

Drivers of Sovereign Bond Yields in Emerging Asia

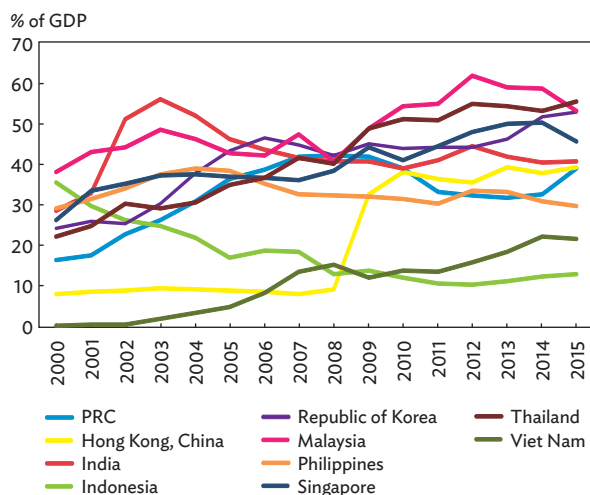
Introduction

Bond markets have an important role to play in building a diversified financial system and promoting long-term financing to support growth. In emerging Asia, debt securities issued in local currency have become a key source of government financing (**Figure 13**).⁷ While economies in the region are increasingly relying on local currency debt markets for long-term financing, the interest rates that governments pay have varied widely across economies and time.

Emerging Asian domestic bond yields showed differing patterns across the region over the period 2000–2015. **Figure 14** presents trends in 5-year sovereign domestic yields of selected economies in comparison with United States (US) bond yields. US yields have trended down since the 2008–2009 global financial crisis and have remained below precrisis levels amid uncertain growth prospects. While we observe some correlation between domestic yields and US yields, we also observe different trends across the region.

Bond yields in Indonesia, the Republic of Korea, the Philippines, Singapore, and Thailand have trended down since the global financial crisis, similar to US bond yields. The premium vis-à-vis US yields also fell for both the Republic of Korea and the Philippines. In Singapore, bond yields were below those of the US in most years during 2000–2014, only exceeding US yields in 2015. Indonesian bond yields declined after reaching a peak during the 2008–2009 global financial crisis, and while the premium over US bonds declined between 2008 and 2012, it increased slightly after that. Malaysian bond yields were broadly stable during the period. Prior to the global financial crisis, the premium on US bonds vis-à-vis Malaysian bonds was negative. Following the decline in US bond yields in 2008, a positive premium emerged as Malaysian bond yields barely changed. Bond yields in India and Thailand showed a more cyclical pattern than was observed for Malaysia, including a decline in yields in both economies since 2014. However, as with Malaysia, there was no overall trend observed during the review period. The different movements in yields across the region indicate economy-specific macroeconomic conditions that affect yield patterns.

Figure 13: Local Currency Government Bonds

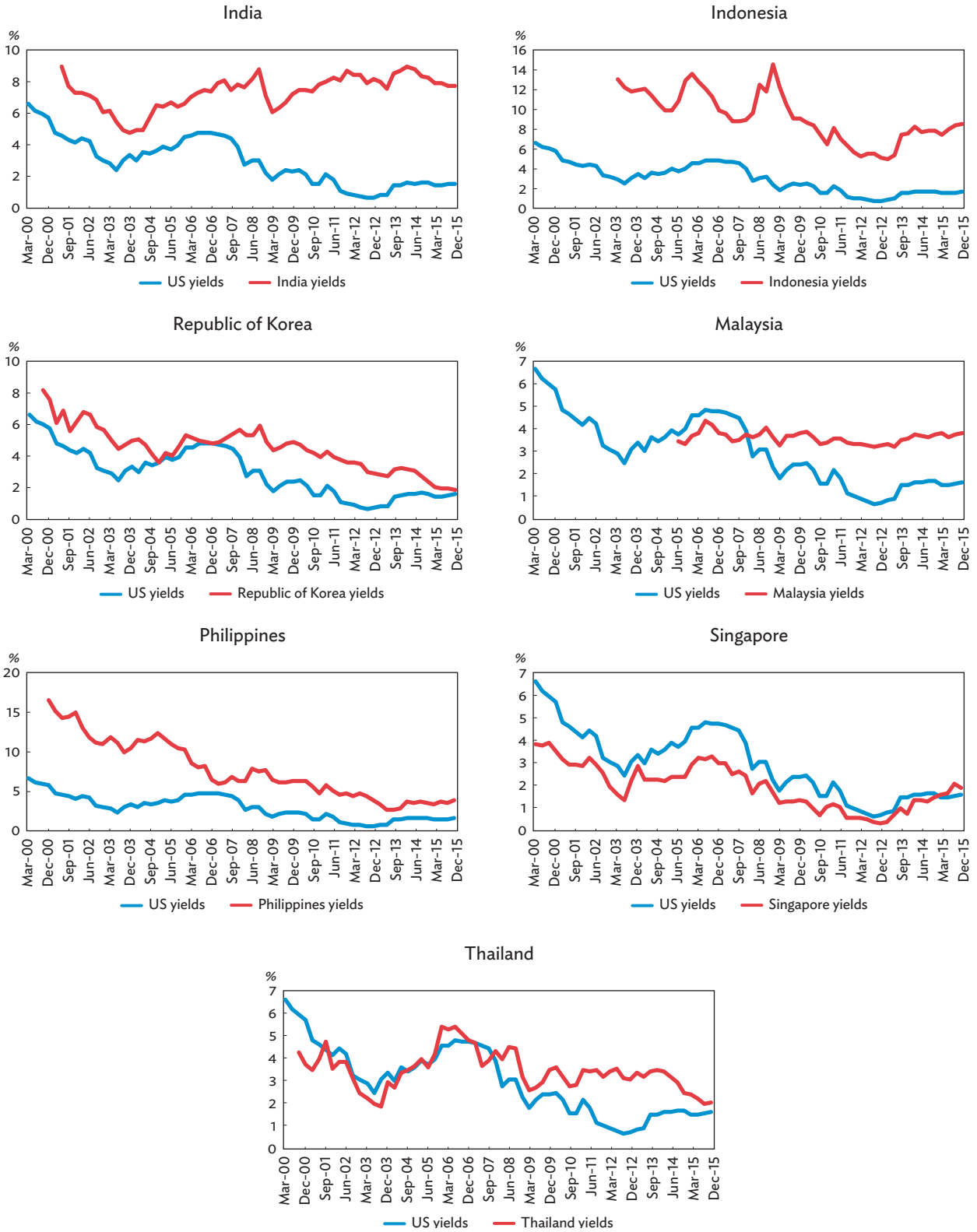


PRC = People's Republic of China.
Sources: AsianBondsOnline and Bloomberg LP.

Movements in bond yields across the region can be attributed both to fundamental conditions in domestic economies and the influence of global factors. Since bond markets can be an important source of financing, it is necessary to examine the factors that promote their development. We place particular emphasis on local currency bond markets as an important funding source for domestic investors; a deep bond market gives them access to long-term financing that avoids currency mismatch issues. This section analyzes the role of macroeconomic factors and policies affecting bond market development in the region, with particular focus on how such factors affect local currency sovereign bond yields. The literature suggests that economic growth, inflation, fiscal conditions and other domestic factors, and global influences affect domestic bond yields. Better information on the factors that affect the cost of government borrowing can help economies more

⁷ In this chapter, emerging Asia comprises India, Indonesia, the Republic of Korea, Malaysia, the Philippines, Singapore, and Thailand.

Figure 14: 5-Year Bond Yields



US = United States.
 Source: Quarterly averages based on daily data from Bloomberg LP.

effectively manage the impacts of those factors that they can control. Further, predicting the impacts of global factors, over which emerging economies in most cases have no direct influence, can help economies better prepare for adverse global conditions.

The next section discusses macroeconomic factors that affect bond yields and how emerging Asian economies fare on key indicators. The third section presents an empirical analysis of the impact of macroeconomic factors on bond yields using quantitative models. The last section provides concluding observations and discusses the policy implications.

Macroeconomic Factors and Bond Yields

Economic Growth Performance

Gross domestic product (GDP) growth measures economic activity and is the most common indicator of the health of an economy. An expanding economy requires more funds to support growth and can therefore increase yields because of the increased demand for borrowed funds. On the other hand, to the extent that yields contain risk information, such that riskier assets are higher-yielding, strong economic growth can increase investor confidence and reduce yields.

