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This article uses a structural vector autoregression approach to analyse the impact of financial stress on the economy and the relationship between monetary policy and financial stress in the ASEAN-5 economies (Indonesia, Malaysia, Philippines, Singapore and Thailand). We find that an increase in financial stress leads to tighter credit conditions and lower economic activity in all five countries. The estimated impact on the real economy displays an initial rapid decline followed by a gradual dissipation. In Malaysia, the Philippines and Thailand, the central banks tend to reduce policy interest rates (IRs) when financial stress increases, although there is substantial cross-country variation in the magnitude and time dynamics. The lower policy IRs are found to have little significant effects in lowering financial stress, but are still effective in stimulating economic activity through other channels. These findings imply that easing monetary policy is likely necessary but insufficient to address growth slowdowns associated with financial stress. Monetary easing should instead be complemented with other policy measures which are targeted at restoring financial stress to normal levels.

Index Terms—financial stress; monetary policy; small open economy

I. INTRODUCTION

There has been a resurgence of interest in the interconnections between macroeconomic and financial stability since the 2008 Global Financial Crisis (GFC) and euro debt crisis. This is no doubt attributable to the large scale and depth of the crises. The large adverse growth effects in economies at the epicentre of these crises were consistent with earlier crisis experiences (Reinhart and Rogoff, 2009). In other economies, particularly small-open economies, these episodes were stark reminders that their growth and financial stability prospects are susceptible to both domestic imbalances and external spillovers. Most of such economies were significantly affected through weak exports and the financial spillovers.

Although the policy responses during the GFC period were tailored largely to country-specific conditions, a notable observation was the move by central banks globally to reduce their policy interest rates (IRs) during this period. This held true irrespective of the respective central banks’ monetary policy mandates (inflation targeting or not), which raises the questions of whether monetary policy was influenced directly by the financial stress and if monetary policy was effective in facilitating the economic recovery.

In this context, this article aims to shed light on these issues for five small-open economies in Asia – Indonesia, Malaysia, Philippines, Singapore and Thailand (henceforth, ASEAN-5). Using a structural vector autoregression (SVAR) approach, we attempt to give insight to four questions: first, what is the impact of financial stress on economic activity? While the spillover to growth from lower exports is well understood, relatively less is known of the growth effects from the financial spillovers. This is especially true for economies with few past incidences of financial crisis, such as the ASEAN-5, to infer the growth effects from. Second, does monetary policy respond systematically to increases in financial stress? Third, is monetary policy effective in alleviating financial stress? Finally, do changes in financial stress levels alter the transmission of financial stress to the real economy?

The model builds from the existing open-economy VAR literature by using financial stress indices (FSIs), continuous indicators of stress in financial markets, to reflect financial cycles in global financial markets and in the ASEAN-5 economies. Through the FSIs, the VAR models capture in a parsimonious manner distinct features of financial episodes, such as underlying risk appetite and uncertainty. Using the FSIs offers two advantages: first, they facilitate analysis of macro-financial linkages during tranquil and stressful periods in financial markets, as they are continuous measures of financial stress. FSIs are thus useful for analysing issues pertaining to the financial cycle in countries with fewer historical incidences of severe financial episodes. Second, the FSIs summarize financial conditions in all major asset markets, hence sidestepping potential pitfalls from analysing spillovers within specific asset markets.

We find that an increase in financial stress leads to tighter credit conditions and lower economic activity in all five countries. The estimated impact on the real economy displays an initial rapid decline followed by a gradual dissipation. In Malaysia, the Philippines and Thailand, the central banks reduced policy IRs when financial stress increases, although there is substantial cross-country variation in the magnitude and time dynamics. The lower policy IRs are found to have little significant effects in lowering financial stress, but are still effective in stimulating economic activity through other channels. Overall, this result is consistent with these central banks acting to achieve macroeconomic stability, as lower policy IRs act to offset the contractionary effects of higher financial stress on economic activity.
The remaining article is organized as follows. Section II reviews the transmission channels of financial stress to the real economy and the related monetary policy issues. The SVAR model and data used are detailed in Section III. Section IV presents the results. Section VI concludes.

