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Opening remarks

By Juyeol Lee[1]

Ladies and gentlemen, it is a great pleasure for me to welcome all of you today to this BOK-BIS Joint Conference. I would like to express my sincere gratitude to our keynote speaker, Dr Emanuel Mönch, Head of Research at the Deutsche Bundesbank, and also to BIS General Manager, Agustin Carstens, and Head of Research, Hyun Song Shin, who will join us tomorrow. Let me also thank all of our distinguished moderators, speakers and discussants.

In 2016, the BIS Asian Office suggested Asia-Pacific fixed income markets as a research theme, in recognition of the need to assess the role of such markets and their future development. The BIS Asian Consultative Council (ACC), comprising the central banks in the Asia-Pacific region, also judged this work as timely and has been actively supporting it through the participation of its researchers. After an interim workshop held in Hong Kong in September last year, I am pleased that we have reached the final stage where we can share and discuss the results with each other at today's conference.

As you probably know, prior to the 1997 Asian financial crisis, fixed income markets in the Asia-Pacific region were underdeveloped while financial intermediation depended greatly upon short-term bank borrowings. In such a case, domestic or external shocks that hinder the smooth roll-over of loans can lead to a major crisis – something we learned the hard way. Through this lesson, countries in the region have made great efforts to foster sound financial markets that can support stable economic growth. As a result, our region's fixed income markets have developed remarkably: they are now bigger, more liquid and more open.

This fixed income market development in the region has brought about two positive changes. First, it has contributed significantly to the successful transition to interest rate-based monetary policy frameworks. Fixed income markets are one of the most important channels through which the effects of policy rate adjustments are transmitted to the real economy. Central banks are now able to assess market expectations more quickly by analysing bond yields for different maturities, making their policies more effective.

Second, with greater bond investment from abroad, foreign capital is flowing in more diverse ways. It used to come in mostly through short-term bank borrowings or equity investment, but now a considerable portion of capital inflows is invested in local currency-denominated longer-term bonds - this change has made foreign capital flows much more stable.

On the other hand, the development of fixed income markets in the region has also brought new difficulties. First, as foreign investors hold a greater share of bonds in the region, bond yields are greatly affected not only by domestic economic developments or monetary policy, but also by global economic conditions. In addition, there are increased concerns about financial and foreign exchange market unrest in the event of a sudden reversal of capital inflows to the regional bond

[1] Governor of the Bank of Korea.

markets. There have recently been dramatic changes in the global economic environment, including the continuing monetary policy normalisation by the US Federal Reserve and the rising trade tensions between the US and China. In fact, some emerging market economies with weaker fundamentals have experienced large-scale capital outflows, resulting in more volatile stock prices, exchange rates and interest rates.

So far, we have seen that the development of the fixed income market in the Asia-Pacific region has greatly contributed to better market functioning and a better policy environment, while creating no small difficulties. Against this backdrop, allow me to suggest some policy tasks that countries in the region must first pursue to enhance financial and economic stability.

To begin with, we must enhance the overall resilience of the regional economy so that sudden changes in capital flows triggered by external shocks do not lead to systemic risk. To this end, we must reinforce our capacities and policy space to properly respond to external risks. This may be done by improving current account balances, holding sufficient foreign reserves, and enhancing exchange rate flexibility.

Next, we must continue our international cooperation to reinforce financial safety nets. Asia-Pacific countries have striven to establish regional financial safety nets and develop fixed income markets through the Chiang Mai Initiative Multilateralization (CMIM), the Asian Bond Markets Initiative (ABMI), and the Asian Bond Fund (ABF). We also need to continuously expand our cooperation not only within the region but also with international organisations such as the IMF and BIS to strengthen global financial safety nets.

Last but not least, we have to continue our policy efforts to strengthen fixed income market infrastructure and functioning, such as by seeking diverse investors, making corporate bond markets more vibrant, and improving the processes for bond issuance and trading. I believe that these efforts would expand both the depth and liquidity, and therefore the stability of our region's financial markets.

Ladies and Gentlemen! The research papers to be presented at today's conference reflect the serious thoughts and ideas of expert researchers on major issues. These include not only the development of fixed income markets in the Asia-Pacific region, but also the impacts of changing global risk preferences on emerging market capital flows, the determinants of fixed income market yields, and the relationship between the term structure of interest rates and macroeconomic variables.

I hope that the research presented at today's conference will spark vigorous debate and allow the sharing of diverse opinions that will help solve the financial and economic problems facing the Asia-Pacific region. Thank you.

The term structures of global yields

By Emanuel Mönch[1]

Abstract

Sovereign bond yields in more than 20 developed and emerging market economies are decomposed into expected short rates and term premia using the Adrian, Crump and Moench (2013) approach. I document that (i) term premia account for large fractions of global bond yield variation; (ii) the co-movement of sovereign bond yields is, to a large extent, driven by the term premium components of sovereign yields, especially in recent years; (iii) connectedness and tail dependence between international bond markets are primarily driven by the term premium components of global yields; and (iv) global bond yields strongly respond to US target rate shocks, albeit with considerable delay. This response is primarily driven by a reassessment of global policy rate expectations.

JEL classification: G12, G15

Keywords: term structure decomposition, sovereign bond yields

[1] Deutsche Bundesbank, Goethe University Frankfurt and the Centre for Economic Policy Research.

This is an expanded version of the keynote speech given at the Bank of Korea–BIS conference on "Asia-Pacific Fixed Income Markets" held in Seoul on 19–20 November 2018. The keynote is based on ongoing work with Tobias Adrian (International Monetary Fund), Richard Crump (Federal Reserve Bank of New York), and Benson Durham (Blackrock). I thank conference participants for very helpful comments. Nora Lamersdorf provided excellent research assistance. A special thanks goes to Andreas Schrimpf for sharing the monetary policy shock measures and to Kamil Yilmaz for sharing replication codes. The views expressed in this paper are those of the author and do not necessarily represent those of Blackrock, the IMF, Deutsche Bundesbank, the Eurosystem, the Federal Reserve Bank of New York or the Federal Reserve System.

1. Introduction

Effective monetary policy making relies on central banks' ability to steer longer-term interest rates. This can be achieved indirectly through changes in the short-term policy rate and communication about the intended rate path, or through direct intervention in secondary bond markets. Given its importance for the monetary policy transmission mechanism, surprisingly little is known about central banks' effectiveness at affecting longer-term rates.

Without the risk of default, the yield on longer-term bonds can be decomposed into two components: the average short-term rate expected to prevail over the life of the bond, and a term premium. The latter compensates investors in longer-term bonds for the risk that interest rates may not evolve as expected. While central banks can affect both components through actions and communication, other factors can also influence the evolution of interest rates. Due to limited or slow-moving arbitrage capital, changes in the supply and demand for bonds likely drive their evolution. With bond markets becoming more integrated globally, events in foreign economies may also affect the dynamics of national sovereign debt markets. In particular, monetary policy decisions by major central banks may spill over into other national bond markets.

Against this background, this paper seeks to provide tentative answers to the following questions. How much of the variation of global longer-term interest rates is due to term premia? How much of the co-movement of global sovereign yields is due to short rate expectations versus term premia? Does national monetary policy spill over into global yield curves and, if so, through which component of bond yields?

Of course, I am not the first one to ask these questions. There is a growing literature studying these topics. Given the limited space available here, however, I will only reference a few selected related papers. I refer the interested reader to the reviews in these papers for a more comprehensive account of the relevant literature.

This paper is structured as follows. Section 2 shows how to decompose global sovereign bond yields into expected short rate and term premium components using the methodology of Adrian, Crump and Moench (2013). In Section 3, I characterise the co-movement among sovereign yield curves and their components. Section 4 documents that global yield curves show a delayed and persistent response to US monetary policy shocks. Section 5 concludes.

2. Decomposing global yield curves

This section discusses decompositions of the sovereign yield curves of 21 developed and emerging market economies into expected short rate and term premium components. I start by describing the yield data and estimation approach. I then briefly document the properties of the estimated term structure decompositions.

We use zero coupon yield curves obtained from Bloomberg as input for our term structure decompositions. To minimise the influence of default risk, we rely exclusively on local currency bond yields. Depending on the country, the yield curve data becomes available between 1991 and 1997. The sample ends in September 2018.

We decompose these local currency yield curves into expected rate and term premium components using the estimation approach of Adrian, Crump and Moench (2013), ACM henceforth)). Given a set of yield curve factors summarising the cross-section and time series of bond yields, this method consists in running three sets of consecutive regressions. First, a vector autoregression (VAR) of order one is estimated on the yield curve factors via ordinary least squares. This provides autoregressive coefficients and estimated factor innovations. Second, monthly excess bond returns are regressed on a constant, lagged yield curve factors, and the factor innovations estimated in the first step. This delivers a vector of predictive coefficients and a vector of factor risk exposures akin to "betas" in empirical asset pricing models. ACM show that no-arbitrage implies that the two sets of coefficients are directly related to one another when market prices of risk are affine in the pricing factors, as is commonly assumed in many term structure models. The relevant market price of risk coefficients are then easily estimated via a third cross-sectional regression of the predictive coefficients on the factor risk exposures, both obtained in the second step. ACM prove the consistency of this estimator and provide the asymptotic variance, taking into account the estimation uncertainty in the first two stages of the regression.

Following the common practice in the term structure literature (see eg Joslin, Singleton and Zhu (2011) and Wright (2011)), we choose principal components of yields as pricing factors. To span both the cross-sectional as well as the time series dynamics of yields, we use the first four principal components for each country as pricing factors.[2] The model fits the sovereign yield curves very precisely, with absolute mean fitting errors below 10 basis points in all countries. Figure 1 exemplarily shows the model fit for the 10-year maturity for the United States, Japan, Germany, and the United Kingdom. In all four countries, the model implied is effectively indistinguishable from the observed yield. The figures also provide the decomposition of 10-year yields into average expected future short rates over the next 10 years and the 10-year term premium. These show plausible time series variation. While still being elevated in the early 1990s, term premia saw a secular decline in all four countries over the past 20 years, consistent with a reduction of inflation uncertainty (Wright (2011)). In the case of the United Kingdom, the timing of this decline is clearly associated with the announcement of the independence of the Bank of England in May 1997. In Japan, the bulk of variation in 10-year yields is driven by term premia, consistent with investors expecting short rates to stay close to the zero lower bound through most of the sample.

3. Global term structure co-movement

An inspection of term structure decompositions for all other countries shows that the decline of term premia is not restricted to the largest economies, but is also prevalent for the remaining developed and emerging market economies in our panel. But the

[2] ACM show that for the United States, five principal components are needed to fully span the monthly excess returns, while Joslin, Singleton, Zhou (2011), Wright (2011) and others rely on three principal components as these fully span the cross-section of contemporaneous yields. Our results are robust to using four or five principal components. Note that due to the different number of pricing factors and the different sample period used in the estimation, the term structure decomposition for the United States differs slightly from the one based on ACM, which is updated on the Federal Reserve Bank of New York website (https://www.newyorkfed.org/research/data_indicators/term_premia.html)

prominent role of term premia in explaining yield variation is not merely due to a common trend in interest rate risk compensation.

Table 1 documents the importance of term premia in explaining the (co)-variance in monthly changes of 10-year sovereign bond yields. For ease of presentation, I focus on the G7 countries here, but the general pattern extends to the remaining countries as well. On the diagonal, I report the share of variance explained by the term premium component. With the exception of Germany, these shares exceed 50% of the variance in all G7 countries, and are particularly elevated in Italy and Japan. The off-diagonal elements show the share of covariance of monthly yield changes explained by the term premium. These shares are also sizable and indicate that a large fraction of the month-to-month co-variation of sovereign yield curves is due to global term premium co-movement.

The unconditional variance and covariance shares summarised in Table 1 may mask interesting time variation in sovereign yield co-movement. The top panel of Figure 2 shows one-year rolling window correlation coefficients of daily yield changes (black), term premium changes (red), and expected rate path changes (blue) averaged across all country pairs in our panel of 21 countries. The chart shows that global yield curves have co-moved strongly since the late 1990s, but this co-movement declined sharply during the Great Financial Crisis (GFC) and only picked up again around 2013. Interestingly, while average expected short rates were correlated more strongly over the earlier episode, since 2013, the pick-up in cross-country yield correlation is almost exclusively driven by a strong increase in term premium correlation. Moreover, as the bottom panel of Figure 2 also documents, much of the increased correlation may be explained by the fact that global term premia have co-moved particularly strongly with US term premia in recent years.

These preliminary findings suggest that global yield curves and especially their term premium components have become more closely interrelated in recent years. Does this imply that shocks to one sovereign bond market transmit to other sovereign bond markets more strongly? Diebold and Yilmaz (2014) propose a measure of connectedness that enables me to directly assess this question. More precisely, their approach quantifies how much of the forecast error variance in a country's bond market is driven by shocks arising in other countries' bond markets.

Figure 3 shows the time series of global sovereign bond market connectedness measures according to Diebold and Yilmaz (2014). This index is obtained using a VAR of order one on daily changes of 10-year sovereign yields and their expected short rate and term premium components, respectively, for all 21 countries in our panel. The figure documents that global yield curve connectedness has been elevated throughout the last two decades, with a dip around the GFC. Strikingly, however, while the expected rates and term premium components were connected across countries to similar extents until around 2007, the term premium connectedness declined sharply during the GFC and only picked up again around 2010. At the same time, the connectedness of expected short rates declined and has since remained at lower levels than before the GFC. In contrast, the connectedness of global term premia has continued to increase and reached levels not seen before the crisis at the end of the sample. This suggests that in recent years, innovations to term premia in other countries have become substantially more important for the variation in sovereign bonds yields than in the early 2000s.

In light of this finding, policy makers might be particularly concerned with a strong tail dependence of global sovereign yields in the sense that sharp movements in one bond market spill over into other bond markets. A simple heuristic to measure such tail dependence is the number of days over the past year on which the sovereign yields of two countries both experienced sharp increases.[3] This measure, averaged across all country pairs, is plotted in Figure 4. It shows that tail dependence had seen a secular decline since 2001 but moved up sharply starting around 2013. More importantly, this increase was almost entirely driven by the term premium component of global yields, suggesting that risk attitudes of global bond investors might be an important source of co-movement in tail events.

The increased average tail dependence shown above may be a reflection of changes in the network structure of global yield dependencies. Figure 5 shows the tail dependence between pairs of countries in August 2010 and in August 2017. To highlight the changing network structure, I exclude edges between countries whose bilateral tail dependence estimates are lower than the average of all country pairs across the two different dates. The charts give rise to two main observations. First, tail dependence in yields is generally higher among countries in the same economic region. This is most obvious in the August 2017 network chart, which shows a clear association among countries in Europe or the Asia-Pacific region, respectively. Second, the estimated tail dependence for the term premium components of global yields has increased sharply between the two dates. In 2017, the network of term premium tail dependence was considerably denser than in 2010. This highlights that sudden jumps in term premia have become much more synchronised across countries in recent years.