GDP growth rates across economies in the region have varied since the 2008–2009 global financial crisis. Except for India, all experienced a decline in growth rates in the first quarter (Q1) of 2009 amid the global fallout from the crisis. In the Republic of Korea, Malaysia, Singapore, and Thailand, GDP even contracted (**Figure 15**). The economies displayed different recovery rates and patterns after Q1 2009. Indonesia quickly recovered to precrisis growth levels but has experienced a downward trend in growth since 2011, which appears to have a negative correlation with yields. Growth in the Republic of Korea recovered sharply in 2010 but has since slowed and is exhibiting a cyclical pattern at levels below precrisis rates. As growth remains subdued, yields continue to trend down. Growth in the Philippines has rebounded well since 2011 when domestic political issues were a concern for the economy. The improved economic conditions supported the decline in yields as some risks decrease with output growth. Malaysian GDP growth has also been robust, rebounding to 10.2% in Q1 2010 after declining in Q1 2009 and then stabilizing at close to 6.0% in 2010–2015. Along with stable growth, yields have also been quite steady at around 3.0%–4.0%.

Thailand has faced domestic political concerns that are taking a toll on output performance as shown by large swings in growth. India experienced a strong growth performance even during the period immediately following global financial turmoil in 2008–2009. Since 2012, however, economic growth has shifted to a lower range of 2.0%–6.0% from the 6.0%–10.0% growth experienced from 2003–2011.

Inflation

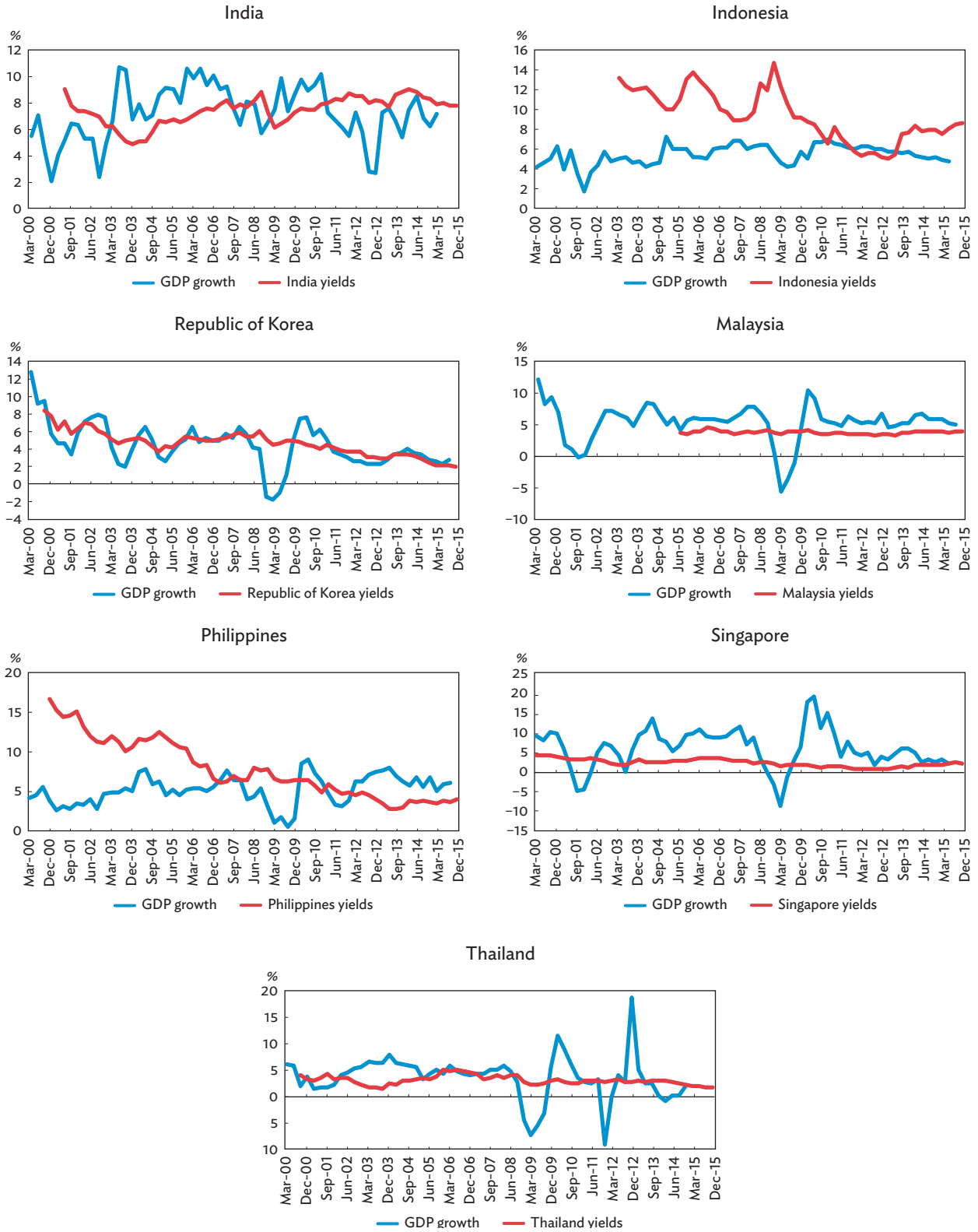
Inflation is a key indicator of macroeconomic stability and in most of the related literature is seen as a significant factor in determining yields. Persistently high inflation can affect investment decisions as it can erode investor confidence and increase yields. It also has implications for consumer spending; a huge loss in the value of money due to high inflation can breed widespread discontent and pose a direct threat to macroeconomic stability. On the other hand, moderate inflation that comes with economic expansion can improve investor confidence and increase investor appetite for higher yielding assets pulling down bond prices or equivalently increasing yields.

While headline inflation is often measured by changes in the Consumer Price Index (CPI), there is growing interest in the Producer Price Index (PPI), owing to the emergence of PPI deflation in recent years (ADB 2016). It is worthwhile to examine the links to bond yields of both measures of inflation given their diverging patterns and drivers. As seen in **Figure 16**, consumer prices in the region are less prone to volatility than producer prices, which may be due to slow adjustments in taxes, subsidies, and distribution costs. What is quite evident in recent years is slowing inflation, and even deflation, especially in terms of the PPI. Inflationary pressures have been tempered by the recent decline in global commodity prices. While the drop in prices has been mainly due to supply shocks, weaker demand has also played a role. Feeble economic conditions have contributed to subdued inflation in some economies and to deflation in others. Deflation in both consumer and producer prices accompanied slower GDP growth in Singapore in 2015. In the Republic of Korea, growth slowed in 2015 amid deeper producer price deflation and milder inflation.

Other Domestic Factors

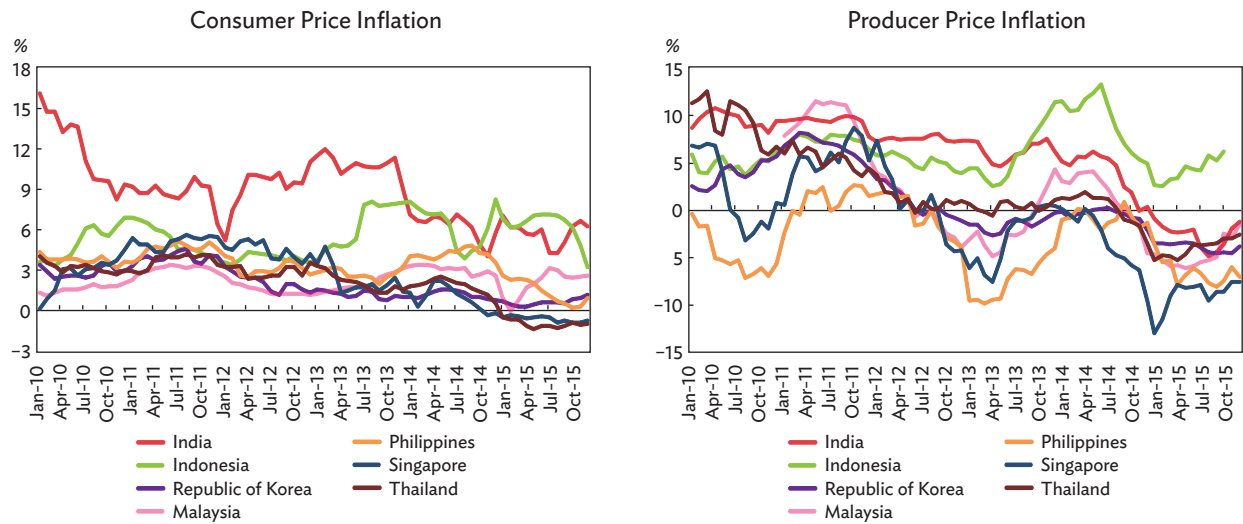
Domestic bond yields are closely linked to an economy's fiscal position. Economies with healthy finances tend to have lower bond yields, while those with higher debt

Figure 15: GDP Growth and 5-Year Bond Yields



GDP = gross domestic product.
Sources: CEIC Data for GDP growth; bond yield quarterly averages based on daily data from Bloomberg LP.