II. HOW FINANCIAL STRESS AFFECTS ECONOMIC

A. Access to financing

A main channel in which financial stress affects real economic activity is through access to financing. Higher financial stress can lead to lower access to financing by firms and households as the economic outlook deteriorates and asset prices decline. This occurs through several mechanisms. From borrowers’ perspective, the financial accelerator mechanism posits that external finance premiums increase when an adverse financial shock leads to a decline in net worth as asset prices fall and the economic outlook deteriorates (Bernanke and Gertler, 1989; Garber and Grilli, 1989). This happens because lenders perceive investments as more risky and have lower expected profits. The higher cost of funds then reduces access to desired financing and causes a decline in spending that is more persistent compared to the size of the initial shock. Meanwhile, the bank capital and bank lending channels emphasize the role of lenders. Adverse financial shocks erode banks’ capital base through lower profits, losses on existing loans and other assets on their balance sheets, forcing them to reduce lending (Bernanke and Blinder, 1992; Kashyap and Stein, 1995; Van Den Heuvel, 2002). This leads firms to reduce capital expenditures and households to reduce spending.

In equity markets, the Tobin’s q mechanism depicts how financial stress affects the cost of equity and suppresses economic activity (Tobin, 1969). This mechanism establishes a positive link between equity prices and capital investments by relating the market value of firms to the replacement cost of capital goods. Since equity prices decline during stress episodes, the market value of firms relative to their cost of capital goods also declines. Firms therefore need to issue more equity relative to periods when their market value is higher. This depresses fund raising in equity markets and leads to a decline in investment expenditure.

B. Uncertainty

Financial stress is also transmitted to the economy through higher uncertainty in financial markets and the economic outlook. Bloom (2009) studies the transmission of uncertainty through a reduced form VAR model and a structural firm-level model of investment. Firms hire and invest when business conditions are above a certain level and fire and disinvest when business conditions are below a threshold. There is a range of business conditions where firms find it optimal to take no action. This region of inaction increases with the level of uncertainty. Bloom (2009) finds a sharp fall, a rebound and an overshoot in employment, output and productivity. He explains that hiring and investment initially fall rapidly as firms hold back on planned projects and adopt a wait-and-see approach. Lower employment and investment by higher productivity firms then cause a fall in productivity. As the uncertainty dissipates, firms react to pent-up demand for capital and labour, hence causing an overshoot in investment, employment and productivity. Consumer spending is also affected by uncertainty, as consumers delay spending amid uncertain employment and wealth statuses. Lee et al. (2010) estimate a three-variable VAR and finds that higher uncertainty leads to a hump-shaped decline in household wealth and consumption over approximately 2 years. Carrière-Swallow and Céspedes (2013) analyse the impact of uncertainty shocks on investment and private consumption in developed and emerging markets using a VAR model. The authors find notable differences between developed and emerging economies. In developed economies, they find that investment displays a similar dynamic as Bloom (2009). However, the response of investment in emerging economies is larger and there is no subsequent overshoot. For private consumption, the authors find that the impact in emerging economies is larger compared to developed economies.

C. The relationship between monetary policy and financial stress

What is the role of monetary policy when financial stress increases and the real economy slows? There is no conceptual agreement yet on whether a monetary policy regime that best promotes price and output stability should respond to financial stability. The question of whether financial factors should enter the monetary policy reaction function is still being debated.

One literature analyses the desirability for monetary policy to respond to asset prices and credit through dynamic stochastic general equilibrium (DSGE) models. In a DSGE model with equity market cycles, Bernanke and Gertler (1999, 2001) find that a monetary policy rule based on inflation targeting is optimal for stabilizing inflation and output. This arises because stock market booms lead to stronger demand and higher inflation. It is therefore sufficient to consider the inflation forecast alone to set monetary policy once the informational content of asset prices in predicting inflation is incorporated.

Cecchetti et al. (2000) find, in contrast, that it is optimal for central banks to include equity prices in their policy reaction

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1 Defined as the difference in cost of financing an investment between internally and externally sourced funds.
2 See Dell’Ariccia et al. (2008) and Mendoza and Terrones (2008) for other selected examples of empirical studies that address the relationship between credit and real economy.
3 For instance, industrial production falls rapidly for 4 months, rebounds after 7 months and subsequently overshoots before its effects gradually dissipates approximately 3 years after the uncertainty shock.
4 See Baxa et al. (2013) for a more extensive review of this literature.
5 Despite their strong stance against systematic reactions to asset prices, Bernanke and Gertler (2001) caveat that this does not preclude short-term monetary policy interventions during periods of financial instability.
function. A key departure in the underlying assumptions from Bernanke and Gertler (1999, 2001) is that the central bank has information on whether the equity prices are driven by fundamentals and the timing of the bubble burst. More recently, Christiano et al. (2010) find that there are welfare gains from expanding the Taylor rule to include credit. Cúrdia and Woodford (2010) analyse the benefits of adding credit and credit spreads to the Taylor rule. They show that there are economic benefits to augmenting the Taylor rule with credit spreads and, to a smaller extent, credit as well.