In sum, the results documented in this section show that global sovereign yield curves co-move strongly, more so since around 2013. Spillovers between national bond markets have become more important and large movements in sovereign yields and especially in term premia tend to occur on the same dates. As all major central banks have intervened in bond markets via quantitative easing policies during this period, this raises the question whether monetary policy has important international spillovers. This question is addressed in the next section, focusing on US monetary policy as a case in point.

4. US monetary policy and global yield curves

In this section, I estimate the effects of US monetary policy shocks on global yield curves and their components via panel local projections, following the approach in Jordà (2005). Specifically, for a given measure of a monetary policy shock ε, I run the following regression:

$$Y_{i,t+h} - Y_{i,t} = \alpha_h + \alpha_i + \alpha t + \beta_h \epsilon_t + \sum_{1}^{P} \gamma_{p,h} Y_{i,t-p} + \sum_{0}^{P} \phi_{q,h} x_{i,t-q} + \sum_{R_1}^{-R_2} \delta_{r,h} \epsilon_{i,t-r} + u_{t+h}.$$

The coefficients of interest β_h measure the average response of yields Y_i across countries i in period $t+h$ to an impulse ϵ_t, controlling for country-specific fixed

[3] Here, sharp increases are defined as those in the top decile of daily changes of 10-year yields over the past year. Considering the top 5% of daily yield changes gives very similar results.

effects, a linear time trend, past and future shocks, lagged dependent and additional (country-specific) controls $x_{i,t-q}$.[4] To study the differential response of the expected short rate and term premium components of global yields, I run identical regressions for the two components of yields.

I obtain monetary policy shock measures from Kearns, Schrimpf and Xia (2018). These are identified as interest rate changes in a 40-minute window around salient monetary policy events, including central bank announcements and the release of minutes and speeches. Kearns et al (2018) distinguish between "target", "path", and "term premium" shocks. Target shocks are identified as the 40-minute change of the one-month overnight indexed swap (OIS) rate around the policy event. Path and term premium shocks are identified as the 40-minute change of the two-year Treasury and 10-year Treasury yields, orthogonalised with respect to the 40-minute change of the one-month OIS rate as well as the 40-minute change of the two-year Treasury in the case of term premium shocks. Their sample period is from 2004 through 2015. For the sake of brevity, I focus here on the effects of US target rate shocks on global yield curves and their components.

Figure 6 shows the impulse responses of global sovereign bond yields as well as their expected short rate and term premium components to US target shocks for the two- and 10-year maturity, respectively. As controls, I include five lags of the dependent variables, past and future target shocks, past and contemporaneous path and term premium shocks, and past and contemporaneous observations of country i's exchange rate vis-à-vis the US dollar. The response of global yields to US monetary policy shocks, shown in the left column, is significant but small on impact. This is in line with earlier work. For example, Kearns et al (2018) document an average pass-through below 0.3 from US target rate shocks to international two-year bond yields on the same day. Similarly, Gilchrist, Yue, and Zakrajsek (2014) find that the pass-through of the conventional Federal Reserve interest rate policy to global sovereign yields is substantially lower than one to one after two days, with Canada being an exception. Their sample period runs from 1992 to 2008 and is thus considerably longer than the one studied in Kearns et al (2018). The on-impact spillovers of US target rate changes documented here are thus comparable to those reported in previous studies.

That said, the response of global bond yields to target rate shocks strongly increases with the horizon. Specifically, while there are only small spillovers on impact, the estimated β_h coefficients rise sharply over the following days and weeks. After 50 and 100 days, global two-year bond yields increase by a coefficient of about 3.5 and 5, respectively, relative to a target rate shock. This implies that a 10 basis points surprise in the US one-month OIS rate in tight windows around salient Federal Reserve announcements leads to an increase of global two-year bond yields by 50 basis points after about four to five months.[5] While also statistically significant, the increase in global 10-year bond yields is somewhat smaller in magnitude, peaking

4 Controlling for future shocks is important here since longer response windows may contain additional policy decisions or communication events that likely have an effect on bond yields and their components (see also the discussion in Brooks et al (2018)).

5 These effects are even larger when excluding the three largest target rate shocks observed in the sample, and thus are not driven by outliers. The timing of the responses is very similar with and without the largest shocks included.

around 15 basis points for a 10 basis point shock after 50 days and flattening out at 10 basis points after 100 business days.

These results are striking and in sharp contrast to the typical estimates of less than one to one for on-impact spillovers of US monetary policy shocks to international bond markets documented in the prior literature. To the best of my knowledge, a six-day window after the monetary shock in the paper by Gilchrist et al (2014) is the longest horizon studied thus far in the literature. However, my finding of a delayed and protracted response of global yields to US target rate shocks is consistent with recent evidence of a similar response of US Treasury yields documented in Brooks, Katz and Lustig (2018). These authors show that longer term US Treasury yields also respond more than one to one, albeit only with a substantial delay, to US target rate shocks.

There are a number of differences between their analysis and the one conducted here. First, Brooks et al (2018) only consider US Treasury yields instead of global bond yields. Second, their measure of a policy shock follows Kuttner (2001), who uses changes in federal funds futures on announcement dates from the Federal Open Market Committee to measure the surprise component of the target rate decision. Instead, the Kearns et al (2018) shocks considered here are based on tighter windows around the policy events, which also include the release of minutes and speeches. Third, Brooks et al (2018) study a different sample covering the period 1989–2008. Despite these differences, the delayed response of longer-term US Treasury yields to US target rate shocks, which they document, is qualitatively and quantitatively similar to the response of global sovereign yields documented here.

Brooks et al (2018) provide evidence that this pattern is driven by downward (upward) price pressures arising via investors withdrawing from or shifting money into bond mutual funds following the federal funds target increases (decreases). In a similar vein, the results documented here could be consistent with investors withdrawing from or moving into international bond funds following policy actions by the Federal Reserve. Such investment behaviour, in turn, could be consistent both with investor expectations about further federal policy tightening (easing) or with a repricing of interest rate risk leading to higher term premia.

Which of the two components of sovereign bond yields explain the observed responses of global yields? The decomposition into expected short rates and term premia allows me to answer this question. The middle column of Figure 7 shows the response of the expected short rate component of global yields to US target rate shocks. Both at the two-year and the 10-year horizon, short rate expectations increase strongly and persistently in response to a surprise monetary tightening. This suggests that investors expect global central banks to follow the Federal Reserve's policy decision or communication. Importantly, the estimated responses control for current and lagged levels of each country's foreign exchange rate with respect to the US dollar. A simple reaction of short rate expectations in response to exchange rate movements is therefore ruled out as an explanation for this finding.

The responses of global term premia to US target rate shocks are shown in the right column of Figure 7. They are positive but insignificant at the two-year maturity and slightly negatively significant at the 10-year maturity after around 20 days. Combined, these results suggest that the sharp reaction of global bond yields to US target rate shocks is primarily driven by a reassessment of global policy rate expectations, and not by a repricing of global interest rate risk. Note, however, that this latter finding is specific to the target rate shocks studied here. In unreported results I find that US path and term premium shocks as identified by Kearns et al (2018) lead to substantial adjustments of global yields through their term premium components. A more detailed analysis of these spillovers is left for future work.

5. Conclusion

Based on term structure decompositions of local currency sovereign yield curves for 21 developed and emerging market economies, I have documented substantial co-movement of sovereign debt markets since the 1990s. The extent of co-movement and spillovers has become more pronounced since the GFC, and this is primarily due to the term premium components of global yields. Panel regressions show that global bond markets react strongly to identified US Federal Reserve target rate shocks, but only with a substantial lag of several weeks. This is consistent with similar recent finding of a delayed response of US Treasury yields to US target rate shocks by Brooks et al (2018). Term structure decompositions suggest that the Federal Reserve's short rate decisions and communication primarily drive global bond markets via a reassessment of global policy rate expectations and, to a lesser extent, via a repricing of risk. More research is needed to better understand the dynamic effects of monetary policies on global sovereign bond yields.

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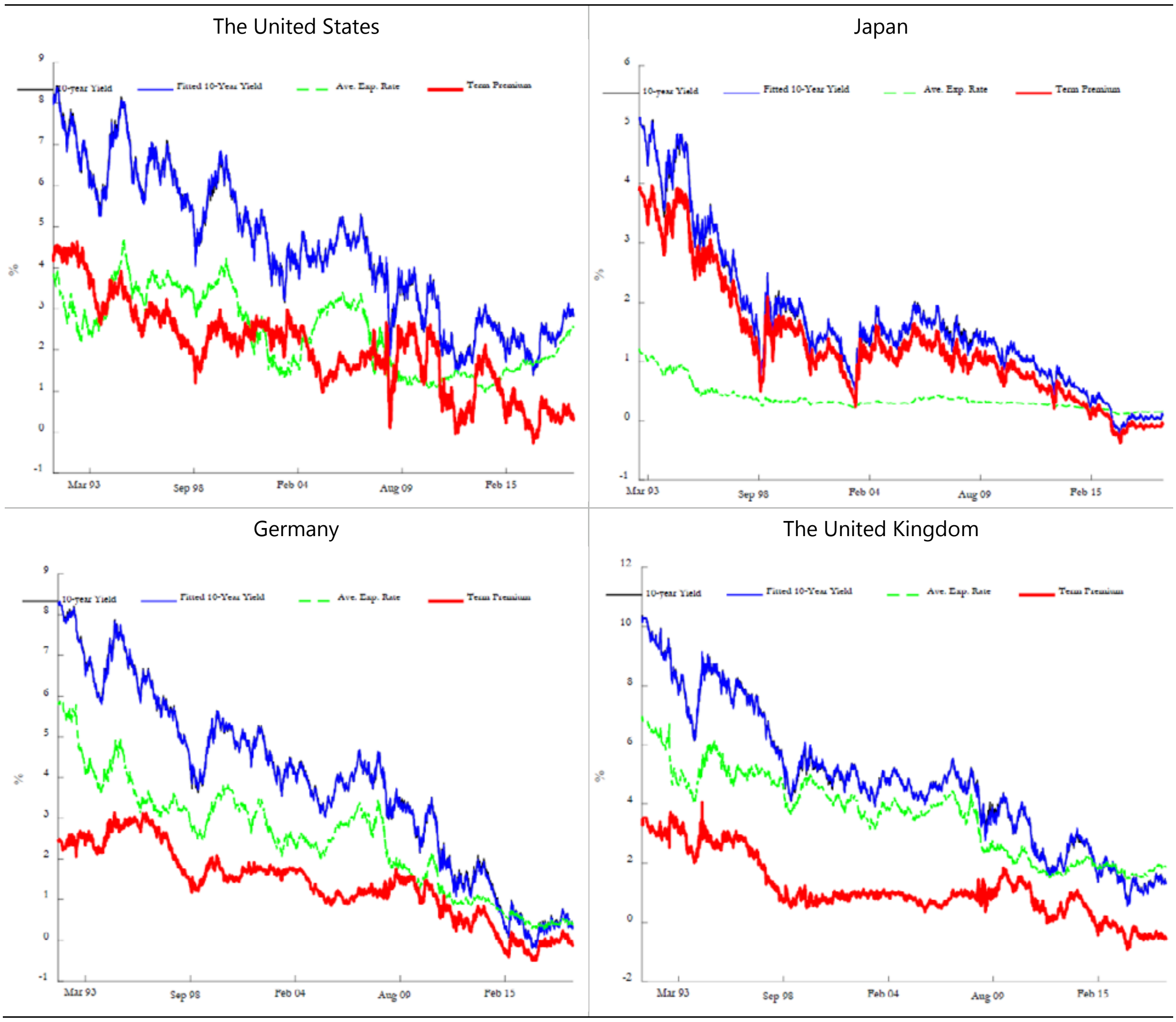
Tables and figures

G4 yield curve decompositions

Figure 1



G7 variance and covariance shares due to term premia

Table 1

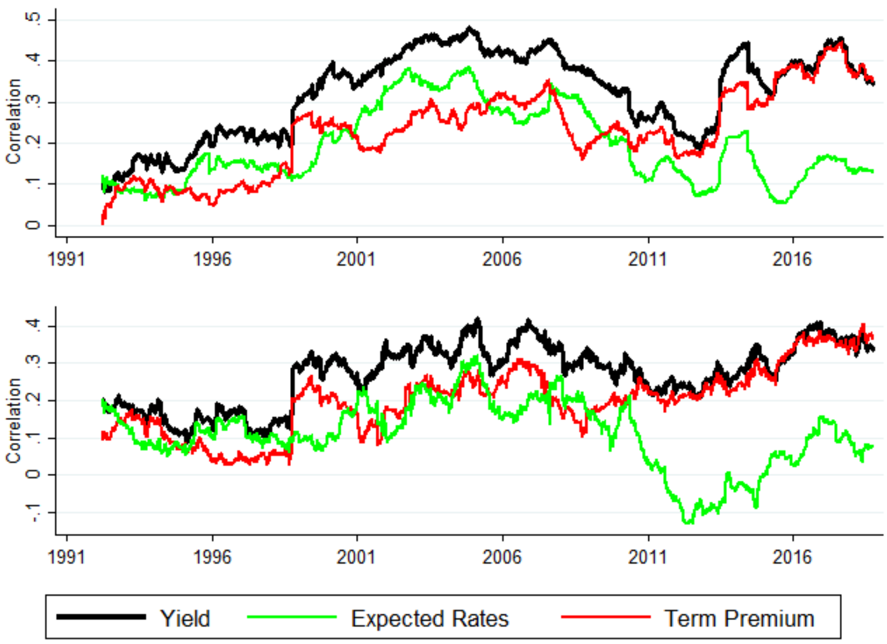
Table 1: G7 Variance and covariance shares due to term premia

	dUSA	dJPN	dDEU	dGBR	dFRA	dITA	dCAN
dUSA	.73						
dJPN	.82	.92					
dDEU	.43	.42	.49				
dGBR	.48	.45	.33	.61			
dFRA	.47	.34	.38	.39	.56		
dITA	.73	.78	.54	.61	.60	.89	
dCAN	.53	.47	.33	.40	.38	.72	.65

Note: Diagonal elements report the share of variance of 10-year yields explained by the term premium component for each G7 country: $\frac{Cov(\Delta Y^{10}_{i,t}, \Delta TP^{10}_{i,t})}{Var(\Delta Y^{10}_{i,t})}$, off-diagonal elements the share of covariance explained by the 10-year term premium comovement between the two countries: $\frac{Cov(\Delta TP^{10}_{i,t}, \Delta TP^{10}_{j,t})}{Cov(\Delta Y^{10}_{i,t}, \Delta Y^{10}_{j,t})}$

Rolling correlations of global sovereign yields

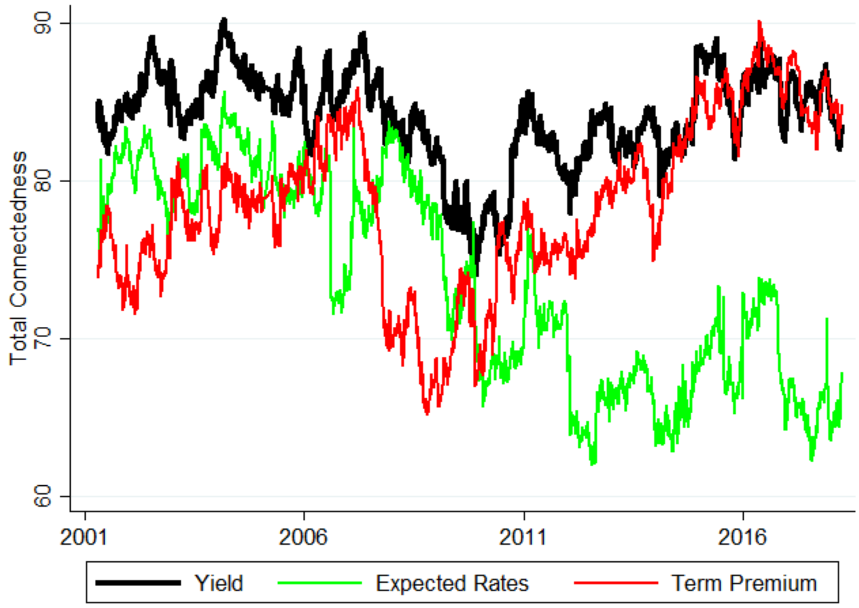
Figure 2



[1] One-year rolling window correlation coefficients of daily yield changes (black), term premium changes (red), and expected rate path changes (green) averaged across all country pairs (top panel) and averaged across all countries with the United States (bottom panel).