Figure 16: Consumer and Producer Price Inflation



Source: CEIC Data.

have higher bond yields (Jaramillo and Weber 2012). Debt buildup can result in unsustainable debt levels and increased default risk, leading to a loss of investor confidence and higher sovereign bond yields.

Sovereign bond yields may also be affected by changes in money market rates. The expectation hypothesis holds that the yield on long-term bonds (long rates) is the expected future yield on short-term bonds plus a term premium to compensate for risks associated with long positions. The long rates must carry a premium over short rates, such that higher short-term interest rates are expected to increase yields. Money market rates are also an indicator of the monetary policy stance, with higher short-term rates leading to tighter liquidity, which reduces the availability of credit and pushes yields up.

Global Factors

Global factors are important in explaining movements in sovereign bond yields in emerging markets. One of the most significant developments in the region's bond markets over the past few years is rising foreign investor holdings of local currency bonds. This mirrors an overall trend among international institutional investors toward greater exposure to local currency instruments. Greater foreign participation can benefit domestic bond markets by enabling a broader investor base and contributing toward more liquid and efficient markets, which in turn is important in driving down

borrowing costs. However, there are risks that increased foreign participation can increase volatility in bond markets, as heightened global risk aversion can lead to sudden shifts in investor sentiment (Ebeke and Lu 2014). In such cases, movements in bond yields may be determined more by shifts in market sentiment rather than changes in fundamentals. Alternatively, the impact of macroeconomic variables on yields may be affected by global risk considerations. It is possible that a large part of movements in emerging market spreads are due to outside factors such as global liquidity and risk appetite (Gonzales-Rozada and Levy-Yeyati 2008). Further, volatility in global bond yields can be transmitted to domestic bond yields (Azis et al. 2013).

As shown in Figure 14, low world interest rates, as proxied by US bond yields, have been evident in recent years, indicating favorable liquidity conditions. A low interest rate environment has helped drive foreign investors in search of higher yields into emerging markets. Increased demand in emerging bond markets has in turn helped drive movements in the region's bond yields.

What is Driving Bond Yields? Empirical Evidence

Demand and supply for bonds are influenced by bond yields and vice versa. Higher bond yields increase the quantity of bonds demanded, while bond issuances decrease with increased borrowing costs (Ciarlone,

Pisellin, and Trebeschi 2007). From a macroeconomic policy standpoint, keeping yields low is important to encourage real investment and promote growth. And while higher yields may increase bond demand, portfolio choice theory suggests that investor preference for risks is an important consideration in portfolio decisions. To the extent that yields in emerging markets are higher than those in more developed markets because of associated market risks, higher bond yields may not always increase bond market participation. Lower bond yields resulting from an improved risk profile may also encourage bond market participation.

Several term structure models on the macroeconomic links to yields have been discussed in the literature, including the pioneering work of Ang and Piazzesi (2003), in which measures of real economic activity and inflation are included as determinants of the term structure alongside unobservable state variables used in finance literature. Most other literature is a variant of their methodology with additional macroeconomic variables. Succeeding work in the macrofinance literature imposed a structural specification of macroeconomic conditions in yield curve models (see, for example, Hordahl, Tristani, and Vestin 2002; Rudebusch and Wu 2004; and Bekaert, Cho, and Moreno 2005).

There have been some studies that examined macrofinance linkages using sovereign bond yields of a particular maturity rather than the term structure. Poghosyan (2012) looks into the macroeconomic determinants of sovereign bond yields and tests whether there is a long-run relationship between yields and debt, as well as between yields and output growth. The study models changes in sovereign bond yields using as determinants potential output and government debt in the long-run and some short-run determinants including inflation, changes in debt, monetary and fiscal policy variables. Similar to Poghosyan (2012), Pham (2014) distinguishes between the long-run and short-run determinants of yields in examining sovereign bond yields in several emerging Asian economies.

To formally test the factors that are known to drive bond yields, we do not model the yield curve in contrast to a number of macrofinance studies. This is due to the absence of a meaningful yield curve for most economies in the region where bond markets remain

thin, particularly for longer-term maturities. Instead, we follow the approach taken by other studies that rely on a particular maturity to model macrofinance linkages rather than the yield curve (see, for example, Poghosyan 2012 and Jaramillo and Weber 2012). We examine the factors affecting yields on 5-year bonds, being one of the more actively traded issues in the region. The framework used in Matovu (2007) is extended to include fiscal sector variables.

Following the early literature in yield curve-macroeconomic analysis, we identify economic indicators that may influence yield movements. A base model is initially introduced where the macroeconomic variables included to explain sovereign yields are GDP growth, inflation, and short-term interest rates. GDP growth is the main measure of economic performance, and thus is expected to significantly influence bond yields. Inflation is commonly used in the literature as an indicator of macroeconomic stability. Money market rates are added to account for the impact of short-term interest rates on bond yields.

The model rests on some basic assumptions to identify the vector autoregression (VAR) ordering to be used for extracting the impulse responses. Output growth is seen to have a contemporaneous effect on other variables in the system. Inflation may have a contemporaneous effect on interest rates because interest rates are a policy tool used to control inflation. The money market rate is seen to influence market rates on other loans, including bond notes. The base model is then extended to allow for a measure of fiscal health and to account for external influences. Thus, the expanded model will have the base model variables: GDP growth, inflation, and short-term interest rates, plus fiscal and global factors.⁸ Debt accumulation is added as an indicator of the health of the public sector, while the 5-year US Treasury bond yield is included to account for external factor effects.

A panel VAR is estimated for a pool of nine Asian economies in both the base model and the expanded system. Both CPI and PPI are tested to examine which of the two price indexes is more relevant to yield movements. The economies included in the panel VAR are India, Indonesia, the Republic of Korea, Malaysia, Pakistan, the Philippines, Singapore, Sri Lanka, and

⁸ See Table A.1 for the list of variables and their description.

Thailand.⁹ An unbalanced panel from Q1 2000 to Q4 2015 is estimated.¹⁰

To account for economy differences, separate models were estimated for each economy. Following the panel VAR specification, the variables were tested for endogeneity to determine the adequacy of a single-equation specification.¹¹ Single-equation estimates use the same yield drivers as the VAR model:

$$Yields = \beta_0 + \beta_1 r + \beta_2 debt + \beta_3 \pi + \beta_4 USyields + \beta_5 y + \epsilon$$

where *r* is short-term interest rate, *debt* is growth in government debt, *π* is CPI or PPI inflation, *USyields* is the 5-year US Treasury bond yield, and *y* is GDP growth. Each individual economy specification differs depending on the significant yield drivers and yield dynamics. For variables that are integrated at order 1 [I(1)], cointegration tests were performed to validate whether there are long-run relationships between the variables and, if so, appropriately model for such. Only India’s bond yields were shown to have cointegrating relationships with the yield factors. For estimation purposes, we transform

I(1) variables into I(0) if there are no cointegrating relationships. We obtain first differences of the I(1) variables to transform these into I(0) as is standard in time-series literature, thus we have quarter-on-quarter inflation rates and debt accumulation, and quarter-on-quarter changes in money market rates and yields.

Evidence across Economies

The impulse response functions from a panel VAR of nine economies show that the main drivers of yields are inflation (either CPI or PPI), money market rates, and US yields. Output growth and debt accumulation have an indirect effect on yields channeled through inflation. **Table 5** presents a summary of impulse responses obtained from the VAR that show what macroeconomic variables affect yields either directly or through pass-through effects on other variables that directly affect yields. The left panel shows the impulse responses generated using CPI, while the right panel shows the results from the VAR estimates using PPI. The impulse responses of yields from shocks to macroeconomic factors are shown in **Figure 17**.