One of the highlighted pitfalls of a monetary policy approach that responds only to inflation is that past experiences reveal that asset price booms are not always inflationary. This is pointed out, among many others, by Borio and Lowe (2002), Bordo and Wheelock (2004) and Christiano et al. (2010). For example, Borio and Lowe (2002) find three stylized features of financial imbalances – rapid asset price increases, fast credit expansions and above average capital accumulation. The authors also provide evidence from a large number of financial crises that inflation does not systematically increase during the build-up to financial crises or unwinding of lending booms, but are deflationary thereafter. This feature induces an asymmetry among the financial cycle, inflation and monetary policy. Specifically, monetary policy stays unchanged during the build-up of financial imbalances because there is no inflation, but is loosened aggressively after the onset of the crisis due to deflationary pressures. A major pitfall is that because monetary policy was not tightened earlier in the financial cycle, there is subsequently less space in how much monetary easing the central bank can do, at least in its conventional instrument. Borio and Lowe (2002, 2004) thus advocate explicit consideration of financial imbalances in setting monetary policy.

Despite the lack of intellectual consensus, there is evidence that many central banks do respond to financial factors in practice. A survey of over 90 central banks in both advanced and emerging economies revealed a significant correlation between monetary policy and financial stability concerns, including financial sector solvency, credit rationing and asset price volatility (Mahadeva and Sterne, 2000). Studies have also estimated the monetary policy reaction functions of central banks to search for indications of explicit attention to financial factors. Borio and Lowe (2004) estimate several permutations of the monetary policy reaction functions for the United States, Germany, Australia and Japan. They start with a standard Taylor rule specification and gradually add three measures of financial imbalances – the credit gap, equity price gap and a dummy variable capturing banking sector stress. Their results reflect variations in the reaction functions across countries. The German central bank paid little attention to financial imbalances in its monetary policy decisions. In Australia, the equity and credit gaps were jointly significant predictors of monetary policy movements. In Japan, there is evidence that monetary policy responded asymmetrically to credit and equity gaps, more when the gaps were negative. In the United States, the study also finds evidence that the Federal Reserve responded asymmetrically to financial imbalances. Policy IRs are more responsive to negative credit and equity gaps than positive gaps. More recently, Baxa et al. (2013) test the significance of financial stress in IR decisions using a time-varying specification of monetary policy in five advanced economies (United States, United Kingdom, Australia, Canada and Sweden). The authors find that central banks were unresponsive to financial stress at low and normal levels, but often eased their policy rates in response to higher financial stress, in particular, to equity and bank-related financial stress.

III. METHODOLOGY

In this study, we use an SVAR approach to assess the impact of financial stress on the economy and the relationship between financial stress and monetary policy. This modelling approach draws from more recent efforts to study linkages between financial conditions and economic activity using FSIs and VAR models. Representative studies are Li and St-Amant (2010), Davig and Hakkio (2010), Hollo et al. (2012), Mallick and Sousa (2013) and Roye (2011). Although the indices used vary with studies, all reflect stress in financial markets through declining and volatile asset prices, and higher bond yields/spreads. The existing analyses have thus far tended to focus on developed economies, particularly euro area economies and the United States, which is unsurprising given the recent financial episodes there. We contribute to this literature by adapting the model structure to be more suited for small-open economies, by including external variables to account for large exposures to the foreign environment.