Global yield curve connectedness

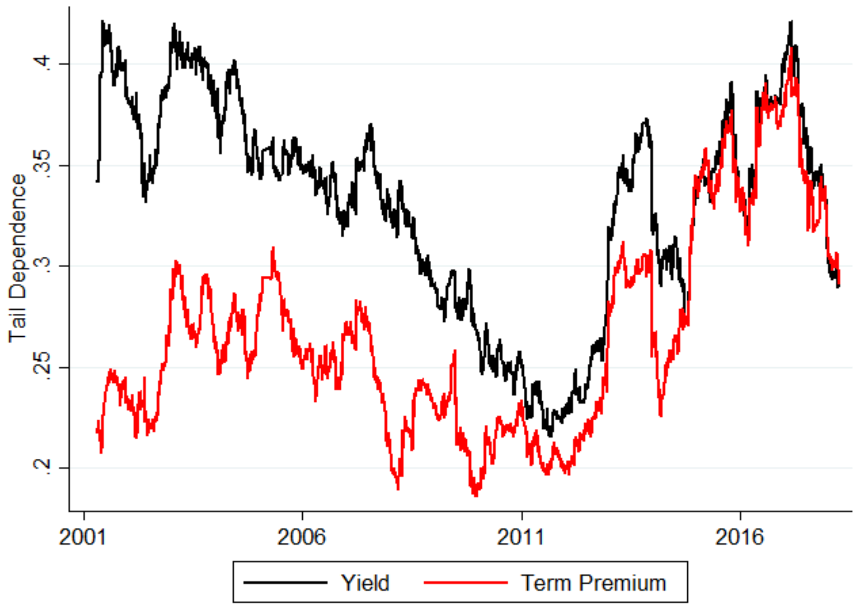
Figure 3



[1] Diebold and Yilmaz (2014) connectedness index based on one-year rolling VAR(1) estimation of daily yield changes (black), term premium (red) and expected short rate (green) components.

Global yield curve tail dependence

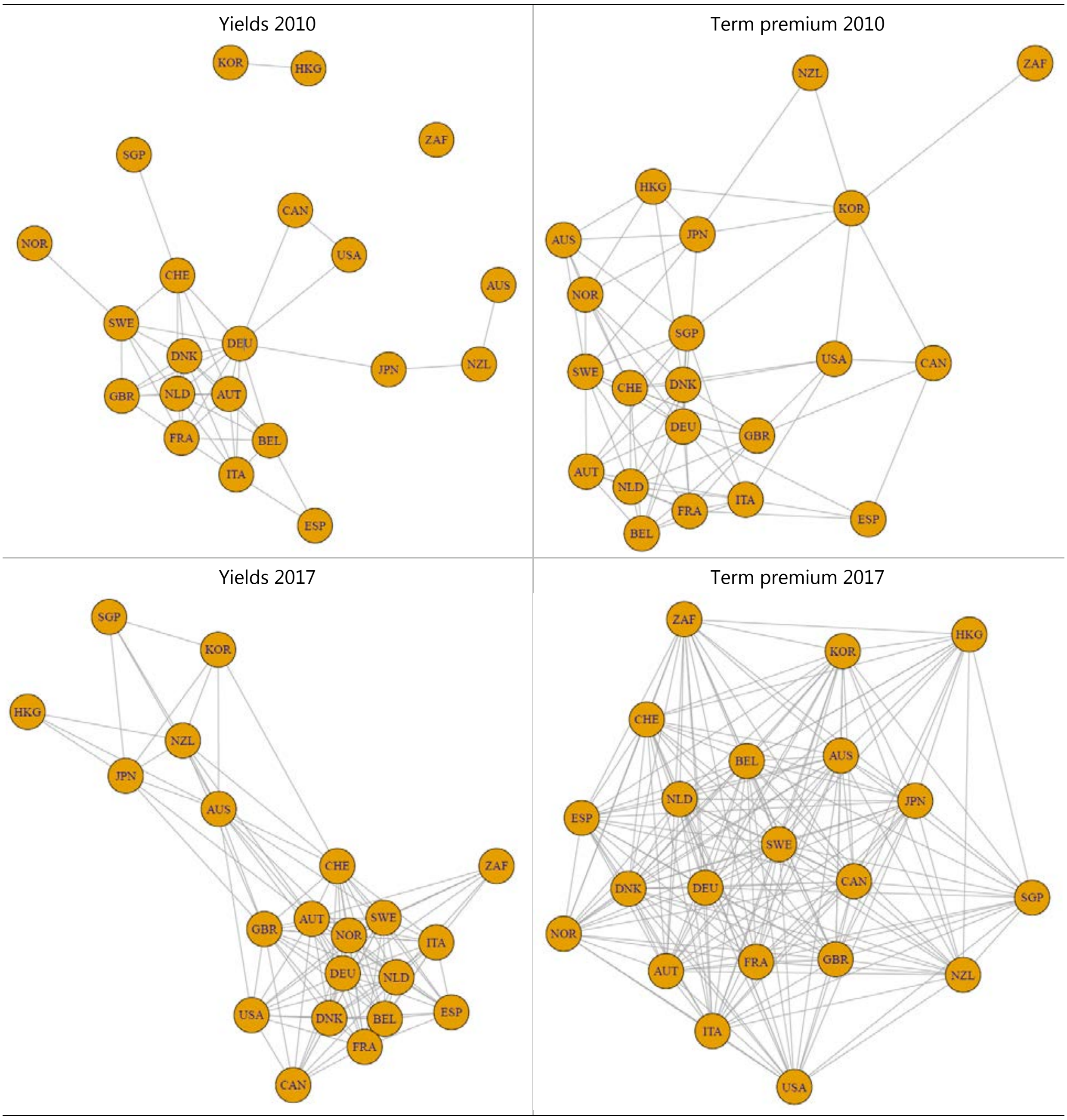
Figure 4



[1] Tail dependence between two countries is measured as the probability that both experienced large (in top 10% of all days over previous year) 10-year yield (black) or term premium (red) increases on the same days. Probabilities averaged across all country pairs.

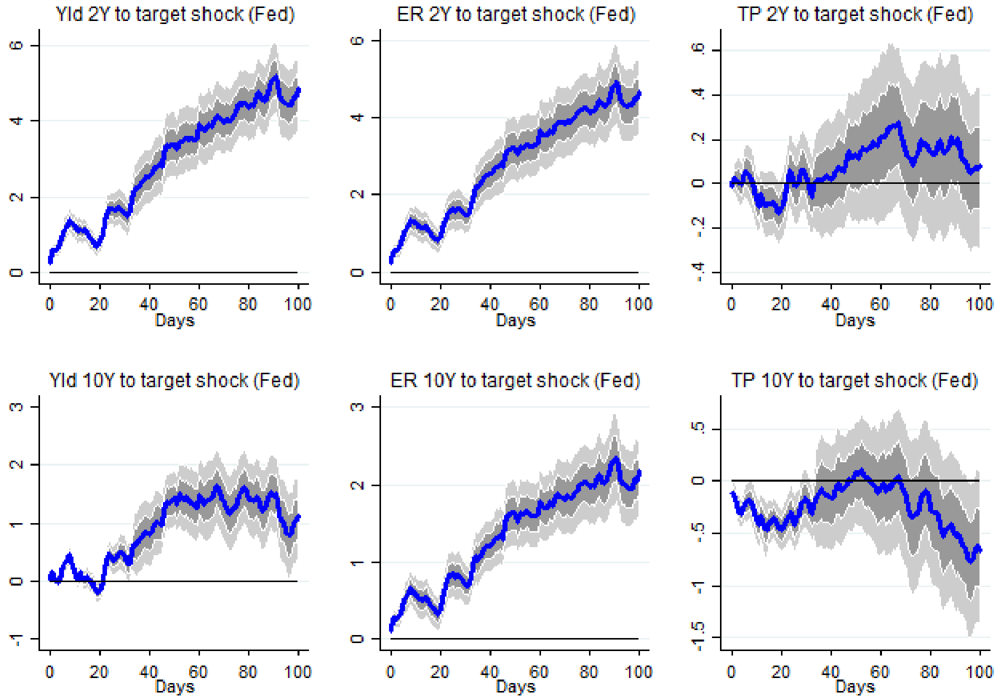
Tail dependence between two countries

Figure 5



[1] Tail dependence between two countries is measured as the probability that both experienced large (in top 10% of all days over previous year) 10-year yield or term premium increases on the same days. Edges between pairs with lower than average tail dependence (across all pairs across August 2010 and August 2017) are not shown.

Response of global yields to US target rate shocks Figure 6



[1] Responses of two- and 10-year zero coupon yields and their components to Federal Reserve target shocks based on panel of 21 countries. Sample: Jul 2004 - Oct 2015.

The global impact of risk-off shocks

By Ricardo Caballero[1] and Gunes Kamber[2]

Abstract

Global risk-off shocks can be highly destabilising for financial markets and, absent an adequate policy response, may trigger severe recessions. In Caballero and Kamber (2019), we document that the unconventional policies adopted by the main central banks were effective in containing asset price declines following risk-off episodes. These policies impacted long rates and inspired confidence in a policy-put framework that reduced the persistence of risk-off shocks. We also show that domestic macroeconomic and financial conditions play a key role in benefiting from the spillovers of these policies during risk-off episodes.

JEL classification: E40, E44, E52, E58, F30, F41, F44, G01

Keywords: risk-off, conventional and unconventional monetary policy, policy-puts, spillovers, macroeconomic fundamentals, developed and emerging markets, Asia-Pacific region

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1. Introduction

Big sell-offs in financial markets (risk-off shocks) can trigger severe recessions if fiscal and monetary policymakers fail to respond appropriately. During the Great Financial Crisis (GFC) and its aftermath, central banks in advanced economies (AEs) resorted to unconventional monetary tools such as asset purchases. These measures successfully propped up the economy, but they have been criticised for encouraging investors to buy riskier assets (reach-for-yield behaviour). As such, these unconventional policies have been seen as a sort of free "put option" or insurance for investors.

In this paper, we summarise our work in Caballero and Kamber (2019), which looks at how financial markets around the world have reacted to risk-off shocks and how the authorities have responded to these upheavals. First, we focus on how risk-off shocks have affected the financial markets of AEs, comparing their effects before and after the GFC. We then study the knock-on effects (spillovers) from these shocks to emerging market economies (EMEs). We explore how these effects were influenced by the monetary policy of AEs, as well as the economic conditions of EMEs. We pay particular attention to how the response of EMEs to these shocks has changed after the GFC.

In Caballero and Kamber (2019), we find that the unconventional monetary policies of the main AEs were highly effective, at a time when already low interest rates would have hindered central banks from attempting to boost the economy through further policy rate cuts. Without these policies, financial markets would have been more vulnerable to global sell-offs. Most of the policy discussion has focused on the problems arising from the strong capital flows into EMEs that these policies encouraged. But we document a positive side to these policies. They increased the resilience of the rest of the world against global risk-off shocks. For EMEs in particular, credit spreads were smaller and long-term interest rates rose less following such shocks.

The remainder of the paper is organised as follows: Section 2 presents an overview of the theoretical framework underlying our empirical analysis. Section 3 summarises the impact of risk-off shocks for AEs and EMEs. Section 4 contains final remarks.

2. Theoretical framework

In this section, we present the risk-centric view of macroeconomic fluctuations. The modelling details of the risk centric view are presented in Caballero and Simsek (2018). This research is part of an agenda that argues that looking at risk market dislocations helps us think about the mechanism behind several of the main economic imbalances, crises, and structural fragilities observed in recent decades in the global economy (see Caballero (2018)). This perspective sheds light on the types of policies, especially unconventional ones, that may help the world economy navigate this tumultuous environment.

This risk-centric perspective starts by observing that economic activity generates both output and risks. Economic agents must absorb both to ensure smooth growth. During normal expansions and contractions, macroeconomists and mainstream macroeconomic models mainly focus on goods markets, studying whether the demand for output is well aligned with potential output, while risk markets considerations are relegated to a secondary role, mostly relevant to the field of finance. In sharp contrast, this hierarchy flips during severe risk-off events. Risk markets become central and their disruptions quickly permeate the real side of the economy. Insufficient demand for the risks generated by economic activity contaminates – often in a chaotic (even Knightian uncertainty) fashion – equilibrium in goods markets.

These risk-off events take place in a global economy with heterogeneous and highly interconnected financial markets. These markets operate in different currencies and are exposed to large swings in capital flows. These flows provide many useful services to the global economy but can be fickle, perhaps because foreign crises cause faster transitions from speculation mode to Knightian uncertainty mode than local crises. This difference is partly due to the fact that the policy infrastructure to support risk markets during international crises is much less developed than the infrastructure to combat local crises. Furthermore, the international dimension creates multiple substitutes for distressed markets, which facilitates a speedy exodus, particularly from peripheral markets.

There are important structural factors behind the build-ups to these risk events, which stem from frictions in the production of financial assets (ie in the mapping from risk generation to asset production). These frictions are more acute in EMEs, but fast growth in EMEs relative to developed markets (DMs), combined with increased prudence in EMEs, has turned the global economy into a sort of "advanced EME" with recurring risk events. A central ingredient in the instability of this global integration process is the large asymmetry in safe asset production across the world, with the United States supplying most safe assets.

