_{t+h}^q = \alpha^q + \beta_C^q X_{C,t} + \beta_{FS}^q X_{FS,t+r} + \beta_F^q X_{F,t} + \beta_E^q X_{E,t} + \beta_G^q X_{G,t} + \varepsilon_{t+h}$ . Green "+++" and orange "---" show statistically significant findings at the 90 percent confidence level.

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Address: 10 Shenton Way, #15-08  
MAS Building, Singapore 079117  
Website: [www.amro-asia.org](http://www.amro-asia.org)  
Tel: +65 6323 9844  
Email: [enquiry@amro-asia.org](mailto:enquiry@amro-asia.org)

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