A. Data

The sample consists of the ASEAN-5 countries of Indonesia, Malaysia, Philippines, Singapore and Thailand. The variables are in monthly frequency and range from January 1997 to December 2013. A summary of the variables is presented in Table 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Abbreviation</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>External</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commodity prices</td>
<td>GCP</td>
<td>Commodity price index (sa, log)</td>
<td>International Monetary Fund</td>
</tr>
<tr>
<td>World price</td>
<td>IPIw</td>
<td>World industrial production index (v, log)</td>
<td>CPB Netherlands Bureau for Economic Policy Analysis</td>
</tr>
<tr>
<td>Domestic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>D1</td>
<td>Industrial production index (sa, log)</td>
<td>International Financial Statistics (IFS)</td>
</tr>
<tr>
<td>Prices</td>
<td>CPI</td>
<td>Consumer price index (sa, log)</td>
<td>IFS</td>
</tr>
<tr>
<td>Interest rate</td>
<td>R</td>
<td>Short-term interest rate</td>
<td>IFS</td>
</tr>
<tr>
<td>Credit</td>
<td>C</td>
<td>Bank credit, defined by CPI (sa, log)</td>
<td>IFS</td>
</tr>
<tr>
<td>Exchange rate</td>
<td>EX</td>
<td>Nominal/effective exchange rate (log)</td>
<td>Bank for International Settlements</td>
</tr>
<tr>
<td>Financial stress</td>
<td>FSI</td>
<td>Financial stress index</td>
<td>Tagi et al. (2012)</td>
</tr>
</tbody>
</table>

Notes: ‘sa’ refers to seasonally adjusted. ‘Log’ refers to the natural log.

Three variables characterize the external environment: a global commodity price index (GCP), a world industrial production index (IPIw) and a FSI for the US economy (FSIUS). GCP captures global prices of food, fuel and metal commodities. IPIw captures global real economic conditions. This global measure is preferred for the US focused indicator, as it abstracts from trade diversification.
away from the United States. In addition, focusing on US demand alone risks misidentification of commodity price shocks, as commodity price movements are increasingly being attributed to demand from emerging markets, such as China. The final external variable is an index of financial stress for the US economy, FSIs, which proxies for global financial conditions. To be sure, financial episodes occur in other countries as well, especially in emerging markets. However, Kaminsky and Reinhart (2003) find that financial episodes tend to remain confined within their regions unless they spread to major financial centres. This suggests that ASEAN-5 financial markets are unaffected by financial episodes that originate outside the region and that financial spillovers to the region only occur when major financial markets are affected. Therefore, we do not attempt to measure global financial stress and assume that US financial stress aptly reflect global financial conditions.

Six variables characterize the domestic environment: the industrial production index (IPI) captures real economic activity; the consumer price index (CPI) reflects the price level; the short-term IR is the monetary policy instrument in Indonesia, Malaysia, Philippines and Thailand, and a floating short-term money market IR in Singapore; credit (C) is claims from the domestic banking system, and the exchange rate (EX) is the nominal effective exchange rate. The last variable, an index of financial stress (FSI), is a summary indicator of stress in financial markets from Tng et al. (2012). This index comprises stress indicators in four segments of domestic financial markets: the banking sector, foreign exchange market, bond market and equity market. The market-specific indicators of stress are weighted to their markets’ relative sizes, as reflected by the amount of outstanding financing in the market segments. The ASEAN-5 and US FSIs are shown in Fig. 1.

FIGURE 1– Financial stress in the ASEAN-5 economies (1997–2013)

Source: Authors’ calculation and Hakkio and Keeton (2009).

The variables are standardized prior to aggregation. A value of 0 reflects neutral financial conditions, high values reflect stress and low values reflect buoyance in financial markets. The FSIs indicate that higher stress in ASEAN-5 is observed during three periods. In order of severity, they are the Asian Financial Crisis (AFC) (1997–1998), the technology bubble burst in the US (2000–2001) and the recent GFC (2008–2009). The FSIs suggest that, for the ASEAN-5, the latter two episodes originated externally while the AFC was a domestic and regional episode.7

B. The SVAR Model8

A schematic summarizing the assumptions of the SVAR model is illustrated in Fig. 2. Domestic output and prices are influenced by two groups of variables: the first is the external environment, consisting of commodity prices, world demand and global financial conditions. The second group characterizes domestic financial markets with a short-term IR, the exchange rate, credit and the FSI. The sample countries are modelled as small-open economies and are thus affected by but do not affect external conditions. The external variables directly affect domestic output and prices through trade and price channels and indirectly through domestic financial markets.