Conventional monetary policy, the quintessential tool for plain vanilla cycles, plays an important role in risk-based contractions, mostly by improving the (ex ante) Sharpe ratio of risky assets. However, this channel can become insufficient, because interest rate adjustments may be constrained by an effective lower bound, or by the need to defend a rapidly weakening exchange rate. In this context, unconventional monetary policies may play a significant role. These unconventional policies are mostly risk markets interventions. These interventions can work via two channels. In the first channel, a government/central bank with a credible balance sheet absorbs part of the risk the private sector does not want when interest rates are at their effective lower bound. For example, quantitative easing policies that swap credit products for US Treasury bonds effectively amount to reducing the supply of risk in the economy. By purchasing risky assets from the private sector, the government has decreased the private sector's exposure to risk. In the second channel, the central bank can increase the expected capital gain in case of a recovery. One can think of forward guidance as increasing the expected value of future asset prices by keeping rates below the natural rate for an extended period during the recovery.

3. The impact of risk-off shocks in advanced and emerging market economies

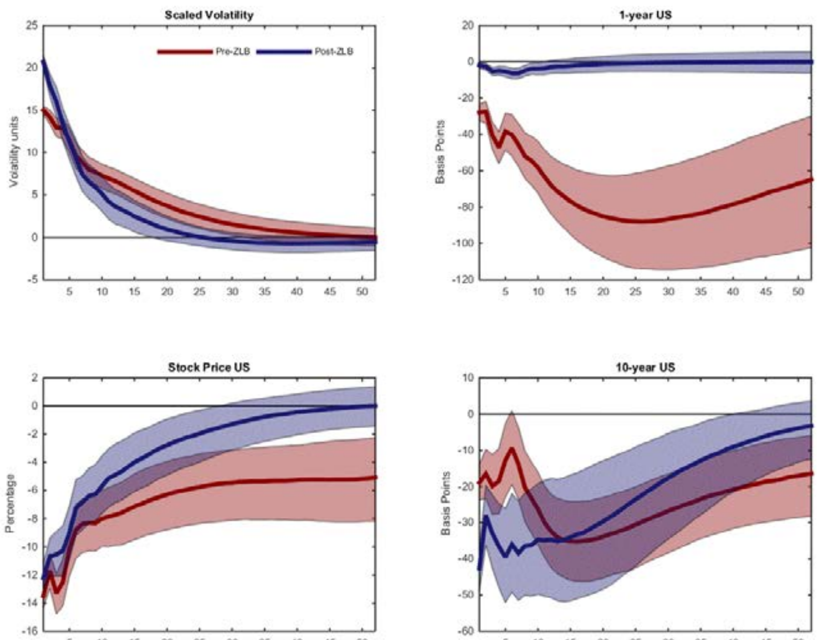
With the risk-centric perspective in mind, in Caballero and Kamber (2019) we present empirical evidence on the impact of risk-off shocks on financial markets in AEs and

EMEs. We highlight the role played by unconventional policy frameworks in dealing with the effects of risk-off shocks.

For AEs, our empirical analysis is based on structural vector autoregressions (SVARs). The risk-off shocks are identified in line with the empirical literature on the macroeconomic effects of uncertainty shocks. That is, global risk-off shocks are identified as unexpected movements in the VIX Index. Although the VIX refers to the implied volatility of stock prices in the United States, using the VIX does not mean that we are only interested in shocks originating in the US economy. Given the high correlation of implied volatility indexes across major economies, this approach can account for shocks happening anywhere in the world if they are large enough to affect the VIX.

The baseline VAR for the US economy is estimated on weekly data and includes data on the VIX, short-term and long-term interest rates and equity prices. Graph 1 presents the dynamic effects of a risk-off shock in the United States. We present the effects of the risk-off shocks for two subsamples. The first one, the pre-zero-lower bound (ZLB), shows the effects of the risk-off shocks estimated for the subsample starting in 1999 and ending just before the collapse of Lehman Brothers. During this period, conventional monetary policy tools were available to the Federal Reserve. In order to contrast the results when conventional monetary policy tools were constrained, the second subsample covers April 2009 to December 2015. This is a period when policy rates in the United States were at their zero lower bound and the Federal Reserve engaged in a number of unconventional monetary policies.

The effects of risk-off shocks in the US | Graph 1



[1] The figure shows impulse responses to a risk-off shock obtained from weekly VARs estimated for two subsamples. The variables included in the VAR are the VIX Index, one- and 10-year US Treasury yield and the log of the S \& P 500 index. The first subsample, labelled pre-ZLB, covers January 1999 to September 2008. The second subsample, labelled post-ZLB, covers April 2009 to December 2015. Red (blue) solid lines and shaded areas correspond to point estimates and one standard deviation confidence intervals. The volatility shock is calibrated to generate a 15 vols increase in VIX in the first subsample. The impulse responses in the post-ZLB sample are scaled so that the 12-week cumulative increase in the response of VIX is the same in both subsamples. The units of the vertical axes are vols for the VIX, basis points for interest rates and percentage points for stock prices.

In order to give our results a quantitative dimension, we calibrate the initial response of the VIX to be equal to the average of the three largest weekly increases in our sample. These three events are associated with major risk-off episodes over the last decade. The first episode is immediately following the collapse of Lehman Brothers. The second one is in August 2011, amidst concerns of the European sovereign debt crisis spreading to Spain and Italy. And the final event is during the sell-off following China's Black Monday in August 2015. The average increase in VIX in these three events corresponds to about a 15-volatility point spike.

Focusing on the first period, following an unexpected risk-off shock the VIX increases persistently and returns to its baseline after about nine months. The shock triggers a sharp drop in equity prices of around 14%. In response, the Federal Reserve eases monetary policy and the one-year Treasury yield falls immediately after the risk-off shock. The peak decline in the one-year Treasury yield is around 100 basis points and happens after four to five months. Although the effect of the risk-off shock slowly dissipates, the one-year yield is still lower than normal after a year. The easier monetary policy also affects long term interest rates. The evolution of the 10-year Treasury yield after a risk-off shock is similar to the evolution of short-term interest rates, but the impact is smaller. At its lowest point, the 10-year Treasury yield is around 40 basis points lower than before the shock.

The effects of risk-off shocks in the aftermath of the GFC are labelled post-ZLB in Graph 1. A first observation is that the effect of a risk-off shock on the VIX dies out much faster in this period. While the VIX stays significantly above the pre-shock level for more than nine months in the conventional policy period, in the ZLB subsample the effect on the VIX dies out after about four months. The response of the one-year Treasury yield is small and mostly insignificant. This is not surprising since the federal funds rate was constrained by the ZLB during this sample.

The interesting observation is that the 10-year Treasury yield responds more quickly to risk-off shocks compared to the pre-ZLB sample. Immediately after the shock, the 10-year yield declines by about 40 basis points and stays significantly below the pre-shock level for more than half a year. While its decline is less persistent than in the pre-ZLB sample, its quick recovery is consistent with the risk-off shock itself being less persistent. This policy response limits the sell-off in financial markets. If the monetary policy reaction is completely muted in all dimensions, one would expect an equivalently large increase in volatility to trigger a bigger fall in asset prices. We find, however, that stock prices fall by a similar amount in both periods.

This finding supports the view that, despite the ZLB binding on short term interest rates, the Federal Reserve was still able to generate significant movements in longer term interest rates via its unconventional monetary policy tools. It also appears that the policy-put framework was credible enough to trigger an immediate and reinforcing response from the private sector. Moreover, signalling a reliable policy-put framework seems to have reduced the persistence of risk-off shocks.

Risk-off shocks have significant negative effects on EMEs. In Caballero and Kamber (2019), we document that following a risk-off shock, equity markets in EMEs decline sharply. At the same time, as capital leaves the country, their long-term interest rates tend to increase and their currencies depreciate.

We show, that the effects of risk-off shocks on EMEs seem to have changed after the GFC and are linked to the stance of monetary policy in AEs. We first compare the effects of risk-off shocks on EMEs between the conventional and unconventional monetary policy periods. We find that a similarly sized risk-off shock triggers a larger fall in stock prices during the conventional policy period. Therefore, and somewhat paradoxically, unconventional monetary policies in major economies appear to benefit EME equity markets more than conventional policies during risk-off episodes. We conjecture that this is related to the change in the response of EMEs' long rates to a risk-off shock. For instance, prior to the GFC, we find that the long-term interest rates in EMEs rise in response to a risk-off shock, despite falling long-term interest rates in major economies. In the unconventional policy period, however, after an initial jump EMEs' long rates fall persistently.

To further explore the impact of monetary policy in major economies, we interact the effect of risk-off shocks with measures of US monetary policy. We find that the interaction term has a significant effect on the response of EME variables. That is, when short rates are low or monetary policy is loose in core economies, a risk-off shock triggers a smaller decline in EME equity markets and a smaller increase in their long-term interest rates, and their exchange rates depreciate less. Conversely, the effects of risk-off shocks on EMEs are larger when monetary policy in AEs is tight.

Macroeconomic characteristics and risk-off shocks Table 1

	Stock Prices	**10-year yields**	**Exchange rates**
CA/GDP	–0.66	–27.66***	–3.63***
ST debt/reserves	–0.04	2.07	0.33***
Reserves/GDP	–0.08	–3.23***	–0.33***
Sovereign sating	0.00	–0.35***	–0.01***
Total debt/GDP	0.00	0.00	0.00
Safe asset index	0.36	–6.78**	–0.52***
Fin openness	0.00	–0.09***	–0.01***
GDP per capita	0.02	–0.63**	0.00

[1] The table reports the estimated coefficients risk-off shock when interacted with measures of economic fundamentals. See Caballero and Kamber (2019) for details. The first column indicates which measure of economic fundamentals was used as an interaction term. Columns 2–4 report the estimated coefficient on EMEs' stock prices, 10-year sovereign yields and exchange rates. Asterisks indicate statistical significance at the 5% (**) or 1% (***) level.

Source: Authors' calculations.

We next investigate whether the effects of risk-off shocks are homogeneous across EMEs and whether EMEs' economic fundamentals shape how their financial markets respond to global risk-off shocks. We consider a wide range of indicators that could contribute to cross-country differences in response to global risk-off shocks. Table 1 reports the coefficient on the interaction term between the risk-off shock and selected indicators of economic fundamentals. Larger estimates indicate that a country's response is tightly linked to its fundamentals

We find a rather limited role for economic fundamentals in differentiating the responses of equity markets across EMEs. None of our estimated interaction terms are significantly different from zero for equity market response. We find, however, that most of the interaction terms are significant and have the expected sign for the responses of long-term interest rates and exchange rates. For instance, countries with low current account deficits (or surpluses), countries with low short-term debt to foreign reserves, and countries with high foreign reserves to GDP ratios appear to experience less upward pressure on their bond yields and their exchange rates depreciate less.

The same seems to be true for countries with higher levels of GDP per capita and countries that are more integrated with international financial markets, as both interaction terms are statistically significant. Regarding indicators related to public debt, our results suggest that, while a country's sovereign debt rating appears to attenuate the effects of risk-off shocks, the level of total public debt doesn't have a statistically significant effect. Finally, the interaction term with the index of ability to create safe assets also has a negative coefficient. This suggests that, in countries that can produce local currency-denominated sovereign debt at low spreads, the long end of their yield curves are less sensitive to global risk-off shocks.

4. Final remarks

We have shown that the policy-put framework implemented by core economies following the GFC was highly effective in substituting for the exhausted conventional monetary policy instruments. Absent these policies, financial markets would have been substantially more vulnerable to the periodic risk-off episodes experienced by the world economy.

These policies had substantial spillovers to the rest of the world. While most of the policy discussion has focused on the problems caused by the reach-for-yield capital flows towards EMEs, we document that there is a positive side of these policy-put frameworks since they increase the resilience of the rest of the world with respect to global risk-off shocks. For EMEs in particular, this increased resilience took the form of more stable long rates and smaller credit spreads in the face of risk-off shocks. Core policy-put frameworks seem to have prevented the traditional unhinging of the long end of EMEs' yield curves during risk-off episodes.

By the same token, this policy-framework spillover observation raises the issue that as (and if) the core policy-put framework is gradually removed, individual economies may need to boost their self-hedging mechanisms. Self-hedging often means an increased demand for safe assets, which may reignite the downward pressure on long interest rates and global imbalances, unless regional supplies of safe assets expand as well, an issue on which the Asia-Pacific region has much to contribute. This expansion in the supply of safe assets can take place at the individual country or regional level, perhaps by creating tranches from pooled regional debts. Similarly, the region could consider creating a regional policy-put framework.

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Comments on "The global impact of risk-off shocks"

by Piti Disyatat[1]

In this paper, Caballero and Kamber study how monetary policy frameworks influence the impact of risk-off shocks for a broad set of advanced market economies (AEs) and emerging market economies (EMEs). It is a very interesting and thought provoking paper. The key propositions of the paper are: (i) risk-off shocks have become more benign post-Great Financial Crisis for EMEs; (ii) this is attributable to unconventional US policies (so-called policy-put frameworks); and (iii) stronger country fundamentals imply more resilience to risk-off shocks. The overall conclusion is that policy easing in the United States, particularly unconventional ones, has been good for all. This is a good story. But is it too good to be true?

1. Empirical issues

The key empirical issue is identification. There are two parts to this.

The first has to do with the identification (and hence the interpretation) of risk shocks using the VIX Index. There is a tendency to view the VIX as exogenous. But it is not, varying as it does with underlying economic developments and vulnerabilities. Thus, the omission of controls for macro and financial vulnerability such as news, valuations, credit growth and risk spreads makes interpretation difficult. Relatedly, we know that the VIX reflects both objective risk and the price of risk (risk aversion). Which one do we care about? It might be worth decomposing the VIX and exploring their separate impacts along the lines of Bekaert et al (2013).

The second part concerns identifying the role of monetary policy in the vector autoregression (VAR). The paper simply attributes the shape of impulse responses to monetary policy. For example, the negative response of the 10-year bond yield to risk shocks is taken to be evidence of monetary policy working to cushion the adverse impact. But there is no clear reason why this should be the case, especially in the zero-lower bound period where policy rates cannot move and the VAR contains no other policy variable such as central bank asset purchases or balance sheet size. How do we know that the reaction of bond yields and the other financial variables in the VAR is due to monetary policy rather than just a reflection of market response to risk-off?

More critically, the presumption that differences between the pre- and post-Great Financial Crisis (GFC) subsamples reflect differences in monetary policy reactions is problematic on two levels.

First, the nature of shocks may be quite different. Not all shocks are created equal and similar-sized VIX shocks can have different implications. For example, the VIX spiked up by about the same amount during the 11 September 2001 attacks in the United States and the 6 May 2010 "flash crash" in US equity markets. But one was a

[1] Bank of Thailand.

geo-political shock while the other a purely financial shock. Are these two events really comparable in terms of their effects on confidence and the economy?