Table 5: Impulse Response Matrix

Base Model											
		Impulse						Impulse			
		Yields	CPI	MMR	GDP			Yields	PPI	MMR	GDP
Response	Yields		x	x		Response	Yields		x	x	
	CPI				x		PPI	x			x
	MMR		x		x		MMR		x		x
	GDP						GDP				

Expanded Model															
		Impulse							Impulse						
		Yields	CPI	MMR	GDP	Debt	US yields			Yields	PPI	MMR	GDP	Debt	US yields
Response	Yields		x	x			x	Response	Yields		x	x			x
	CPI				x				PPI	x			x	x	
	MMR				x		x		MMR		x		x		x
	GDP								GDP						
	Debt	x							Debt	x					
	US yields								US yields						

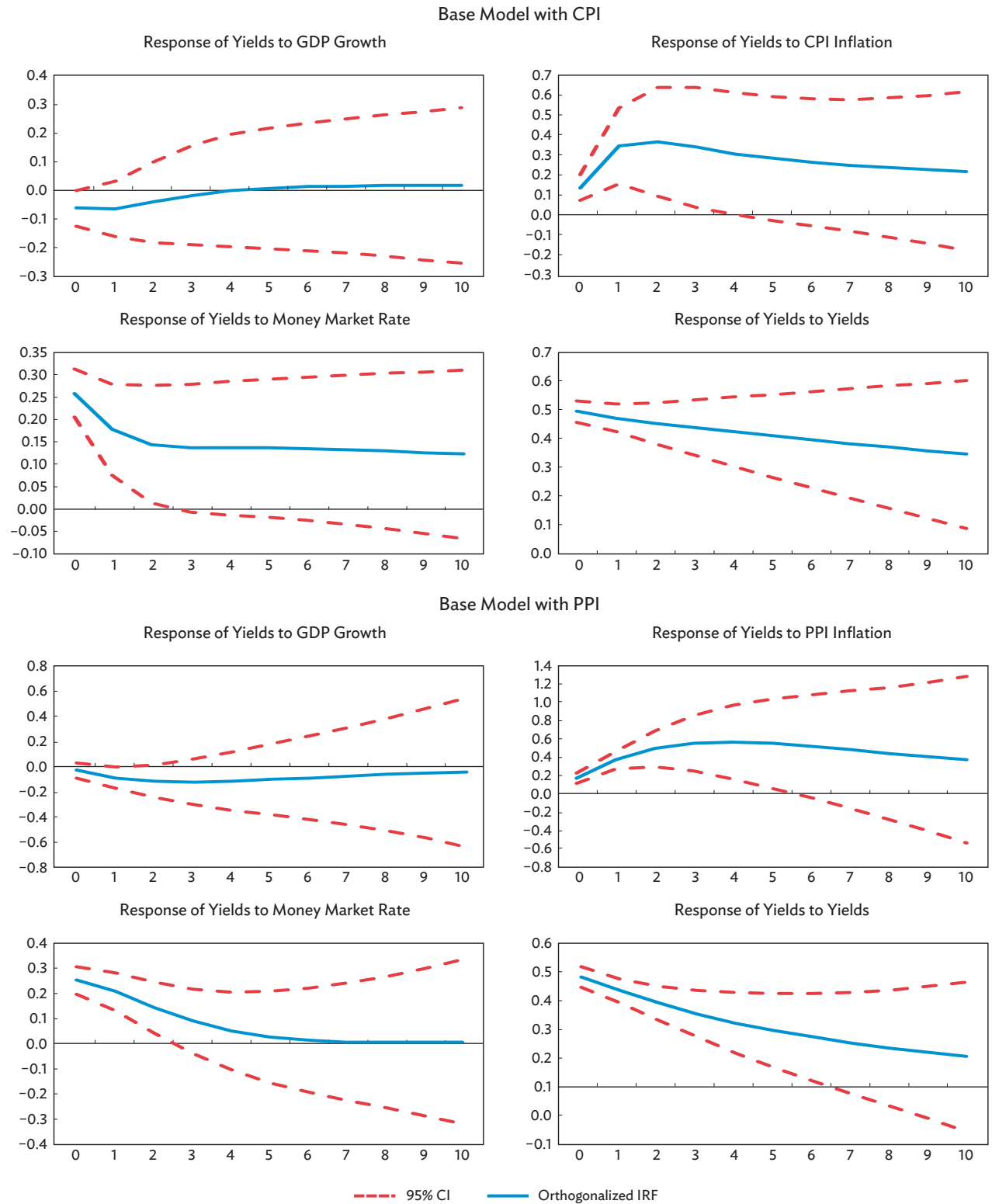
CPI = Consumer Price Index, GDP = gross domestic product, MMR = money market rates, PPI = Producer Price Index, US = United States. Source: ADB estimates.

⁹ These economies were included in the analysis primarily based on the availability of quarterly debt data. See Table A.2 for the period covered for each economy.

¹⁰ To implement the panel VAR we use the Stata package on panel VAR estimation created by Abrigo and Love (2015).

¹¹ Granger causality tests on the variables in the panel VAR are implemented and if yields do not Granger cause any of its determinants, for parsimony, single equations model are estimated.

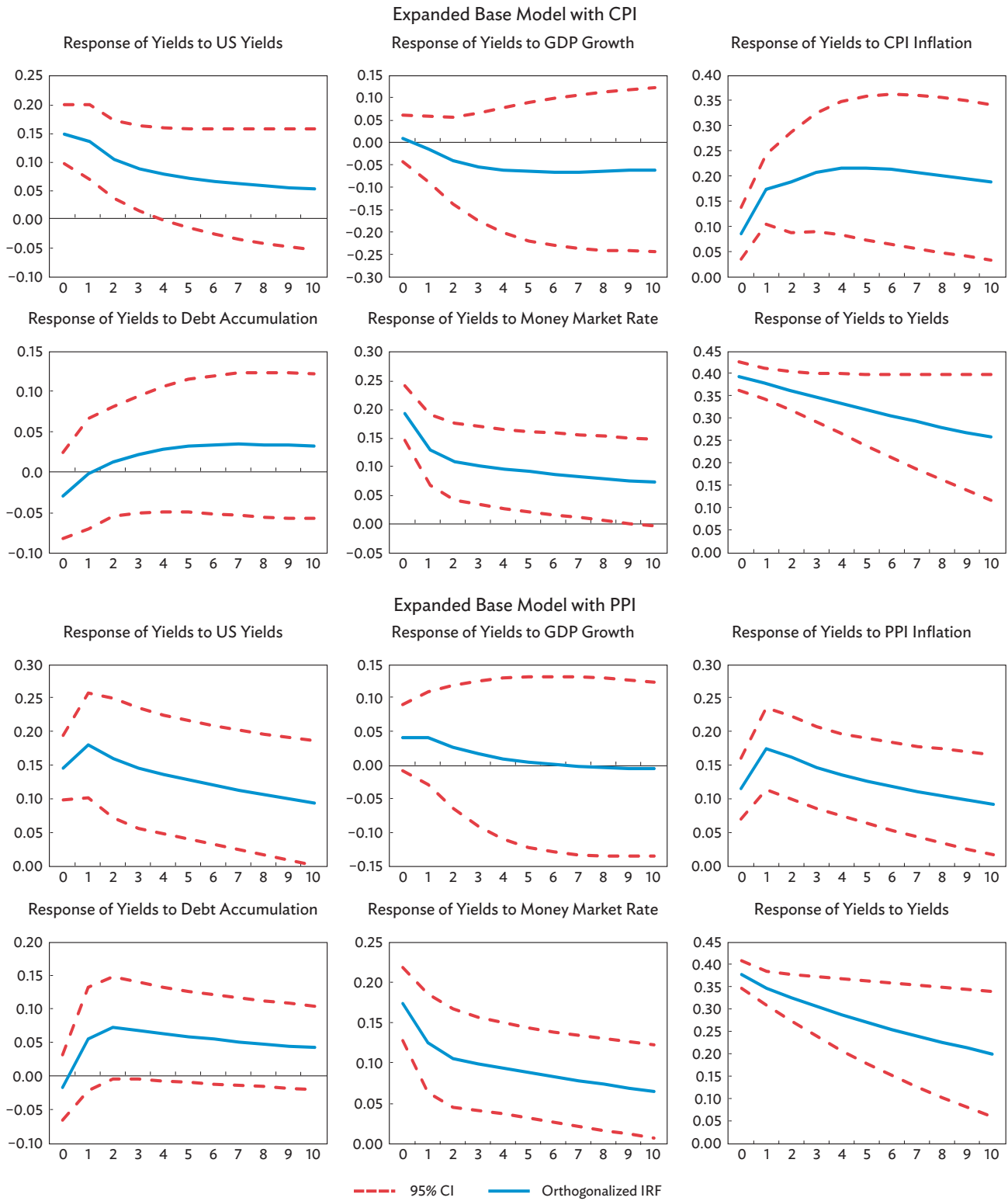
Figure 17: Panel Vector Auto-Regression Impulse Response Functions



CI = Confidence Interval, CPI = Consumer Price Index, GDP = gross domestic product, IRF = Impulse Response Function, PPI = Producer Price Index.