FIGURE 2– Schematic illustration of causality assumptions in the VAR model

External conditions may influence monetary policy. This in turn affects domestic financial conditions, output and prices. External conditions also influence the exchange rate and domestic asset prices through cross-border capital flows. This consequently affects the terms of trade, wealth and financing conditions, which in turn affect output and prices. The financial accelerator mechanism may also amplify the direct effects of external shocks through a feedback effect from interactions between the real economy and financial markets. For instance, when faced with an adverse external demand

7 See Tng et al. (2012) for a discussion of financial stress in the ASEAN-5 economies during these three financial episodes.
8 This model also applied in Tng (2013) to analyse the exposure of the ASEAN-5 economies to external shocks. Hence, the description of the VAR model is largely similar to that article.
shock, lower profits and deteriorating balance sheet positions of export-oriented companies may cause an increase in borrowing premiums and lower access to financing. This leads to moderating investment and credit-financed trade.

To characterize these channels, consider the following SVAR model for each economy:

$$AX_t = B(L)X_{t-1} + \varepsilon_t$$

(1)

$$\varepsilon_t = Ae_t$$

(2)

$X$ is a vector of variables with a similar ordering as Table 1. $A$ is a matrix of contemporaneous coefficients in structural form. $B(L)$ is a matrix polynomial in the lag operator, $L$. $\varepsilon_t$ is a vector of structural disturbances, such that $\varepsilon_t$ is a vector of residuals from the corresponding reduced-form VAR. The equations can be organized into external and domestic blocks. Structural shocks are identified using the approach suggested by Sims (1986), Bernanke (1986) and applied by many others thereafter, by placing restrictions on the contemporaneous coefficients. The assumptions made on $A$ are:

- Commodity prices are contemporaneously exogenous to all other variables. World output and US financial stress are identified recursively by assuming the former is contemporaneously affected by commodity prices, while US financial stress is contemporaneously affected by commodity prices and world industrial production. The external variables are contemporaneously unaffected by the country-specific variables. The first four variables in the domestic block are ordered recursively in the following order—IPI, CPI, IR, C, EX and FSI. The short-term IR broadly follows a ‘Taylor rule’ principle, as it reacts contemporaneously to economic activity (IPI) and prices (CPI).

- The exchange rate is ordered before financial stress to model the narrative that a financial shock may trigger capital outflows and affect the exchange rate with a lag.

Block-exogeneity restrictions are also imposed on the domestic variables in the external equations to impose the small-open economy assumption. This means that the external variables affect each other in lags, but are unaffected by the domestic variables both in lags and contemporaneously. This approach follows from Cushman and Zha (1997), Maćkowiak (2005) and Raghavan et al. (2012).

The estimations are carried out using four lags. Table 2 presents results from the Akaike Information Criterion (AIC) and the Schwarz Information Criterion (SIC), with six lags set as the maximum length given the relatively short sample. The AIC chose a longer lag length with a wide range from 3 to 6, while the SIC selected one lag for all countries. Given these differing results, we use these tests as guides rather than a hard-and-fast rule and choose the average of the AIC lags of 4.

**TABLE 2 – Lag length selection from Akaike Information and Schwarz Criteria**

<table>
<thead>
<tr>
<th>Country</th>
<th>AIC Criterion</th>
<th>Schwarz Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Malaysia</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Philippines</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Singapore</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Thailand</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

C. Estimation issues

Two issues arise from the estimation of the SVAR model. The first is addressing potential structural breaks during the AFC period. Many studies tackle this by splitting their sample into pre-AFC and post-AFC subsamples. In this study, the sample period before the AFC is relatively short since the data start from 1997. This partially mitigates the need to differentiate pre- and post-AFC conditions. In addition, a benefit to utilizing the full sample is that it includes the AFC episode, which for the ASEAN-5 economies is the only major domestic financial episode to have occurred during the sample period. Having this variation in domestic financial stress during the AFC is important to differentiate domestic and foreign financial shocks, and hence their impact on the economies. In addition, a disadvantage of using a post-AFC subsample is that the smaller sample results in lower

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9 This reaction function is not exactly the same as the one originally suggested in Taylor (1993) as other variables enter the function in lags.

efficiency. We attempt to balance these trade-offs by using the full sample to estimate the interactions among financial stress (FSI), real economic activity (IPI) and policy IRs, but use data from 2000 onwards when studying the impact of monetary policy shocks on the real economy. The former is done since having the AFC episode is important to properly identify financial shocks, while the latter is done to avoid well-known instabilities in the monetary policy reaction function during the AFC period.