Second, similar-sized shocks can have vastly different impacts because the propagation mechanism is different. This can be due to changing context, behaviours, perceptions, preferences and, of course, policy regimes. But without controls for these, how can we attribute all the differences to different monetary policy regimes? For example, the fact that equity valuations post-GFC were lower may explain why equity prices do not fall as much in response to risk-off shocks in this period.

Either way, differences in the nature and the propagation of shocks makes comparison between two periods difficult. Indeed, the fact that the persistence of VIX shocks are found to be different in the two samples is precisely an example of why it is difficult to compare responses across regimes.

2. Conceptual issues

In terms of the conceptual issues, there is a distinction to be made between risk-centric and finance-centric views. The paper stresses the importance of the market for risk. I come from a perspective that emphasises the importance of financing. At some level, this is just semantics: what the authors call risk, I call financing. One can talk about the demand and supply of risk vs of financing, a risk gap vs a financing gap and so forth. But at a deeper level, there are some key differences in perspectives.

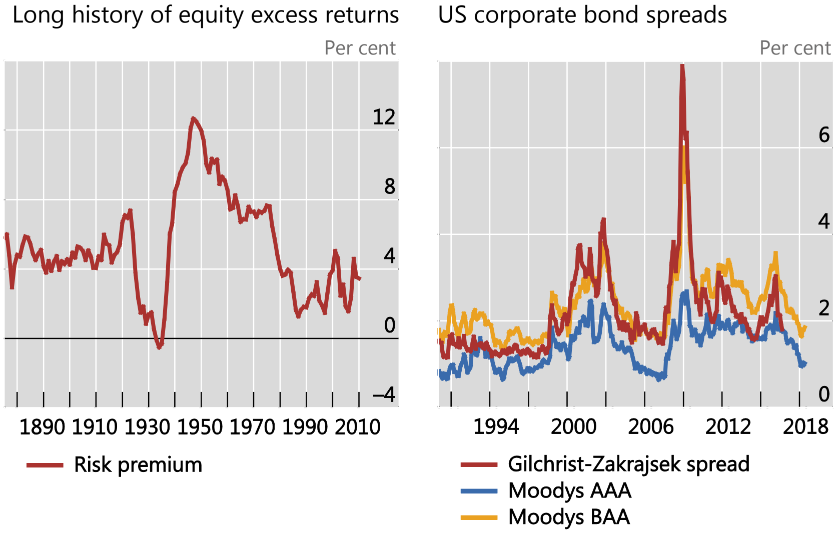
In the risk-centric view, output generates risks that needs to be absorbed. In the finance-centric view, financing generates output. Without financing, no production takes place. Borrowing and lending, and hence trust, is essential. The conceptual premise of the paper is that firms produce as much as is demanded and do not require financing. There is really no borrowing and lending. Thus, the underlying framework is real rather than monetary.

One manifestation of this is that it views the decline in real interest rates over the last decade as an equilibrium outcome driven by real factors. In the model, the only way to reconcile this is to have an excess supply of risk or an excess demand for safe assets. In other words, the last 10 years have been a period of risk intolerance. This implies that risk spreads should rise as people seek safety.

The finance view sees the decline in real interest rates as partly driven by policy and that this forces adjustment in risk markets in the form of risk spread compression as people search for yield. We have been in a period of ever greater risk-taking. Looking at the data for the United States in Graph 1, the proposition that risk premia has been exceptionally high is questionable. Whether it be excess equity returns or corporate bond spreads, risk premia do not seem particularly high over the last couple of decades. In fact, risk spreads have compressed significantly in two phases since 2000, punctuated by the GFC. Both of these phases coincided with periods of accommodative monetary policy.

The second distinction worth highlighting is between shocks and vulnerabilities. The framework of the paper focuses on risk shocks taken to be exogenous. But these could be endogenous. Sharp declines in asset prices usually do not come out of nowhere. Often, they are the culmination of vulnerabilities built up over time. Thus, rather than shocks, it may be better to think of vulnerabilities. And these could be endogenous to policy. This could give rise to a trade-off between low risk today at the expense of high risk tomorrow (see Rungcharoenkitkul et al (2019) and Adrian and Duarte (2018)). The idea is to relate the busts to the booms that preceded it, rather than just thinking of busts as random shocks. Here it is good to remind ourselves that risk is not volatility. And indeed, low volatility often means higher risk. One could, in fact, argue that monetary policy, especially during the post-GFC period, has suppressed volatility and built up risk.

Risk premia Graph 1



Sources: Jordà et al (2017), Gilchrist and Zakrajsek (2012), Bank of America Merrill Lynch, Bloomberg, FRED, BIS calculations.

Finally, this is another model that views zero-lower bound as the root of all problems. While it is certainly true that the zero-lower bound limits stimulus, it is a leap to presume that everything would have been fine if only central banks could have lowered rates more. This neglects the role of stock variables and supply-side problems that may explain the persistence of the output shortfall. Debt overhangs need to be worked out, resource misallocations resolved. Again, this is an outcome of viewing crises as shocks rather than the result of accumulated vulnerabilities that generate path dependency (see Juselius et al (2016)).

3. Policy implications

Turning now to the policy implications. Essentially, the paper is arguing that put-policies, particularly monetary easing, are good and beneficial to both AEs and EMEs. With respect to the impact on EMEs, I would raise three questions.

First, the paper focuses on the capacity of monetary policy frameworks to offset volatility shocks but neglects the possibility that the framework itself may contribute to the likelihood of and susceptibility to shocks. Indeed, the monetary spillovers documented can be viewed as the reason to worry rather than to cheer. The 2013 taper tantrum, for example, can be seen as an episode where put-polices, rather than alleviating the effects of risk-off shocks, sometimes are the shocks!

Second, the horizon of analysis matters for the assessment. As mentioned earlier, to the extent that put-policies build up vulnerability to risk-off shocks, the benefit from US monetary easing is a veil because although it helps at the moment of the shock, it also contributes to the susceptibility to those shocks over time. Indeed, one wonders whether the susceptibility to capital outflows and exchange rate depreciations would have been less without prior put-policies. This relates to the importance of linking booms and busts as noted before.

Third, I wonder if it is too early to judge the benefits of cleaning through put-policies. The post-GFC period of analysis is one of policy easing. One could say that, so far, we have been in a risk-on regime all along, punctuated by some hiccups. The true risk-off regime starts now when monetary policy is normalised. We are just in the beginning of that globally.

Finally, I also fear that high reliance on put-policies contributes to central banks becoming the only game in town. This could contribute to elevating overall system risk and vulnerability in the long run.

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Determinants of Asia-Pacific government bond yields

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Abstract

This paper examines the dynamic properties of Asia-Pacific local currency sovereign bond yields and risk premiums. We focus, in particular, on the properties and interactions of components of bond risk premiums that are due to credit spreads and exchange rates. We find that local variables are significant in explaining the dynamics of these components. In particular, the credit risk premium component is, unsurprisingly, mostly affected by a factor that reflects local sovereign credit risk, while the currency risk premium component is affected by the credit factor as well as by the difference in the interest rate level between the local and US yield curves. Moreover, we find that, quantitatively, local variables play a large role in explaining the variation in the credit and currency risk premium components.

JEL classification: F30, G12, G15

Keywords: emerging market bonds, bond risk premia, currency risk, credit risk

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1. Introduction

We study the determinants of sovereign bond yields in emerging market economies (EMEs), focusing on common features of local determinants within a region and global ones. Two natural drivers of bond yields in this context are credit and currency risks, which we label as the Twin Cs. A changing likelihood of sovereign default is likely to affect the exchange rate. A weakening exchange rate could be a precursor of fiscal stress and higher credit risk. Our focus on the Twin Cs is related to the literature on the so-called Twin Ds (default and devaluation), eg Na et al (2018) and Reinhart (2002). Since we do not observe any defaults in our sample, we emphasise the Cs rather than the Ds.

When studying EME bond markets, it is particularly relevant to examine potential spillovers from the US bond market. We test whether factors driving EME bond yields contain information about future local interest rates and macro variables, beyond what is contained in the factors that drive US yields. Here, we consider US and local versions of factors constructed from yields, specifically principal components of yields and macro factors (inflation, output, exchange rates), as well as local credit factors. We also study the impact of these local and US factors on bond risk premiums and assess their relative importance for risk premia.

In order to identify the Twin Cs separately, we need data on bonds denominated in local currency (LC) in addition to bonds denominated in US dollars. This prompts us to study sovereign bonds from Asia-Pacific (AP) countries. AP local currency government bond markets have been characterised by rapid growth in recent years. Partly as a result of policy initiatives in response to the 1997-98 Asian crisis, these markets have grown from less than a quarter of a trillion USD in 1995 (or 10% of GDP) to USD 10.1 trillion in 2018 (48.5% of GDP).[2] This rapid growth stands in contrast to other EME bond markets. For example, the amount of outstanding Latin American LC bonds has barely increased over the past decade, in part due to insufficient macroeconomic stability.

When studying EME bond markets, the literature has thus far largely focused on the role of only one of the Cs, namely credit risks (eg Hilscher and Nosebusch (2010) and Longstaff et al (2011)). Data limitations have also led most researchers to use the EMBI index that aggregates across different maturities of US dollar-denominated bonds, or to study credit default swap (CDS) contracts for one single maturity. Regarding the second C, currency risk, little work has been carried out on understanding the connection between currency risk and cross-country differences in bond yields, in particular for EMEs. Hofmann et al (2017) document that movements in the dollar exchange rate of EMEs affect local government bond yields through changes in the sovereign credit risk. While they emphasise this interaction between currency and credit risk, they do not formally jointly model bond yields, exchange rates and credit risk or their drivers.

We address the questions raised above by studying the behaviour of LC bond yields of China, Indonesia, Korea, and Singapore. Despite relative macroeconomic stability, these countries vary in terms of monetary policy, exchange rate stabilisation

2 This includes LC government bonds of China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Thailand and Vietnam; source: Asian Development Bank and Reserve Bank of India.

policy, credit quality and tightness of capital controls. This is in contrast to the traditional analysis of bond markets in G7 countries, which share a lot of similarities across all of these dimensions. The significant cross-country differences among AP countries complicate the analysis of the factors driving bond yields in these countries. Another complication arises from the relatively short time span of most AP bond markets. We address both complications through the use of panel regressions with fixed effects, which allows us to identify commonalities across countries while at the same time establishing predictability patterns in the data. Using this approach, we study both the lead-lag relations between US and local yield and macro factors and how such factors affect bond risk premiums.

We find that US variables matter for both local yield factors and local macro factors, as well as for the credit factor. Importantly, we also find that local factors themselves matter for the future evolution of local variables. In particular, the local credit factor predicts all other local variables with the exception of output and credit. The local credit factor is predictable by the depreciation rate (the Twin Cs effect) and by the cross-country differences in the levels of the interest rates and term spreads. The fact that the credit factor and the depreciation rate predict each other highlights the interaction between the Twin Cs.

For local excess bond returns, US macro variables are important across all return horizons. Among local factors, the depreciation rate and the credit factor are significant for the component reflecting compensations for credit risk. Regarding compensation for currency risk, the depreciation rate is significant at short horizons and the credit factor is significant at long horizons. Moreover, we find that local variables play a major quantitative role in both time-series of depreciation rates and credit spreads, and bond risk premiums associated with the Twin Cs.

2. Data

For our analysis, we require data on bond yields and macroeconomic factors for the Asian countries we study, as well as for the United States. We also need exchange rates between the currencies of the AP countries in our sample and the US dollar, as well as data on the credit risk of individual sovereigns.

For the macroeconomic data, we rely on inflation (the monthly log-difference of the consumer price index) and a measure of economic activity (the monthly growth rate of industrial production (IP)). The exchange rate data consists of end-of-month quotes of the Chinese yuan, the Indonesian rupiah, the Korean won, and the Singapore dollar, against the US dollar.[3]

As for the bond market data, we use zero-coupon government bond yields. For the four AP economies we study (China, Indonesia, Korea and Singapore), we rely on Bloomberg zero-coupon yields, which are estimated using a spline approach on available prices of individual bonds in domestic markets. For the United States, we use the standard dataset from the Federal Reserve, as constructed by Gürkaynak et al (2007). The zero-coupon yield series available for our four AP countries are relatively short compared to US data. Specifically, yield data is available as of September 2003

[3] The source of the macro and FX data is Bloomberg, except for Chinese IP data, which comes from China's National Bureau of Statistics.

for China, from October 2003 for Indonesia, from September 1999 for Korea and as of June 1998 for Singapore.

In order to allow us to separately identify default and currency risks, we need US dollar-denominated bond yields for the AP countries in our sample. Singapore is an exception, as we consider Singaporean bonds as credit risk-free due to their AAA-status. In the case of Korea, we again rely on Bloomberg zero-coupon yields, which are available for US dollar-denominated bonds. For China, no data on US dollar-denominated zero-coupon yields exist, whereas Indonesian data are available only as of very recently. For these two countries, we therefore instead construct synthetic US dollar yields by adding Chinese or Indonesian sovereign CDS spreads to US Treasury par yields and estimating zero-coupon yields. We take the difference between the one-year US dollar-denominated AP yield and the corresponding US Treasury yield as our credit risk factor. Table 1 reports summary statistics for our data.

Macro and yield variables: summary statistics

Table 1

Variable	Statistic	China	Indonesia	Country Korea	Singapore	US
Depr rate	mean	–0.14	0.28	–0.05	–0.10	-
	st dev	0.66	2.80	3.08	1.68	-
	serial corr	0.28	0.09	0.01	–0.05	-
Inflation	mean	0.23	0.53	0.21	0.13	0.29
	st dev	0.59	0.80	0.36	0.49	0.37
	serial corr	0.09	0.21	0.26	–0.16	0.62
IP growth	mean	0.93	0.28	0.40	0.47	0.17
	st dev	0.63	3.86	2.21	7.10	0.68
	serial corr	0.31	–0.48	–0.02	–0.37	0.28
1-year yield	mean	0.22	0.65	0.33	0.10	0.42
	st dev	0.06	0.20	0.14	0.07	0.31
	serial corr	0.94	0.94	0.99	0.98	0.99
3-year yield	mean	0.25	0.72	0.36	0.14	0.46
	st dev	0.06	0.21	0.15	0.09	0.30
	serial corr	0.94	0.94	0.99	0.98	0.99
10-year yield	mean	0.31	0.81	0.40	0.25	0.54
	st dev	0.05	0.21	0.16	0.07	0.26
	serial corr	0.94	0.95	0.99	0.96	0.99
Credit	mean	0.02	0.07	0.11	-	-
	st dev	0.02	0.10	0.08	-	-
	serial corr	0.85	0.92	0.96	-	-

Sample statistics of macroeconomic factors and selected yields. "Depr rate" refers to the deprecation rate of the local currency relative to the US dollar. The depreciation rate, inflation and IP growth are measured as monthly log-differences, scaled up by 100. The yields and the credit factor are zero-coupon based and expressed in monthly continuously compounded terms. All series end in December 2017; series for China start in September 2003, for Indonesia October 2003, for Korea September 1999, for Singapore June 1998 and for the United States February 1977.