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Figure 17: Panel Vector Auto-Regression Impulse Response Functions *continued*



CI = Confidence Interval, CPI = Consumer Price Index, GDP = gross domestic product, IRF = Impulse Response Function, PPI = Producer Price Index, US = United States. Source: ADB estimates.

The results are in line with what is established in macrofinance literature and highlight the importance of macroeconomic stability in promoting local currency bond markets. The link between money market rates and yields is well documented in the literature and its positive impulse effect on yields is as predicted. Money market rates are seen as an indicator of the policy stance of monetary authorities, as well as an instrument to control inflation. Monetary tightening reduces liquidity in the credit market and pushes general interest rates and bond yields higher. With decreased liquidity, demand for bonds among investors may decrease and lead to reduced bond prices and increased yields. Bond issuers may then be willing to quote higher yields to gain access to credit.

The positive impulse effect of inflation on yields is expected. Higher inflation erodes real returns and therefore can push yields up; it also is an indicator of macroeconomic stability that can affect investor confidence and demand for financial assets. PPI inflation also has an impulse effect on yields that may be related to production cost issues as higher yields push up costs for producers. To the extent that higher yields are also related to increased economic activity and increased demand for funds, higher yields can be associated with rising producer costs. Shocks to CPI inflation, on the other hand, do not affect yields.

The effect of US yields on domestic bond yields and on money market rates indicate that bond markets in emerging economies are integrated with the domestic markets since global market sentiments affect the domestic bond market. Likewise, world economic conditions that affect global yields also affect domestic economic outlooks and investor confidence.

Debt is affected by yields, which could indicate that yields are driven by the demand for funds since higher issuance (bond supply) reduces bond prices and increases yields. This is also shown by how output growth indirectly affects yields through prices and money market rates.

Debt has an indirect effect on yields through PPI inflation. The relationship between PPI inflation and debt could be related to production costs, and this is also shown by the impulse effect of yields on PPI inflation. On the other hand, debt does not have an impulse effect on CPI inflation and therefore has no indirect effect on yields through this variable. This suggests that debt is more

driven by production concerns and therefore can affect PPI more than CPI inflation.

Individual Economy Estimations

For individual economy estimates, we consider a parsimonious model given the small sample size. We test whether a single-equation specification is sufficient to model yield determinants and whether there is endogeneity in the factors that need to be modeled in the VAR system. In cases where a system needs to be specified, we identify which variables to include. We also take notice of what price variable is more relevant for a particular economy.

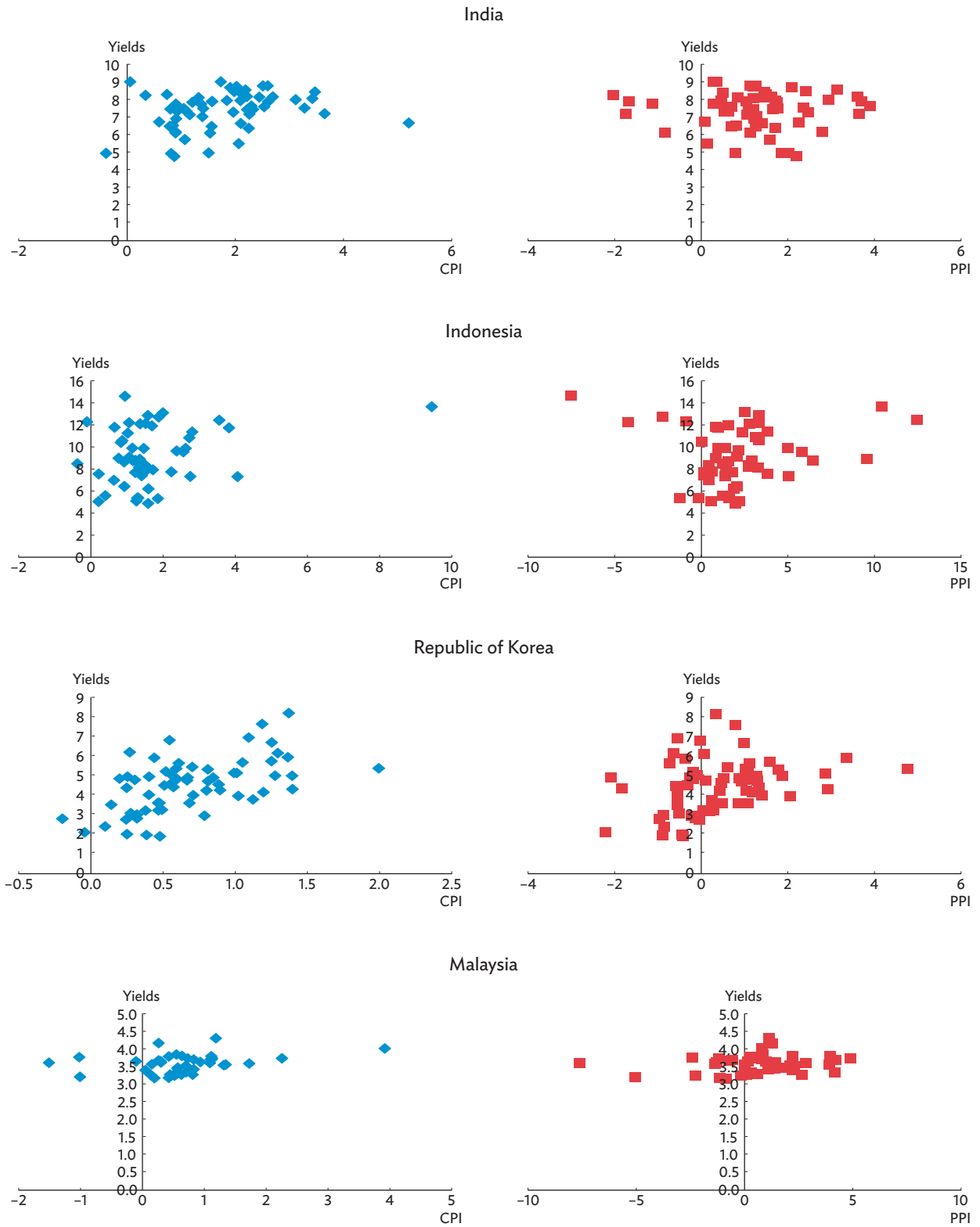
Figure 18 show that there is some correlation between price inflation and yields, albeit to varying degrees across economies. We validate through formal testing whether the reported correlations translate to causality.

A Granger causality test on the variables used in the panel VAR is conducted to determine endogeneity in the variables that might affect yields. The test shows which variables affect yields and whether yields interact with any of the determinants, thereby posing endogeneity issues. If there is endogeneity, a VAR model is estimated, but for parsimonious reasons only the variables that affect yields will be included in the VAR model. A single-equation model will be estimated if yields do not affect any of the determinants. The test is a test of weak exogeneity since it does not involve any contemporaneous relationship between the variables, which is similar to an unrestricted VAR specification. If weak exogeneity is proven, a Hansen-J test for exogeneity of contemporaneous variables will be applied to ensure that a single-equation model is appropriate. A summary of the Granger causality results is shown in **Table 6**. For those economies where the yield model specification does not have factors with quarterly frequency (debt or GDP are not significant), we estimate using monthly data to give us more observations and to allow us to better capture the dynamics of yield movements. **Table A.3** in the Appendix shows the regressions results for economies in which a single-equation model is considered appropriate.