Another issue is whether to difference or de-trend the nonstationary variables. Many studies, following Sims (1980), Sims et al. (1990) and Ramaswamy and Sloek (1997), estimate their VARs with nonstationary variables in levels under the premise that their interest is not in the parameter estimates but rather in the interrelationships. Moreover, parameter estimates are usually not focused on in VARs since they are often over-parameterized. These studies instead analyse the time dynamics of interest from the impulse response functions. We choose to estimate the VAR models in levels. While acknowledging the pitfalls associated with estimating VARs in levels, this is nonetheless a revealing way to examine the interrelationships of interest.

IV. ESTIMATION RESULTS

This section presents the results from the SVAR model. The impulse responses are plotted over 60 months with the 95th percentile confidence intervals.

A. Impact on financial stress

Figure 3 illustrates the impulse responses of industrial production to a 1 SD unexpected increase in financial stress.

FIGURE 3 – Response of IPI to a financial stress shock

The impulse responses show that higher financial stress leads to a decline in output. A similarity in the output responses across countries is that the declines are initially rapid and followed by a more gradual dissipation. Most of the contractionary effects occur within the first year after the shock with a majority of the effects dissipating by the second year. There is nonetheless some cross-country heterogeneity in the time dynamics. In Indonesia and Malaysia, there is a subsequent overshoot in IPI, which is indicative of the presence of an uncertainty channel in which firms subsequently react to pent-up demand for capital and labour. The response for the Philippines is the most persistent, with the largest effects felt approximately 2 years after the shock, followed by dissipation over the subsequent 3 years. IPI in Singapore and Thailand recover quickly with their IPIs returning to baseline levels approximately 1 year after the shock. In general, the time dynamics – a sharp drop and gradual dissipation – are consistent with results from other similar studies, for instance Davig and Hakkio (2010) for the US economy and Holo et al. (2012) for euro area economies.

FIGURE 4 – Response of real credit to a financial stress shock

As alluded to in Section II, a main conduit in which financial stress causes a reduction in economic activity is through lower access to financing from banks. Figure 4 gives evidence of this channel by illustrating the impulse responses of real credit to a 1 SD increase in financial stress. Real credit declines in all cases. Similar to the previous impulse responses, the initial declines in real credit are the sharpest during the first year after the shock, which is then followed by a more gradual dissipation. While deteriorating credit conditions contribute to moderating economic activity as financial stress increase, one factor that may limit the downward pressure on the real economy is if higher financial stress causes higher cross-border capital outflows and depreciation in the exchange rate, which then stimulates the export sector. Figure 5 tries to provide some insight into how exchange rates tend to move when financial stress increases. The results display substantial cross-country heterogeneity. Exchange rate depreciation is observed in Indonesia, the

11 More recent studies in this vein are Disyatat and Vongsinsirikul (2003) and Raghavan et al. (2012).
12 The bootstrap methodology applied is from Hall (1992) using 100 replications. Increasing the number of replications to 500 does not materially change the results.
Philippines and Thailand, albeit with differing time dynamics. In Malaysia, there is initially a depreciating effect followed by temporary appreciation. The estimated effect for Singapore is both economically and statistically insignificant from 0.\(^{13}\)

**FIGURE 5 – Response of real credit to a financial stress shock**

Source: Authors’ estimates

Overall, the impulse responses indicate that financial stress has negative effects on real economic activity. It, nonetheless, begs the question of its over-all influence on economic activity. Financial shocks may have significant negative effects on domestic output, but explain only a small fraction of the total variation in output if they occur infrequently. We next analyse the variance decomposition of IPI to derive the contribution of financial stress to the real economy. The decomposition results at the 24- and 36-month horizons are presented in Table 3. As previously suggested, the contributions from domestic financial stress (FSI) to real economic activity (IPI) are relatively small. Aside from Indonesia as an outlier with the highest contribution of 39\%, the contributions in the other four sample countries are below 5\%. This indicates that, at least for the ASEAN-5 economies, financial stress events have historically been tail risks to real economic activity. But such events have significant adverse effects when they occur. Meanwhile, a large amount of the variation in output can be attributed to external factors, which account for an average of 54\% and 60\% of the total variation in output at the 24- and 36-month horizons. The high external contributions validate the importance of including the foreign variables in VAR models when analysing open economies.\(^{14}\)