3. Econometric approach

While our dataset features yields across a large number of maturities, we reduce the dimension of the yield data by extracting principal components (PCs). Our analysis shows that the first 10 PCs explain 99.6% of the joint variation in 35 yields across the five different countries in our sample. However, in contrast to a traditional PC analysis on yields for a specific single country, these PCs are difficult to interpret. Therefore, we construct a different set of 10 factors from our yield data. Specifically, we take the first two PCs constructed using yield data for each country separately. As shown in numerous studies, these first two PCs largely represent the level of yields (PC1) and the slope of the yield curve (PC2). Since there is a lot of commonality between the US PCs and their AP counterparts, our final set of yield variables uses the differences between the US PCs and the corresponding local ones, $\Delta PC1_{i,t}$ and $\Delta PC2_{i,t}$ for country i, in addition to the US PCs themselves, $PC1_{US,t}$ and $PC2_{US,t}$.

All in all, we have four US variables and six local variables that we will use to try to explain AP government bond yield dynamics. The US variables are US inflation (π_t), US IP growth (g_t), and the two yield PCs, $PC1_{US,t}$ and $PC2_{US,t}$. The local variables are (for country i) domestic inflation ($\hat{\pi}_{i,t}$), IP growth ($\hat{g}_{i,t}$), the two local PC differentials ($\Delta PC1_{i,t}$ and $\Delta PC2_{i,t}$), the nominal exchange rate depreciation rate ($\Delta s_{i,t}$), and the local credit factor ($\hat{c}_{i,t}$).

We model the joint dynamics of all these variables via a first-order vector autoregression, VAR(1). The VAR can provide some insights on whether local or global (US) factors are the main drivers of local bond yields, but it can also tell us something about the relative importance of macro variables vs financial variables for local yields. With four AP countries and the United States, we have a total of 27 variables (Singapore does not have a credit factor). This implies $27+27^2+27\bullet28/2 = 1134$ identified parameters that need to be estimated. This is a daunting challenge in any situation, which is further complicated by relatively short samples.

To overcome these challenges, we pool data from different countries. This approach imposes the constraint that the underlying structure is the same for each country. We make one exception, namely that US variables respond to US variables only, and their responses are allowed to be different from the responses of non-US variables to non-US variables of the same type.

4. Results

4.1 The dynamics of macro and yield variables

As a first step, we estimate a regression with fixed effects that correspond to the predictable component of our macro and yield variables. Table 2 displays the estimated coefficients of the VAR, with the above-mentioned restrictions imposed (we also use the Akaike information criterion (AIC) to select individual parameters that we can set to zero)). Our results show that the cross-country differential in the interest rate slope (PC2) predicts the depreciation rate, so uncovered interest parity (UIP) is violated but not via the traditional interest level differential channel (see related evidence in Bansal and Dahlquist (2000)). An increase in the US minus local yield slope implies a depreciation of the LC against the US dollar the next period. The LC also tends to depreciate if US economic activity (IP) falls.

The effects of the interest rate differential on the exchange rate are intuitive. To the extent that changes in yield slopes reflect changes in investors' perceptions of monetary policy, this suggests that LCs tend to depreciate against the dollar when the US monetary policy outlook becomes more hawkish, or when the local policy outlook turns more dovish. Of course, changes in term premia may also contribute to this result. We discuss risk premia considerations in the next section.

Macro and yield variable dynamics: panel VAR parameter estimates — Table 2

Variable	π_{t-1}	g_{t-1}	$PC1_{US,t-1}$	$PC2_{US,t-1}$	$\Delta s_{i,t-1}$	$\hat{\pi}_{i,t-1}$	$\hat{g}_{i,t-1}$	$\Delta PC1_{i,t-1}$	$\Delta PC2_{i,t-1}$	$\hat{c}_{i,t-1}$
π_t	0.488		0.318							
	(0.057)		(0.086)							
g_t	0.327	0.220								
	(0.102)	(0.062)								
$PC1_{US,t}$	0.009		0.987							
	(0.003)		(0.004)							
$PC2_{US,t}$		–0.007		0.994						
		(0.002)		(0.009)						
$\Delta s_{i,t}$		–0.486		–3.398	0.030			1.180	6.112	–1.098
		(0.122)		(2.125)	(0.035)			(0.974)	(2.549)	(1.616)
$\hat{\pi}_{i,t}$			0.588			0.081		–0.817		–0.921
			(0.170)			(0.035)		(0.223)		(0.355)
$\hat{g}_{i,t}$	0.724					–0.419	–0.361			
	(0.375)					(0.259)	(0.033)			
$\Delta PC1_{i,t}$		0.006				–0.007		0.949	–0.053	0.056
		(0.002)				(0.002)		(0.015)	(0.024)	(0.023)
$\Delta PC2_{i,t}$		–0.007	–0.042	0.101	–0.0005			–0.033	0.745	–0.078
		(0.001)	(0.008)	(0.020)	(0.0003)			(0.009)	(0.026)	(0.015)
$\hat{c}_{i,t}$	–0.004	–0.007	0.029		0.0024			–0.019	0.039	0.883
	(0.002)	(0.001)	(0.008)		(0.0003)			(0.009)	(0.019)	(0.015)

The table reports parameter estimates of the persistence matrix in the panel VAR with fixed effects for the state vector consisting of the variables listed in the table. Out of those, the US variables are autonomous. The reported coefficients are chosen by AIC. Figures in parentheses are standard errors.

The fact that the LC depreciates in response to increases in the credit risk reflects the Twin Cs. Further, the difference between US and AP interest rate levels affects the local inflation rate and the local credit factor, in addition to the US interest rate level. As for the remaining local macro variable, IP, the regression provides no evidence that either local or global yield factors matter. Instead, its own lag is important, but the serial correlation is negative, reflecting much higher variability in the production growth of EMEs as compared to the United States. US inflation also seems to matter, and enters marginally significantly for local IP growth.

With respect to drivers of local bond yields, our regression results suggest that AP yields are driven by both local and global macro and yield factors. Among local factors, domestic inflation enters significantly for the level, with higher inflation implying a higher interest rate level compared to that of the United States (thus resulting in a negative response of the US-local differential). Local yield factors naturally also play an important role: both local level and slope (in deviation from the US level and slope) matter for both variables.

Interestingly, the global/US yield level does not seem to influence the local level (beyond what is accounted for by the difference to the US level). However, it does play a significant role for the local slope differential. When the US yield level rises, or when the US slope falls, the difference between the US and the local slope falls. This suggests that local short-term yields rise when the US interest rate level rises, and that the local slope reacts less than one-to-one to changes in the US slope.

Another factor that enters significantly for local yield factors is the sovereign credit factor. As the credit risk goes up, the local interest rate level tends to fall relative to that of the United States, perhaps due to a monetary policy response. At the same time, the local yield curve tends to steepen (because long-term yields rise), reducing the difference between US and local slopes. Furthermore, the results show that a higher US interest rate level tends to raise the local credit risk. Hence, down the line there is an indirect effect from rising US interest rates to a steeper local yield curve via higher credit risk. An appreciating LC also raises the local credit risk, another manifestation of the Twin Cs.

Excess return regressions — Table 3

Variable	Maturities: 2 years	3 years	5 years	10 years
π_{t-1}	–0.226	–0.361	–0.626	–1.187
	(0.076)	(0.113)	(0.187)	(0.382)
g_{t-1}	0.173	0.263	0.433	0.815
	(0.044)	(0.065)	(0.107)	(0.218)
$PC1_{US,t-1}$	0.830	0.992	0.865	–0.589
	(0.308)	(0.457)	(0.753)	(1.541)
$\Delta PC1_{i,t-1}$	–1.216	–1.053	0.670	7.975
	(0.763)	(1.135)	(1.868)	(3.825)
$\Delta PC2_{i,t-1}$	–0.066	–0.109	–0.212	–0.585
	(0.052)	(0.077)	(0.126)	(0.258)
$\hat{c}_{i,t-1}$	–0.226	–0.361	–0.626	–1.187
	(0.076)	(0.113)	(0.187)	(0.382)

The table reports exposures of excess returns on AP LC bonds to the variables listed in the table, obtained through fixed-effects OLS regressions. We omit variables that do not result in significant parameter values in any of the columns. Figures in parentheses are standard errors.

4.2 Bond risk premia

In order to get a sense of determinants of the bond risk premiums, we run several regressions of bond excess returns on our set of macro and yield factors. We implement regressions with fixed effects for the same reasons as when we estimated the dynamics of the variables themselves.

We define LC excess returns on AP bonds as the log-price change earned from purchasing a bond and selling it one month later, less the one-month interest rate prevailing at the time of the bond purchase. In the regressions that we implement, we consider bonds of maturities ranging from two to 10 years. Table 3 reports the results. We see that the global factors play a big role. Both US macro variables are highly significant for local excess returns. Higher US inflation has a negative impact on excess returns, whereas higher US IP growth has the opposite effect. The US level factor is important for short-horizon excess returns, with a higher US level tending to lift such returns.

Among local variables, the yield level differential stands out as particularly important. A higher (lower) US-local yield differential implies lower (higher) excess returns across all maturities. In other words, when local yields rise more than US ones, this tends to result in higher excess returns. The yield slope differential has a similar effect on excess returns, although it is statistically significant only for long-maturity returns. Finally, higher local credit risk, as captured by the credit factor, raises excess returns significantly up to five years.

In principle, LC excess returns reflect not only compensation for the local interest rate risk, but currency and credit risks as well. To demonstrate this, we decompose our excess returns into a part that reflects the currency risk and another part that reflects credit risk. Specifically, by taking the difference between excess returns on LC bonds and USD bonds issued by the same country, we cancel out the sovereign credit risk and isolate the currency risk component. And by taking the difference between excess returns on an Asia-Pacific bond issued in USD and the corresponding excess return on US Treasuries, we are able to cancel out the currency risk component and isolate the credit risk. We then simply run regressions of these excess return differentials on our set of macro and yield variables to examine the determinants of the two bond risk premium components.

Excess return spread regressions

Panel A. Excess returns reflecting currency risk — Table 4

	Maturities			
Variable	2 years	3 years	5 years	10 years
π_{t-1}	–0.261	–0.436	–0.816	–1.514
	(0.096)	(0.142)	(0.238)	(0.496)
g_{t-1}	0.027	–0.050	–0.339	–1.377
	(0.055)	(0.082)	(0.137)	(0.285)
$PC1_{US,t-1}$	–2.638	–2.741	–0.440	12.365
	(1.006)	(1.489)	(2.492)	(5.195)
$\Delta s_{i,t-1}$	0.043	0.049	0.057	0.112
	(0.015)	(0.022)	(0.036)	(0.075)
$\Delta PC1_{i,t-1}$	–1.128	–2.039	–4.279	–10.368
	(0.407)	(0.602)	(1.008)	(2.101)
$\Delta PC2_{i,t-1}$	2.169	0.665	–6.199	–29.942
	(1.271)	(1.882)	(3.149)	(6.563)
$\hat{c}_{i,t-1}$	–0.635	–1.526	–5.224	–20.172
	(0.678)	(1.004)	(1.680)	(3.502)

Panel B. Excess returns reflecting credit risk

	Maturities			
Variable	2 years	3 years	5 years	10 years
g_{t-1}	–0.249	–0.402	–0.662	–1.159
	(0.036)	(0.055)	(0.091)	(0.205)
$\Delta s_{i,t-1}$	0.060	0.082	0.122	0.222
	(0.010)	(0.015)	(0.025)	(0.055)
$\hat{g}_{i,t-1}$	–0.013	–0.022	–0.049	–0.137
	(0.010)	(0.015)	(0.025)	(0.057)
$\hat{c}_{i,t-1}$	–3.691	–5.051	–7.407	–13.954
	(0.339)	(0.515)	(0.859)	(1.933)

The table reports exposures of spreads of excess returns on AP LC bonds over USD bonds (Panel A) and of excess returns on US Treasury bonds over AP USD bonds (Panel B) to the variables listed in the table, obtained through fixed-effects OLS regressions. We omit variables that do not result in significant parameter values in any of the columns. Figures in parentheses are standard errors.

Table 4 reports the results. Panel A controls for credit risk and focuses on the currency risk, assuming no selective defaults. Not surprisingly, the depreciation rate is significant, although only for the shorter maturities. A depreciation of the LC tends to raise excess returns on short-term local bonds relative to US dollar-denominated bonds. The credit factor is significant at intermediate and long maturities, driving up US dollar excess returns more than local returns, reflecting the Twin Cs. US inflation is significant across the board as well, consistent with evidence on US bond risk premiums.

As for yield factors, Panel A also shows that both global and local yield variables matter for the excess return differentials. An increase in the US slope increases excess returns on dollar bonds, while it has little effect on local excess returns (see Table 3). The result is a decline in the difference between LC and USD excess returns. A similar effect is produced by increases in the level differential factor. This time, the effect is due to lower LC excess returns, in line with the results in Table 3. The same goes for the slope differential for the longest maturity.

Panel B controls for currency risk and focuses on the credit risk, which is what most studies on EMEs have concentrated on. As expected, the credit factor enters highly significantly. Higher credit risk raises excess returns on Asia-Pacific dollar bonds, resulting in a decline in the return difference between Treasuries and Asia-Pacific bonds. The depreciation rate also appears as a predictive variable, another manifestation of the Twin Cs. The cross-horizon average coefficient of 0.12 implies an increase in the credit risk premium component of at least 8 basis points for a one-standard-deviation increase in the depreciation rate (decrease in LC value). A depreciating LC lowers the expected return on dollar bonds, perhaps reflecting shifts by investors from LC to USD bonds.

There are other significant variables here as well. We see an important role for US IP. The fact that higher US IP implies higher risk premia on Asia-Pacific bonds may reflect compensation for a greater risk of a policy response in the form of rising US interest rates.

4.3 Variance decomposition analysis

Finally, we would like to be able to quantify the contribution of the various factors in explaining the overall variation in the variables of interest. To this end, we implement a variance decomposition analysis, which allows us to measure the percentage contribution of a shock to a particular variable to the variation in some other variable.[4] As is usually the case, the variance decomposition could be sensitive to the ordering of variables. Therefore, instead of focusing on the impact of individual variables, we distinguish between the US and local variables only. We stack the odds in favour of the US variables by ordering them first.

The first part of Table 5, labelled "factors", displays the results. We find that a lot of variables are primarily impacted by the local shocks: output growth in all countries, inflation in Indonesia and Korea, and the difference between the interest rate levels everywhere except for Singapore. For the Twin Cs, credit is impacted more by local variables across all countries. This conclusion is in contrast to most existing studies on the determinants of sovereign credit spreads. Currencies, in general, are mostly driven by their own shocks, the other local shocks contribute more in Indonesia and Korea. The difference in term spread is the only variable that is primarily driven by the US variables (for Indonesia the impacts of local and US variables are similar).