India

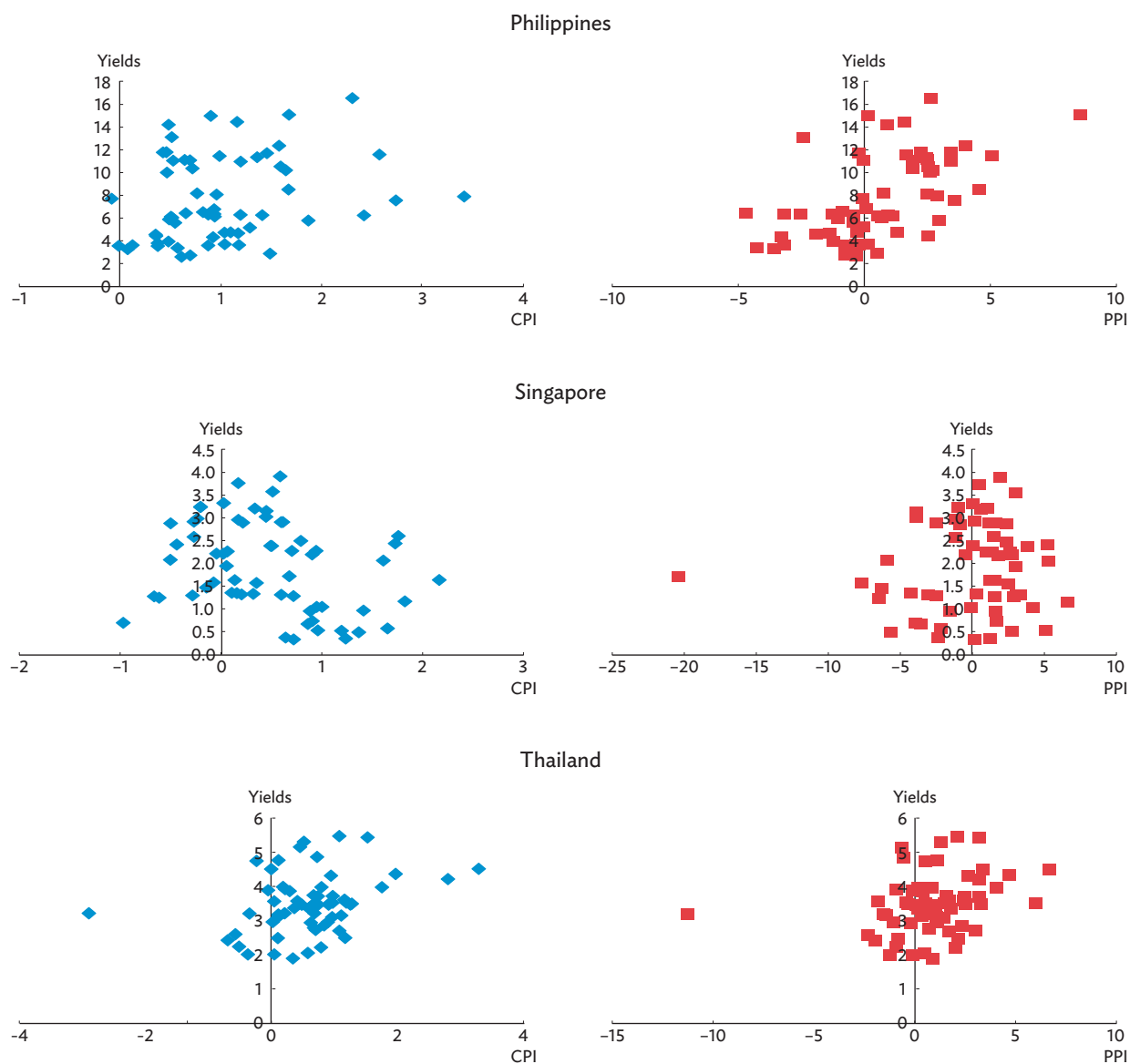
The Granger causality test shows that PPI Granger-causes yields and yields Granger-cause the money market rate. Since the money market rate is not a determinant

Figure 18: Scatter Plot of Inflation and Bond Yields



CPI = Consumer Price Index, PPI = Producer Price Index.

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Figure 18: Scatter Plot of Inflation and Bond Yields *continued*

CPI = Consumer Price Index, PPI = Producer Price Index.

Sources: CEIC Data for inflation; bond yield quarterly averages based on daily data from Bloomberg LP.

of yields, a single-equation specification appears to be adequate. CPI is not shown to Granger-cause yields but yields Granger-cause CPI.

Since causality between CPI and bond yields was not established, we use PPI to model yield drivers for India. Given that the India's bond yields are nonstationary, we determine whether there exists a long-run relationship

between yields and the macroeconomic factors. Since the autoregressive distributed lag bounds test points to a long-run relationship, the appropriate long-run and short-run representations are estimated and included in **Table A.4** in the Appendix.¹²

India's bond yields have a long-run relationship with output growth and US yields. The speed of adjustment is

¹² Pesaran and Shin (1999) and Pesaran, Shin, and Smith (2001) use bounds testing to verify the presence of cointegrating relationships even with a mix of $I(1)$ and $I(0)$ variables. The autoregressive distributed lag form can be transformed into its long-run and short-run forms when cointegrating relationships have been ascertained, as is the case with India's yield-macroeconomic conditions specification in our findings.

Table 6: Summary of Granger Causality Test Results

		Impulse						
		Domestic bond yield	CPI	PPI	Money market rate	GDP growth	Sovereign debt	US yields
Response	Domestic bond yield		MAL, THA	IND, KOR		KOR		IND
	CPI	IND			IND		THA	KOR
	PPI	MAL						KOR, SIN
	Money market rate	IND	KOR, MAL, THA	IND, INO, KOR, MAL, THA		IND, KOR, MAL, THA	KOR	IND, MAL
	GDP growth		MAL, PHI, SIN	MAL	SIN		KOR	
	Sovereign debt	PHI	KOR	INO, KOR	IND, MAL			
	US yields	MAL	SIN	THA	THA	IND, KOR		

IND = India, INO = Indonesia, KOR = Republic of Korea, MAL = Malaysia, PHI = Philippines, SIN = Singapore, THA = Thailand.

Note: Countries indicated are those with significant results at 1% and 5% levels in the Granger causality tests.

Source: ADB estimates.

0.42, which indicates that it will take about 2.4 quarters to get back to the long-run equilibrium after changes occur in output growth and US yields. GDP growth has negative long-run and short-run relationships with yields. The negative relationship appears to be counterintuitive as economic expansion is expected to increase bond yields because of the increased demand for funds. Pham (2014) also obtained a negative correlation between yields and output growth, though it is not significant and he postulated that the negative correlation could be driven by wealth effects that may reduce demand for funds. In addition, expansion can also boost the risk profile of the economy, thereby reducing yields. PPI is the relevant price index and higher PPI inflation is shown to increase bond yields, with a 1 percentage point increase in inflation increasing yields by 0.09 percentage points. Debt accumulation also increases bond yields, which is related to the capacity to pay. The debt market may be viewed as riskier if debt accumulation is rising, and therefore to encourage bond holdings, yields may go up. Jaramillo and Weber (2012) also reported a positive effect for debt on yields.

Indonesia

There are no lagged price effects on yields based on the Granger causality test, and the other variables in the panel VAR system also have no lagged effects on yields. The least squares estimates only indicate contemporaneous effects in line with the Granger causality conclusion of no lagged effects on yields. The Hansen-J test that checks for regressor endogeneity shows that the regressors are exogenous and so the least squares results are valid for

inferences. There was also no causality between PPI inflation and yields despite some correlation; stronger comovements are found between CPI and yields. Since there is no causality between PPI and yields, CPI inflation is used to model yield movements.

The results show that similar to the panel VAR model, the drivers of yields are the money market rates, inflation, and US yields. The relevant price variable is the CPI, where a 1 percentage point increase in inflation increases yields by 0.02 percentage points. Rising prices reduce real interests on assets and decrease demand. Higher prices also increase demand for liquidity in order to meet transaction demand and therefore reduce liquidity allotted for investments in financial assets, which decreases asset prices (and raises bond yields). A 1 percentage point increase in the money market rate increases yields by about 0.48 percentage points. This positive correlation is in line with the impact of liquidity, in which higher interest rates reduce domestic liquidity and the demand for financial assets.

The correlation between US yields and domestic bond yields suggests that global sentiments affect the domestic financial markets. Rising bond market yields in the US signal increase confidence in the global economy and this affects the sentiments on emerging markets as well. As yields in the global market increases, to draw investors to domestic market, domestic yields go up.