**TABLE 3 – Decomposition of the forecast error variance of output (%)**

<table>
<thead>
<tr>
<th></th>
<th>GCP</th>
<th>IPI(_{tx})</th>
<th>FSI(_{tx})</th>
<th>IPI</th>
<th>CPI</th>
<th>IR</th>
<th>C</th>
<th>EX</th>
<th>FSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>4</td>
<td>7</td>
<td>17</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>Malaysia</td>
<td>6</td>
<td>18</td>
<td>49</td>
<td>14</td>
<td>5</td>
<td>1</td>
<td>12</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>24</td>
<td>18</td>
<td>6</td>
<td>25</td>
<td>2</td>
<td>0</td>
<td>10</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Singapore</td>
<td>5</td>
<td>39</td>
<td>24</td>
<td>28</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>6</td>
<td>42</td>
<td>17</td>
<td>31</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors’ estimates

**FIGURE 6 – Response of interest rate to a financial stress shock**

Source: Authors’ estimates

Figure 6 analyses monetary policy behaviour when financial stress increases,\(^{15}\) by illustrating the impulse response of IRs to a 1 SD increase in financial stress. The impulse responses show that the IRs in Malaysia and the Philippines are lowered

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\(^{13}\) The large variations in exchange rate responses across countries likely reflect differences in both institutions and policy regimes that are beyond the intended scope of this study. In Singapore, the NEER serves as the monetary policy instrument, indicating essentially that the Monetary Authority of Singapore’s monetary policy stance does not systematically respond to changes in financial stress. In Malaysia, the central bank intervenes to reduce exchange rate volatility. This may explain why the depreciation is temporary – for example, upon experiencing sudden capital outflows and exchange rate depreciation as financial stress increases, the central bank intervenes to limit the abrupt exchange rate depreciation and hence reduces the overall exchange rate volatility associated with capital flow movements. Malaysia’s exchange rate dynamics is likely also influenced by changes in the exchange rate regime during the sample period.

\(^{14}\) See Tng (2013) for an analysis of the impact of external shocks on output and inflation using the same VAR model and sample.

\(^{15}\) Singapore is excluded from this analysis because its central bank uses the exchange rate instead of a short-term interest rate as its policy instrument to conduct monetary policy. The results for Singapore are therefore not comparable with the other economies, due to differences in the policy instrument and identification of monetary policy shocks in the SVAR.
when financial stress increase. Their IRs decline the most during the first year after the financial shock. In Thailand, the IR displays an initial spike, followed by an easing trajectory similar to Malaysia and the Philippines. To see if the initial IR spike in Thailand’s case is attributable to the brief period of high IR policy during the AFC, we also show the impulse response function from the SVAR model estimated from 2000 onwards in Fig. 6. The results show that removing the AFC period from the sample eliminates the initial spike in the IR, suggesting that the spike is indeed a reflection of monetary policy tightening during the AFC period. In Indonesia, the IR initially increases as well. Unlike Thailand, the initial increase in Indonesia’s IR lasts for a longer duration and does not disappear when the AFC episode is removed from the sample. However, the magnitude of the increase becomes largely statistically insignificant from zero.

A natural follow-up question is whether monetary policy influences financial stress levels. Figure 7 provides an indication through the impulse responses of financial stress to IR shocks. The responses of financial stress are heterogeneous across countries, and are often small and statistically insignificant. This reflects a limit in the use of monetary policy to alleviate financial stress and that direct financial sector intervention is likely necessary to restore financial stability during crisis periods. This result, however, is not a case against monetary policy easing during periods of higher financial stress. As shown earlier, higher financial stress adversely affects economic activity and central banks may still use monetary policy to restore macroeconomic (output) stability. A key premise is that lower IRs stimulate output not by restoring financial stability, but through other channels.