[4] In order to implement the variance decomposition analysis, we first need to estimate the conditional covariance matrix. To handle the unbalanced panel data at our disposal, we therefore reestimate the VAR using MLE and the Kalman filter. This results in slightly different parameter estimates than those reported in Table 2. See the full paper for further details.

Next, we evaluate the impact of shocks on the variation on expected differences in excess returns that are reported in Table 3.[5] The second part of Table 5, labelled "risk premiums", displays the results. The currency risk premiums are primarily affected by the shocks to US factors with the exception of Indonesia. The conclusion is reversed for credit risk premiums. Interestingly, local factors dominate for credit risk premia. What does that mean for the Twin Cs? Out of the local variables, the currency premium is primarily affected by the difference in PC1 (interest rate level), consistent with UIP violations and, to a much larger degree, by the credit factor, despite being ordered to be last. The major US variable affecting the currency component is the term spread variable (PC2). The credit risk premium is, unsurprisingly, overwhelmingly driven by the credit factor itself.

Variance decompositions

Panel A. Factor variance decompositions — Table 5

	China		Indonesia		Korea		Singapore	
Factors	US	local	US	local	US	local	US	local
$\Delta s_{i,t}$	5.72	4.35	0.37	1.51	0.24	0.50	0.77	0.04
$\hat{\pi}_{i,t}$	4.08	2.88	2.12	12.13	7.89	14.43	4.28	1.19
$\hat{g}_{i,t}$	5.45	39.22	0.54	10.75	0.97	13.90	0.14	1.42
$\Delta PC1_{i,t-1}$	21.77	25.88	2.58	16.45	11.33	43.69	34.26	5.11
$\Delta PC2_{i,t-1}$	66.32	11.83	32.81	34.95	57.81	31.02	79.95	2.18
$\hat{c}_{i,t-1}$	2.53	4.66	0.45	10.65	0.83	8.71	-	-

Panel B. Excess return variance decompositions

Type /	China		Indonesia		Korea		Singapore	
maturity	US	local	US	local	US	local	US	local
Currency								
2-year	82.84	17.16	42.14	57.86	65.90	34.10	89.85	10.15
3-year	72.96	27.04	28.90	71.10	49.74	50.26	88.73	11.27
5-year	79.57	20.43	42.29	57.71	59.05	40.95	96.56	3.44
10-year	77.49	22.51	40.95	59.05	56.35	43.65	97.59	2.41
Credit								
2-year	20.09	79.91	4.42	95.58	7.91	92.09	-	-
3-year	21.22	78.78	4.72	95.28	8.43	91.57	-	-
5-year	22.30	77.70	5.01	94.99	8.93	91.07	-	-
10-year	21.80	78.20	4.87	95.13	8.70	91.30	-	-

The table reports contributions, in per cent, of shocks to the state variables to the unconditional variance of the state variables themselves or to the currency and credit components of bond risk premiums corresponding to Table 3. Our factor order is such that US variables are given a first chance to explain the relevant variation with a residual attributed to the local factors. We report cumulative contribution of US vs local variables and do not distinguish between the shocks to individual elements of the state vector. Because many of the state variables are persistent, we exclude the impact of its own shock on a variable in Panel A. As a result, the US and local columns do not add up to 100.

[5] The excess returns can be written as combinations of the state variables in the VAR, allowing us to obtain variance decompositions of excess returns.

5. Conclusions

We study the interaction between the credit and currency risks, the Twin Cs, reflected in LC bonds issued by sovereigns in AP. Our particular focus is on the impact of local vs US variables on the dynamics of these risks and their risk premiums. We adopt a panel VAR with a fixed effects approach to address relatively short samples available, political and economic differences between the countries, and parameter proliferation. We document an important role of local variables in driving the Twin Cs.

We find that local variables play a significant role in both factor dynamics and risk premiums. Although there is a natural separation between macro and yield-based variables, depreciation rates and credit spreads are affected by both types of variables. In particular, past declines in the value of the local currency is highly significant in predicting increased credit spreads (the Twin Cs effect). Bond risk premiums due to currency risk are affected, in particular, by depreciation rates at short horizons and by credit spreads at long horizons. Bond premiums due to credit risk are affected by both variables at all horizons.

Variance decompositions reveal that time-series variation in credit and currency risks is primarily affected by local variables. The credit risk premium is mostly affected by the (local) credit factor. The currency risk premium, meanwhile, is affected by the credit factor as well as by the interest rate differential.

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Comments on "Determinants of Asia-Pacific government bond yields"

By Min Wei[1]

1. Summary of the paper

This paper studies how global and local factors drive local currency (LC) sovereign yields in four Asia-Pacific (AP) countries – China, Korea, Singapore and Indonesia – through the lens of a cross-country term structure model. The analysis distinguishes between the currency risk component of the yields, measured as spreads of LC AP yields over US dollar-denominated AP yields, and the credit risk component, measured as spreads of US dollar-denominated AP yields over US Treasury yields.

The authors (Chernov, Creal and Hördahl) proceed in two steps. First, they examine the dynamics of a large observable state vector that includes four US factors – two macro factors and two yield curve factors; and six local factors for each AP country – currency depreciation, two macro factors, the divergence of two local yield factors from the US counterparts and a credit risk factor. US factors are assumed to be autonomous and their dynamics are estimated using a standard vector autoregression (VAR). The local factors are assumed to depend on both their own lags and the lagged US factors in a fashion that is identical across countries (except for the drift) and their dynamics are estimated using panel regressions with fixed country effects.

Next, the authors incorporate insights from the panel regressions into an unspanned macro term structure model, in which US yields are driven by the US factors only, local yields are driven by both US factors and each country's local factors, and the macro factors are not completely spanned by yields. The estimated model suggests that currency risk components are mostly driven by US shocks, while credit risk premiums are mostly driven by local shocks.

This paper is a useful contribution to emerging market economy (EME) bond pricing literature, which often focuses on credit risks but largely ignores the currency risk dimension of those bonds.

2. Market integration and liquidity differences

The separation between currency and credit risk premiums relies on the accuracy of the proxies used to measure those risk premiums. If the various bond markets are segmented, such that different investor clienteles hold LC versus US dollar-denominated AP bonds, the differences between LC and US dollar-denominated AP yields may reflect factors other than currency risks. Relatedly, any liquidity differences

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among the LC AP bond market, the US dollar-denominated AP bond market and the US Treasury market would contaminate the risk measures.

No US dollar-denominated local bonds are available for China and Indonesia, and the authors construct synthetic US dollar-denominated yields by adding sovereign credit default swap (CDS) spreads to LC yields. They verify that for Korea, this approach replicates the observed US dollar-denominated Korean bond yields accurately. However, the CDS markets for China and Indonesia may not be as developed, as integrated with the bond markets or as liquid as in Korea. In addition, the assumption that a common pricing kernel prices both LC currency yields and CDSs may be especially problematic for China, as it faces severe restrictions on capital movement.

3. Comments on the VAR analysis

The authors may want to test the robustness of their results against alternative macro variables. For example, the unemployment rate may be a better measure of the cyclical position of the economy than industrial production (IP) growth. Bauer and Rudebusch (2017) also show that level indicators, such as the unemployment rate, have higher explanatory power in simple monetary policy rules than growth indicators such as IP growth, and are better spanned by bond yields. Another consideration is that monthly consumer price index (CPI) inflation and IP growth rates might be too noisy. Switching to annual variables and including more lags may help increase the information content of these variables.

The panel regression assumes that the dynamics of the state variables is the same across AP countries. It would be helpful to know by how much the data support this restriction. For example, the authors could run pairwise VARs and test whether the coefficients are statistically different.

In addition, it will be interesting to see whether China provides another anchor to the other AP countries in addition to the United States. Table 1 shows pairwise correlations across countries for the macro and yield factors. For AP countries other than China, the local yield factors appear highly correlated with the US yield factors; however, the local macro variables appear more closely correlated with those from China than those from the United States. The correlations between China and the United States appear weak for all variables.

Cross-country correlations — Table 1

Yield level	US	China	Singapore	Korea
China	–0.15			
Singapore	0.94	–0.18		
Korea	0.66	–0.08	0.49	
Indonesia	0.64	–0.31	0.67	0.63

Inflation	US	China	Singapore	Korea
China	–0.13			
Singapore	–0.14	0.35		
Korea	–0.11	0.18	0.75	
Indonesia	–0.18	0.13	0.61	0.60

Yield slope	US	China	Singapore	Korea
China	0.21			
Singapore	0.90	0.13		
Korea	0.65	0.51	0.44	
Indonesia	0.48	0.56	0.45	0.37

IP growth	US	China	Singapore	Korea
China	0.07			
Singapore	0.18	0.24		
Korea	–0.05	0.23	0.17	
Indonesia	0.10	0.04	0.07	0.05

Finally, some VAR parameter estimates reported in Table 3 of the paper are a bit puzzling and may merit further examinations. For example, in the US block, the yield level and slope factors have no predictive power for future IP growth, inconsistent with previous literature documenting the predictive power of the yield curve for future economic growth. The interest rate level predicts future inflation with a positive sign, contradicting the notion that higher yields are disinflationary. In the exchange rate equation, LC appears to appreciate following an increase in local credit risk, while the US dollar appears to depreciate following stronger US growth, both of which are somewhat counterintuitive.

4. Comments on the term structure model

The large size of the state vector would give rise to a huge number of term structure parameters to be estimated if no restrictions are imposed. To reduce the dimensionality, the authors adopts the framework of unspanned macro risks proposed by Joslin, Priebsch and Zhu (2014). In particular, it's assumed that macro variables affect yield curve factors under the physical measure but not under the risk-neutral measure. This assumption implies that the effects of macro variables on expected future short rates and on term premiums exactly offset, and macro variables have no additional explanatory power for current yields beyond the yield factors.

To examine whether empirical evidence supports this restriction, Table 2 reports adjusted R^2 from predictive regressions of one-year ahead Korean yields and excess returns on various combinations of yield principal component (PC) factors and macro factors (either monthly or annual). Local macro factors appear to have additional predictive power when added to either local PCs or all PCs, and therefore satisfy the unspinning condition. By contrast, US macro variables, currency depreciation and credit factors do not appear important for predicting future local yields, as including those variables in the last two rows generally leaves the R^2 little changed from that using US and local yield PCs and local macro variables only. It is also worth noting that annual macro variables appear to be more informative about future yields and returns than monthly variables, likely due to a higher signal-to-noise ratio.

Redictive one-year ahead yields and excess bond returns (adjusted R^2)

(10-year Korea local currency bond) Table 2

	Monthly macro (208 obs.)		Annual macro (197 obs.)	
	Yield	Excess return	Yield	Excess return
US PC	73%	25%	68%	27%
Local PC	77%	36%	76%	29%
All PC	81%	47%	80%	43%
Local PC + local macro	77%	38%	78%	33%
All PC + local macro	81%	47%	86%	57%
All PC + all macro	82%	48%	86%	59%
All variables	83%	52%	86%	58%

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Measuring corporate bond liquidity in emerging market economies: price- vs quantity-based measures

By Allaudeen Hameed†, Jean Helwege‡, Ran Li§ and Frank Packer**

Abstract

Prior research suggests that corporate bond issuance in emerging market economies increases when the markets exhibit substantial liquidity. While the Malaysian corporate bond market has grown dramatically over the last few decades, having now become one of the largest among emerging market economies, its liquidity has not progressed at a similar pace. Illiquidity may hamper access to local currency debt financing, so its measurement is an important topic for regulators and issuers. We investigate the liquidity of corporate bonds in Malaysia and find that quantity-based measures of liquidity appear more reliable than price-based measures. Low liquidity appears to characterise both conventional and Islamic corporate bonds in Malaysia.

JEL classification: G12, G20, G15JEL classification: G12, G20, G15

Keywords: corporate bonds, bond liquidity, Islamic and conventional bonds, Malaysia

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1. Introduction

Nearly two decades ago, in the wake of the Asian financial crisis, then Federal Reserve Chairman Greenspan (1999) suggested that by fostering local currency bond markets, governments could develop an alternative to domestic bank lending that would make their financial systems more resilient to external shocks. Many other prominent economists drew similar conclusions, focusing on the related risks of external, foreign currency-denominated debt. Feldstein (1999) noted that banks, companies and governments in emerging market economies (EMEs) often borrow in foreign currency and risk a currency crisis. Kaminsky and Reinhart (2000) cite statistics for Thailand, Indonesia, Korea, Malaysia and the Philippines showing that prior to the Asian financial crisis, a reliance on Japanese bank loans left them exposed to credit outflows once the banks started calling in loans. Since then, the development of the corporate bond market has been continuously emphasised as a policy priority in Asia (eg Asia Development Bank (2015) and the Bank for International Settlements (2006, 2012 and 2016)).

Consistent with these priorities, the size of local currency corporate bond markets has increased in Asia and the Pacific over the past two decades, and not least in the Federation of Malaysia. Corporate bonds outstanding as a proportion of GDP in Malaysia has increased steadily. After rising from 31.7% in 2005 to 37.7% in 2010, corporate bond debt to GDP subsequently grew to 43.8% in 2015. This percentage puts it at second among countries in Asia after Korea, and fairly close to the United States' percentage of 46% (BIS (2016)). As a percent of GDP, the Malaysian corporate bond market is among the largest local currency bond markets among EMEs. The growth of bonds outstanding is documented in Graph 1, which shows the stock of the total amount outstanding has grown to around 560 billion Malaysian ringgit from around 220 billion in 2008, with Islamic bonds growing the most.[1]

Nonetheless, Malaysia's corporate bond market is not large on an absolute basis, certainly not when compared to the markets of much larger economies such as China, Japan and Korea. One possible reason for the smaller size of its corporate bond market, besides the size of its economy, is low liquidity in this market. BIS (2012) provides evidence that Malaysia and other countries involved in the Asian Bond Fund Initiative 2 actively sought to improve the liquidity of their local currency bond markets as a way to promote these markets. Their evidence, however, suggests much greater progress towards increasing the liquidity of the government rather than the corporate bond market, a conclusion that was later reached in a follow-up study of corporate bond market development in Asia (BIS (2016)).

Evidence that corporate bond liquidity in Malaysia has been quite low can be seen in Graph 2, which shows the trend for one measure of liquidity: turnover (the amount of trading volume divided by the amount outstanding). While we will analyse the characteristics of this metric in more detail later at the individual bond level, in aggregate it gives a rough indication of the overall level of liquidity in a market and its trend over time. In Graph 2, we chart this aggregate measure (on a 12-month moving average basis) for both conventional and Islamic bonds. The graph indicates

[1] The above numbers are nominal. In real terms, the Conventional (Islamic) corporate bond market amounts outstanding grew by 29% (145%) between January 2008 and August 2017, and the combined amounts grew by 99% over the same period.

that the liquidity of both conventional and Islamic bonds has declined considerably since around 2006, and turnover has essentially been flat since 2010.