The positive correlations between yields and money market rates, domestic yields and US bond yields, and yields and inflation are all as expected based on the

literature. Monetary policies affect the credit market, thereby affecting yields. Economic stability impacts investor confidence, likewise affecting yields. The established links show how macroeconomic and global market conditions affect investor sentiments.

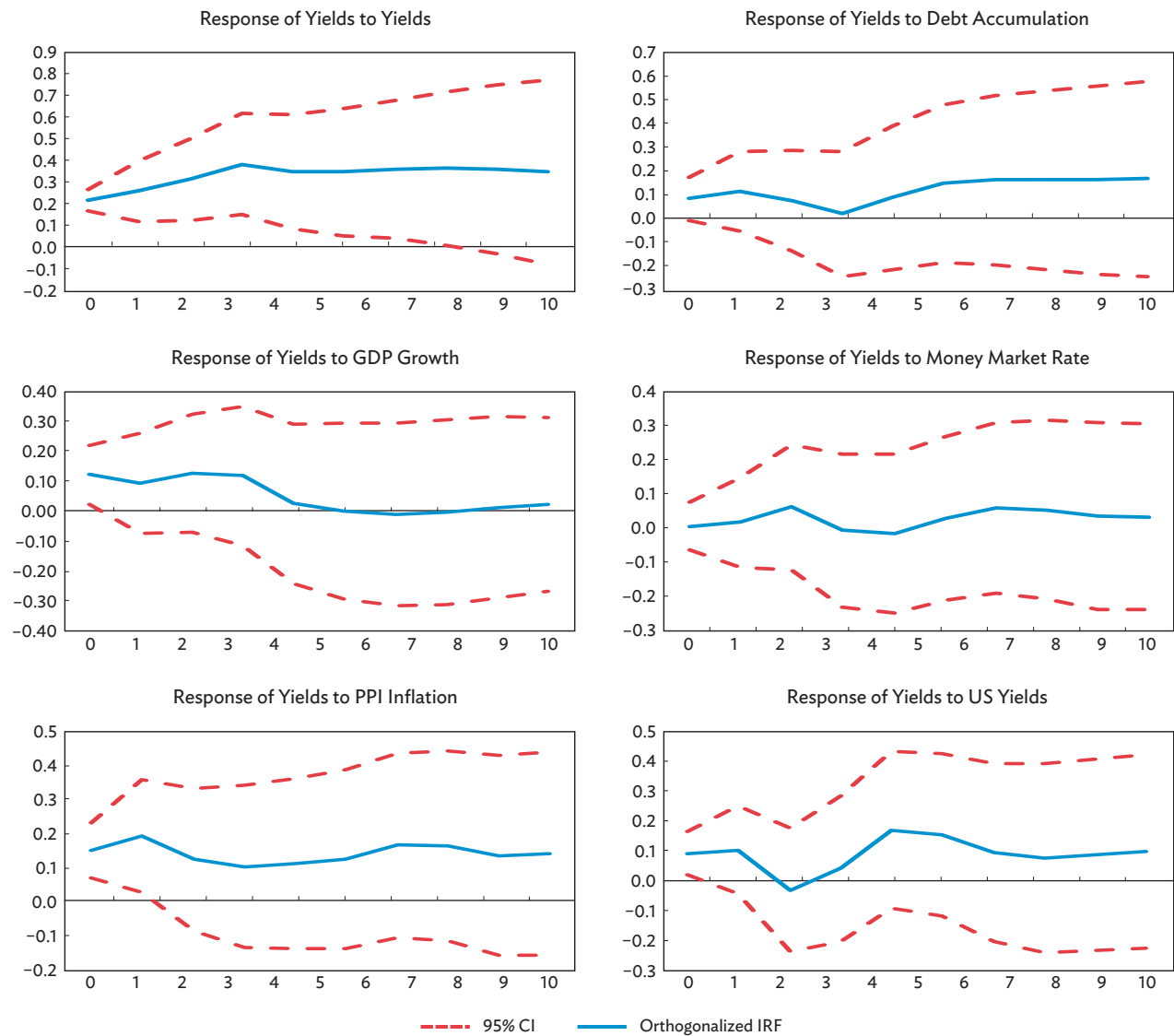
Republic of Korea

The Granger causality test indicates that PPI inflation and GDP growth Granger-cause yields, the rate of debt accumulation Granger-causes GDP growth, and US yields

Granger-cause PPI inflation. The effects on GDP and PPI of debt and US yields, respectively, indicate an indirect effect of debt and US yields on yields. To capture the pass-through effects of debt and US yields, we implement the VAR despite not finding any endogeneity issues.

Results from the VAR estimation show that yields tend to be affected by PPI inflation, GDP growth, and US yields (Figure 19). Debt accumulation has an indirect effect on yields through pass-through effects on PPI inflation and GDP growth. The money market rate also affects

Figure 19: Response of Yields to Shocks on Macroeconomic Factors, Republic of Korea



CI = Confidence Interval, GDP = gross domestic product, IRF = Impulse Response Function, PPI = Producer Price Index, US = United States. Source: ADB estimates.

yields through GDP growth. PPI has an indirect effect on domestic yields through its effect on US yields. The results are similar to those of the panel VAR, suggesting the robustness of the macrofinance correlations.

To the extent that rising domestic prices indicate increased economic activity and lead to an improvement in investor sentiments, the global investment climate may also be affected as indicated through the increase in US yields. On the other hand, if price hikes are seen as a disruption to macroeconomic stability and cause declining real returns, it might result in the movement of capital, which can increase demand for global assets and increase US yields. Debt accumulation affects PPI and GDP growth, which indicates that demand for credit is related to economic activity that improves investor sentiments, thereby pushing bond yields up.

Malaysia

The Granger causality tests show that CPI Granger-causes yields and that there are no endogeneity issues; a single-equation specification therefore is sufficient. The least squares estimates confirm the Granger causality test results of a lagged CPI effect on yields.

Malaysia's bond yields are driven by its past values, US bond yields, and lagged CPI. Since consumer prices are the relevant price variable, it shows how investor demand for assets drives yields.

A 1 percentage point increase in US bond yields is shown to increase domestic yields by 0.1 percentage points in the current period and by 0.2 percentage points in the next period. Similar to domestic bond yields, information contained in US bond yields is carried over into the next period. The results indicate more tempered domestic yield movements compared with US bond yields.

Bond yields move with CPI inflation: a 1 percentage point increase in inflation increases bond yields by 0.06 percentage points. As inflation was moderate in Malaysia during the review period, yields were fairly stable. Inflation is seen as an indicator of economic stability that boosts investor confidence and periods of declining inflation were accompanied by rising stock prices, indicating increased demand for assets.

PPI and US yields are shown to Granger-cause domestic yields at the 10% level of significance. We implement a

VAR on yields, PPI, and US yields to test this relationship since the Granger causality test shows that domestic yields Granger-cause PPI and US yields.

The impulse response function from the VAR shows the same determinants of yields as the least squares estimates: prices and US yields. Shocks to domestic bond yields were not shown to affect US bond yields or PPI inflation, which suggests that the least squares estimates are valid.

The least squares estimates and the VAR both showed US bond yields as a driver of domestic bond yields correlation is shown in the strong comovement between US yields and Malaysia's bond yields. However, domestic yields did not follow the downward trend of US yields as there was no downward movement in the money market rates (Figure 14).

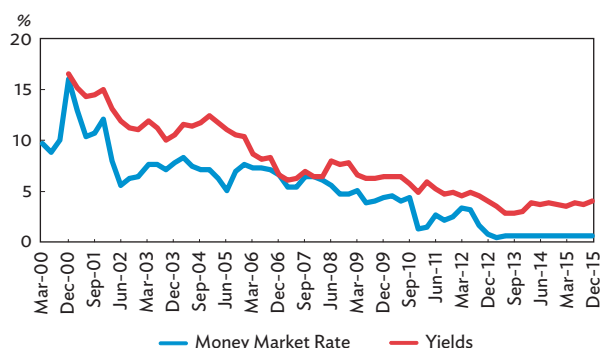
Philippines

The Granger causality tests show lagged CPI inflation and debt accumulation effects on yields at the 10% level of significance. The Hansen-J test on regressor endogeneity also shows that yields have no contemporaneous effects on the macroeconomic variables. Since there are no endogeneity issues, a single-equation model is implemented. The least squares results show that macroeconomic factors only have contemporaneous correlations with yields. On the other hand, PPI inflation has no contemporaneous effect on yields despite some reported correlation, albeit a weaker correlation than that between CPI inflation and yields.