FIGURE 7 – Response of financial stress to an interest rate shock

Source: Authors’ estimates

To give insight to this hypothesis, we attempt to distinguish the effects of IRs on output that is attributable to domestic financial stress as a transmission channel. We achieve this by comparing the impulse response functions from the baseline model to those from a restricted model. The restricted model is similar to the baseline model, except that domestic financial stress is exogenous. Doing so blocks off the responses of output to a change in the IR that passes through financial stress. The differences in impulse responses between the baseline and restricted SVARs reflect the degree of pass-through via domestic financial stress. This method of analysing the transmission channels of monetary policy follows from Morsink and Bayoumi (2001), Chow (2004) and Raghavan et al. (2012). To avoid specification issues due to well-known instabilities in the monetary policy reaction function during the AFC period, the impulse responses for this analysis are estimated using data only from 2000 onwards.

Figure 8 shows impulse responses of IPI to IR shocks from the baseline and restricted models. In all cases, the impulse responses from both models are largely similar and fall within the error bands from the baseline model. Thus, the analysis of monetary policy shows that although lowering IRs generally have limited effects in restoring financial stability, such policy moves are effective in stimulating economic activity through other channels. Easing monetary policy in the midst of financial episodes is therefore a desirable policy strategy to offset the contractionary effects of higher financial stress on output.

FIGURE 8 – Response of IPI to an interest rate shock

Source: Authors’ estimates

Notes: The blue line and dotted lines are the responses and error bands from the baseline model. The red line is the response from the restricted model.

V. ROBUSTNESS

The assumptions made on the exogeneity of the domestic variables in the foreign equations are intuitive and common practice in existing literature. As small-open economies, it is reasonable to assume that they are affected by and cannot affect external developments. It also seems reasonable to assume that output and prices are affected by the financial variables in lags, given that changing them are often time-consuming activities and entail additional costs. But the ordering of the FSI variable within the financial block is not as self-evident. Financial stress can have contemporaneous
effects on the exchange rate since its value is partly determined by cross-border capital flows which can react quickly to changes in financial conditions. Monetary policy may also react contemporaneously to financial stress if central banks take it as a forward-looking signal of macroeconomic prospects. To test the sensitivity of the baseline findings, we estimate the SVAR models with alternative orderings of the FSI within the financial block and replicate the impulse responses from the main findings of this article (Figs 3 and 8) – in the Appendix. The responses generated from alternative specifications are broadly in line with the baseline model. The impact of FSI shocks on the IPI is also broadly similar. The initial fall in IPI is steep, followed by a gradual tapering off. Similarly, the responses of IPI to IR shocks are robust to changes in the ordering of the FSI variable.

VI. CONCLUDING REMARKS

The goal of this article has been to use a SVAR approach to contribute to the understanding of how financial stress affects the economy and monetary policy transmission. We find that financial stress has negative effects on real economic activity, credit and, in some cases, the exchange rate. Although there is some heterogeneity in the responses, an empirical regularity in the responses of output is that the largest effects are felt within the first year of the shock. However, financial stress contributes a small share of the overall variation in output, which is likely attributable to the low frequency of high financial stress episodes. We also find that central banks in Malaysia, Thailand and the Philippines tend to reduce their policy IRs when financial stress increases. Although lower IRs have mixed results in their ability to reduce financial stress, they are still able to stimulate economic activity through other channels. The estimations also find that although lower IRs have limited results in their ability to reduce financial stress, they are still effective in stimulating economic activity through other channels.

More generally, these findings suggest the necessity for monetary policy easing to help offset the contractionary effects of adverse financial shocks on the real economy. But it likely also needs to be accompanied by direct financial sector interventions to restore financial stability. This may include, for example, short-term loans to alleviate liquidity shortages, direct equity injections to financial institutions to reduce solvency concerns and ensuring the sufficiency of trade credit to facilitate continued trade activities. In addition to achieving a higher effectiveness in restoring financial stability, another benefit of a targeted policy approach to restore financial stability is that it reduces time-lag issues between the policies’ effects on output and the effect that higher financial stress has on output. While there is potentially such a timing mismatch for monetary policy, policy instruments that directly restore financial stress to normal levels reduce this pitfall.

APPENDIX – ROBUSTNESS OF IMPULSE RESPONSES TO ALTERNATIVE ORDERING ASSUMPTIONS

FIGURE A1– Impulse responses from alternative ordering assumptions

Source: Authors’ estimates

Notes: B refers to impulse responses from the baseline model. The numerals 2, 3 and 4 are impulse responses from specifications with the FSI ordered, respectively, before the NEER, the NEER and real credit, and the NEER, real credit and the interest rate. Other assumptions remain similar to the baseline model.

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