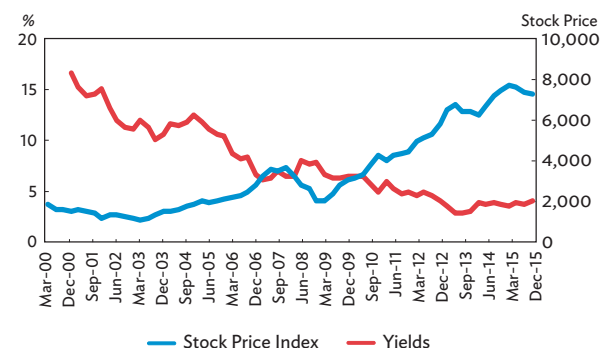
Philippine bond yields exhibit persistence and are driven by domestic liquidity conditions as indicated by the effects of CPI inflation and money market rates on yields. Bond yields tracked the general trend of the money market rate (**Figure 20a**) and also showed correlation with inflation, which suggest domestic liquidity as a driver of financial market activity; this is supported by the negative correlation between bond yields and stock prices (**Figure 20b**).

Singapore

In the case of Singapore, the Granger causality tests show no lagged effects. A single equation specification is implemented to test for any contemporaneous correlations with the macroeconomic variables. The

Figure 20a: 5-Year Bond Yields and 3-Month Money Market—Philippines

Source: Quarterly averages based on daily data from Bloomberg LP.

Figure 20b: 5-Year Bond Yields and Stock Price Index—Philippines

Source: Quarterly averages based on daily data from Bloomberg LP.

estimation results show that Singapore bond yields exhibit some persistence since past information on yields remains relevant. PPI inflation is also identified as a yield driver. The overall fit of the model, however, is very low as may be gleaned from the relatively weak correlation between inflation and yields (Figure 14).

Estimates show that a 1 percentage point increase in US bond yields increases Singapore's yields by 0.49 percentage points, thereby indicating the importance of global sentiments in the domestic market. The results show that Singapore's bond market is integrated with the US market and is highly influenced by global sentiments. This is not surprising given the managed peg of the Singapore dollar vis-à-vis the US dollar and the economy's status as a regional financial center.

Thailand

For Thailand, CPI is shown to Granger-cause yields but yields do not Granger-cause CPI, therefore a single-equation model is estimated. Debt is found to Granger-cause CPI inflation. To capture any indirect effects from debt to yields, a VAR consisting of yields, CPI inflation, and debt accumulation is implemented. The impulse response function indicates that there is no pass-through effect since shocks on debt levels have no impulse effect on CPI. The least squares estimates therefore are valid. Thailand's bond yields are affected by its past values and CPI inflation, which points to the importance of real returns on assets for investor participation in the bond market.

Conclusion

The bond market is an important source of domestic financing; therefore, promoting the bond market is crucial to supporting growth. We examine how macroeconomic conditions affect yields, and consequently bond market participation, for the benefit of macroeconomic managers in promoting bond markets.

Empirical results confirm the importance of keeping inflation under control as rising prices can bring about instability in macroeconomic conditions, causing a loss of investor confidence and retarding the development of the bond market. Inflation erodes the real value of investment returns and drives up yields. Stable prices also allow greater room for monetary policy that can promote growth and further increase investor appetite. The results show that the relevant price variable differs across economies. This may require different policy prescriptions for price measures depending on the factors affecting CPI and PPI.

Growth can improve investor confidence as it may signal macroeconomic stability; in this context, output growth can lower yields as in the case of India. To the extent that expansion increases financing needs, our study finds evidence of a positive correlation between output growth and bond yields. The conduct of monetary policy is thus very important in promoting the bond market, particularly in managing inflation without paralyzing growth prospects. The credibility of the monetary authorities is paramount in the conduct of monetary policy and in how policy actions translate into macroeconomic effects.

The global investment climate is also a significant driver. Therefore, macroeconomic stability is crucial as it can increase the resilience of the domestic market in the face of adverse global events and boost investor sentiments.

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Appendix

Table A.1: Data Description

Series Name	Description	Source
5-Year Sovereign Local Currency Bond Yields	Average of daily closing value of yields on 5-year LCY bonds	Bloomberg LP
Inflation Rate (quarter-on-quarter, month-on-month)	Seasonally adjusted CPI or PPI rate of change	CEIC Data
3-Month Money Market Rate	Average of daily closing value of 3-month money market rates	Bloomberg LP
GDP Growth Rate (year-on-year)	Year-on-year growth in real GDP	CEIC Data
Growth in Debt Levels (Debt Accumulation)	Quarter-on-quarter growth in government debt levels	CEIC Data
5-Year US Sovereign Bond Yields	Average of daily closing value of yields on 5-year US bonds	Bloomberg LP

CPI = Consumer Price Index, GDP = gross domestic product, LCY = local currency, PPI = Producer Price Index, US = United States.
Source: ADB estimates.

Table A.2: Estimation Period Coverage

Economy	Period
India	Q1 2000 to Q4 2015
Indonesia	Q3 2009 to Q4 2015
Republic of Korea	Q2 2005 to Q4 2015
Malaysia	M7 2005 to M10 2015
Philippines	M3 2001 to M10 2015
Singapore	M3 2000 to M9 2015
Thailand	M9 2000 to M11 2015

M = month, Q = quarter.
Source: ADB estimates.

Table A.3: Regression Results of Single Equation Models

Economy	Indonesia	Malaysia (Model 1)	Malaysia (Model 2)	Philippines	Singapore (Model 1)	Singapore (Model 2)	Thailand
Local currency bond yield (Lag 1)		0.880*	0.882*	0.213*	0.160**		0.913*
Local currency bond yield (Lag 2)				(0.272)*			
CPI inflation	21.951*	3.573		31.068*			11.803**
CPI inflation (Lag 1)		4.146					
CPI inflation (Lag 2)		4.845**	6.377**				
PPI inflation					1.963*		
Change in money market rate	0.474**			0.246*			
Change in US 5-year yield	1.430*	0.143**	0.159**			0.485*	
Change in US 5-year yield (Lag 1)		0.173*	0.213*				
Rate of debt accumulation	(2.809)						
Adjusted R-squared	0.307	0.836	0.830	0.256	0.066	0.335	0.909
No. of observations	26	123	125	176	187	190	183

() = negative, CPI = Consumer Price Index, PPI = Producer Price Index, US = United States.

Notes: * and ** indicate significance at the 1% and 5% level, respectively. Quarterly data are used for Indonesia and monthly data are used for Malaysia, the Philippines, Singapore, and Thailand. CPI inflation for Indonesia refers to quarter-on-quarter inflation, while it refers to month-on-month inflation for the other economies. PPI inflation refers to month-on-month inflation for Singapore. All variables are stationary.

Source: ADB estimates.

Table A.4: Autoregressive Distributed Lag Cointegrating and Long-Run Form, India

Variable	Coefficient	Std. Error
Cointegrating Form		
L(1) Change in the dependent variable	(0.183)	0.173
L(2) Change in the dependent variable	(0.070)	0.191
Change in 3-mo. money market rates	0.243	0.069*
L(1) Change in 3-mo. money market rates	(0.065)	0.096
L(2) Change in 3-mo. money market rates	0.047	0.100
L(3) Change in 3-mo. money market rates	0.065	0.065
Change in US 5-year bond yields	0.324	0.130*
PPI Inflation (q-o-q)	9.954	4.212**
L(1) PPI Inflation (q-o-q)	6.856	7.386
Change in rate of debt accumulation	7.013	3.204**
L(1) Change in rate of debt accumulation	4.391	4.075
L(2) Change in rate of debt accumulation	8.001	3.673**
Change in GDP growth	(0.061)	0.028**
L(1) Change in GDP growth	0.049	0.025
CointEq(-1)	(0.423)	0.145*
Long Run Coefficients		
Money market rate	(0.215)	0.281
US 5-year bond yields	1.210	0.460**
Log of PPI	5.057	19.484
Log of Debt levels	1.791	9.198
GDP growth	(0.345)	0.151**
Constant	(35.024)	10.717
Adjusted R-squared	0.943	
Number of observations	53	

GDP = gross domestic product, PPI = Producer Price Index, US = United States.

Notes: L(1) - Lag 1, L(2) - Lag 2, and L(3) - Lag 3.

Source: ADB estimates.