It is possible for a market to have low turnover but still be efficient and have fairly low transaction costs. Thus, the fact that corporate bond trading is sparse in an EME may not pose a high hurdle to the success of that market. In particular, bonds may not trade often but still be liquid in the sense that trades do not exhibit much price impact. Thus, in addition to considering the trading activity of the Malaysian corporate bond market, we also examine price-based measures of liquidity that may indicate greater liquidity.

In this paper, we examine the liquidity of the Malaysian corporate bond market, which we view as informative of large local currency bond markets in EMEs. Our emphasis is on measures of liquidity that are commonly used to describe the ease of transactions in corporate bond markets. Our data are from the Electronic Trading Platform (ETP), which was set up by the government of Malaysia as part of its efforts to improve corporate bond liquidity. The attributes of this database are similar to the US TRACE system.[2] This transaction database of Malaysian corporate bond trades allows us to address fundamental questions about liquidity in EMEs.

Our analysis focuses on measures of liquidity that are constructed with data on the quantity of trading activity or with data on transaction prices. The price-based measures are meant to capture the potential for swings in prices that result from upward or downward price pressure arising from trading activity. Hotchkiss and Jostova (2017) show that issue size and age are by far the two most important determinants of liquidity for US corporate bonds. In general, larger bonds are more liquid because they have more investors and lower inventory costs. Bonds become less liquid as they age because less active portfolios (belonging to so-called buy and hold investors) absorb progressively more of the issue. We relate the quantity- and price-based measures of liquidity to age and size to determine which measures are the most reliable indicators of corporate bond liquidity in the emerging market of this study.

We find that all quantity-based measures of liquidity indicate that the Malaysian corporate bond market is illiquid. Most bonds do not trade more than a few times a year, which is significantly below the infrequent trading observed in the US corporate bond market. This leads to very unreliable price-based measures of liquidity, as few bonds have the minimum number of bonds required to calculate price-based measures. The price-based measures as a group are positively correlated with each other, but negatively correlated with metrics based on the quantity of trading activity. We interpret this result as evidence that quantity-based measures of liquidity are likely to be more reliable indicators for EME corporate bonds.

The rest of this paper is organised as follows. In the next section, we review the different measures of liquidity. Section 3 describes the data used. In Section 4, we present the main results from the empirical analysis. Finally, Section 5 concludes and presents some policy implications.

2 For a description of TRACE and its impact on US corporate bond liquidity, see Goldstein, Hotchkiss and Sirri (2007), Edwards, Harris and Piwowar (2007), Bessembinder, Maxwell and Venkataraman (2006) and Hotchkiss and Jostova (2017).

2. Quantity- vs price-based measures of liquidity

The literature on corporate bonds often measures liquidity by two types of measures: those related to trading activity and those that require corporate bond prices to calculate.[3] The quantity-based measures represent the average trading activity in a bond and gauge the intensity of trading in the bond. The higher the trading intensity the higher the liquidity of the bond. The price-based measures aim to capture the price impact and transaction cost dimensions of liquidity. Bonds that have low transactions costs are considered more liquid than other bonds. Bonds with a large price impact present a risk to bond dealers, which in turn leads to high transaction costs. Commonly used measures based on prices include the Amihud (2002) measure of illiquidity, the Roll (1984) measure of serial covariance of prices, and Lambda (Dick-Nielsen, Feldhutter and Lando (2012)).

In order to calculate price-based measures of liquidity, at least two prices are required. If the two prices are from transactions that occurred at two very different times, the return or dispersion that is calculated may reflect changes in the creditworthiness of an issuer rather than the liquidity of the bond. This factor that can distort price-based measures of liquidity is present even in US corporate bonds, which are more liquid than Malaysian corporate bonds. Thus, many measures of liquidity commonly used in the evaluation of liquidity for US stocks cannot be not reliably calculated in the case of corporate bonds. The price-based measures examined in this paper are: (i) the ratio of absolute returns and trading volume, or the Amihud price impact measure; (ii) the volume-weighted variance of traded bond price relative to the volume-weighted average price of the bond, or price dispersion, (iii) the spread in the monthly high and low traded bond prices as a percentage of the average of the two prices; (iv) the same dispersion measure, but calculated daily; and (v) the average realised bid-ask spread.

The quantity-based measures examined in this paper are: (i) the number of trades in a bond per year; (ii) the number of days a bond traded during the year; (iii) the trading for the bond divided by the outstanding amount of the bond, or turnover; (iv) the percentage of days with zero trading or zero returns during the year (the negative, or multiplied by –1), a close relative of the measure suggested by Lesmond, Ogden and Trzcinka (1999);[4] and (v) the average number of days since the last trade on the bond, also multiplied by –1.

3 See Helwege and Wang (2018), Han and Zhou (2016), Helwege, Huang and Wang (2014), Houweling, Mentink, and Vorst (2005) and Schestag, Schuster and Uhrig-Homburg (2016) for studies that use these variables.

4 Corporate bond studies that use these measures of corporate bond liquidity include Alexander, Edwards, and Ferri (2000), Bao Pan and Wang (2011), Bessembinder, Maxwell and Venkataraman (2006), Chakravarty and Sarkar (2003), Chen, Lesmond and Wei (2007), Crabbe and Turner (1995), DeJong and Driessen (2012), Dick-Nielsen, Feldhutter and Lando (2012), Edwards, Harris and Piwowar (2007), Ericsson and Renault (2006), Feldhutter (2012), Friewald, Jankowitsch and Subrhmanyam (2012), Goldstein and Hotchkiss (2007), Goldstein, Hotchkiss and Sirri (2007), Han and Zhou (2016), Helwege, Huang and Wang (2014), Hong and Warga (2000), Hotchkiss and Jostova (2017), Houweling, Mentick and Vorst (2005), Jacoby, Theocharides and Zheng (2009), Kozhanov and Ogden (2012), Lin, Wang and Wu (2011), Mahanti, Nashikkar, Subrahmanyam, Chacko and Mallik (2008), Nashikkar, Subrahmanyam and Mahanti (2011), Newman and Rierson (2004), O'Hara, Wang and Zhou (2015), Perraudin and Taylor (2003) Rossi (2014), and Schestag, Schuster and Uhrig-Homburg (2016).

3. ETP database

The main data at our disposal are transaction data from the Bursa Malaysia's ETP, which was launched in 1997 as the Bond Information and Dissemination System under the aegis of the Central Bank of Malaysia. Later, in 2008, responsibility for managing and maintaining the platform was transferred to the Bursa Malaysia. Similar to TRACE in the United States, financial institutions (members) are required to report all transactions in the ringgit corporate bond market in Malaysia. We analyse ETP data from 1997 to 2017.

The strengths of this database are manifold. Not only is it, in principle, a comprehensive database that covers all transactions, but it includes the exact amount transacted for all deals. That is, there is no truncation of the ringgit value in cases of very large trades. Between 1997 and mid-2017, there were more than 375,840 transactions in 12,888 securities. The dataset includes numerous details about each transaction, including trade date and time, the face value of the trade, price and counterparty.

There are some limitations to the data set. Bid and offer quotes are not available, as only transaction prices are reported. Thus, while post-trade transparency is, in theory, ensured by ETP, pre-trade transparency is limited, and it does not allow for the estimation of effective spreads.

In addition to an issuer code and name, the ETP reports bond issue, maturity date, the type of instrument (asset-backed securities vs medium-term notes, loan notes, bonds etc), and whether the instrument is Islamic or conventional. The issue amount, the coupon, and the ratings on the instruments from each of Malaysia's two largest rating agencies, MARC and RAM, are recorded as well. Information about the trade itself includes the trade date and time, the time of the valuation of the bond, the nominal amount, effective price, proceeds of the trade and the estimated yield to maturity.

Buyer and seller information are also available to an extent. The ETP includes an identification code for each, which, while it does not allow an identification of the name of the seller or buyer, allows us to determine cases when the buyer and seller is the same across different trades. Buyer and seller organisation type are also provided, indicating whether the trades involve commercial banks, finance company, investment banks or other investors.

Like the TRACE database, the ETP transaction data must be cleaned (eg Dick-Neilsen (2014)). In some cases, there are negative or zero yields, which we delete from our sample. Only transactions involving bonds are included and any fixed income instrument that is not a bond is deleted (ie if the instrument has a maturity of one year or less, it is not included). Cross-trades are also excluded (ie transactions where dealer A sells a bond to dealer B, and then buys the same bond from dealer B at the same price within a few minutes).

4. Efficacy of liquidity measures

4.1 Summary statistics

We start by generating two sets of bond liquidity measures: quantity- and price-based. The quantity-based measures represent the average trading activity of a bond in a year. Given the low trading activity in Malaysian corporate bonds, all bond-specific liquidity measures are computed on an annual basis. In each year, we generate the five quantity-based measures of liquidity, as reported in Section 2 above: (i) the number of trades per year for bond *i* in year *y*, denoted *TradeNo*; (ii) the number of days bond *i* traded during year *y*, *TradeDay*; (iii) trading volume for bond *i* in year *y* divided by the outstanding amount of the bond, *Turnover*; (iv) the percentage of days with zero trading or zero returns during year *y* for bond *i* multiplied by –1, *NegZTD*; and (v) the average number of days since the last trade on bond *i* in year *y* multiplied by –1, *NegTradeInt*. The first three proxies are increasing in bond liquidity. Since the percentage of zero trading (*NegZTD*) and the interval between trades (*NegTradeInt*) reflect illiquidity, these two measures are multiplied by –1 so that all five measures are positively related to liquidity. Finally, we compute an aggregate of all five quantity-based liquidity measures. Each year, all bonds are ranked from highest to lowest based on each liquidity measure and the average rank across all five measures represents the composite quantity-based measure of liquidity for each bond, and is labelled *QtyLiq*.

We also construct five proxies for price-based liquidity measures for each bond-year as described in Section 2: (i) the Amihud price impact measure for bond *i* in year *y* defined as the average ratio of absolute bond return and trading volume, *NegAmihud*; (ii) the volume-weighted variance of traded bond price relative to the volume-weighted average price of bond *i* in year *y*, *NegPriceDisp;* (iii) the spread in the monthly (daily) high and low traded bond prices during the year (month), as a percentage of the average of the two prices, *NegSpdMth* (*NegSpdDay*); and (iv) the average realised bid-ask spread inferred from dealer trades, *NegRSpd*. We multiply each of these five proxies by –1 to convert them to be positively related to liquidity. Similar to the quantity-based liquidity index, we also construct the average rank of bond *i* in year *y* across all five price-based liquidity measures to construct a composite measure, *PriceLiq*.

Table 1 presents the distribution of the liquidity measures for all corporate bonds traded on the Malaysian bond market during the sample period. The statistics for the quantity-based measures are presented in Panel A and the price-based measures in Panel B. The average number of bonds varies from 2,755 to 3,636 across the 12 liquidity proxies. The number of bonds with valid *NegSpdDay* observations is lowest because this measure requires that the bond be traded at least two times in one month during the sample period. As shown in Panel A, the distribution of the data reflects the sparsity of trading in the majority of bonds in the Malaysian market. The average *Turnover* of bonds is a low 0.5% per year, with the trading volume for the middle 50% of bonds lying between 0.2% and 0.6% of bonds outstanding. The *TradeDay* measure indicates that a typical (median) bond trades about 1.5 days a year, with the middle 50% of bonds trading between 0.8 days and 2.8 days per year. This is consistent with a low percentage of days during the year on which a bond trades, as indicated by *NegZTD* and *TradeNo*. The extremely low trading activity in these bonds is also reflected in the fact that the bonds do not trade for 97.6% of trading days in a year. The number of days between two trades in a year, *NegTradeInt*, averages to a large interval of 95 days. Hence, Panel A underscores that the Malaysian corporate bond market is characterised by infrequently traded bonds. The average index of the five quantity-based liquidity measures, *QtyLiq*, captures the cross-sectional variation in bond liquidity. Here we find that *QtyLiq* varies across bonds, ranging from 0.37 to 0.60 for the middle 50% of the bonds.

The distribution of the price-based liquidity measures is reported in Panel B of Table 1. The average spread in high and low monthly prices for a bond within a year, *NegSpdMth*, has a median value of 7.6%, ranging from 1.6% to 24.8% for the middle 50% of bonds. The high-low spread based on daily traded prices within a month (*NegSpdDay*) is lower, with a range of 1.4% and 10% for the middle 50% of the bonds. Similarly, the realised spread, *NegRSpd*, for a median bond is 4.2%. The mean values of these spread measures are much higher than their median, suggesting that the distribution is highly skewed. For example, the mean of *NegSpdDay* (*NegRSpd*) is 78 (433) times the median value. We observe a similar skewness in the measure of dispersion in traded bond prices, with more than one-half of the bonds exhibiting low price variance. The 75th (25th) percentile of *NegPriceDisp* is 0.003 (1.5), and the median is 0.028. Chen et al (2018), for example, report that the equivalent price dispersion measures for Malaysian sovereign bonds, which is a more liquid market, have medians of 0.043 and 0.019 for conventional and Islamic sovereign bonds, respectively. These figures suggest that the variation in the prices of the highly illiquid Malaysian corporate bond market appears to be much lower than what we would expect. This is our first indication that price-based liquidity measures may be problematic when the security is rarely traded. The standard deviation of the price-based liquidity proxies in Panel B are substantially higher than those for quantity-based measures in Panel A. While the price-based liquidity measures appear to have a wider distribution of values across bonds, we are interested to know if these measures pick up the cross-sectional differences in corporate bond liquidity. Hence, it is also important to compare the aggregated measures of liquidity across the five proxies, which are standardised based on relative ranks. The aggregate of the relative ranks of all five price-based liquidity measures, *PriceLiq*, ranges between 0.35 and 0.55 for the middle 50% of bonds, similar to *QtyLiq*.

4.2 Correlations among quantity- and price-based liquidity measures

We report the correlation among the different liquidity proxies in Table 2. Since all proxies are increasing in liquidity, we expect the variables to be positively correlated, if they uniformly measure bond liquidity. In Panel A, we present the correlations among the quantity-based liquidity proxies. The five quantity-based liquidity proxies are all positively correlated, with the Spearman rank correlations ranging from 0.24 to 0.99. For example, bond *Turnover* is higher for bonds that trade more often (*TradeDay*), and higher for bonds that have a shorter interval between trades (*NegTradeInt*), resulting in correlations of 0.24 and 0.42, respectively. The index of the five quantity-based liquidity proxies, *QtyLiq*, is highly correlated with each of the five components, with correlations ranging from 0.59 to 0.92.

The correlations among the five price-based liquidity measures are also positive, ranging from 0.07 to 0.75 as shown in Panel B of Table 2. However, these correlations are generally lower than those among the quantity-based measures. The dispersion in prices, *NegPriceDisp*, is higher for bonds that have higher high-low spreads in the transacted prices, *NegSpdMth*, or exhibit greater price impact, *NegAmihud*, with correlations of 0.76 and 0.41, respectively. These three proxies have positive, although lower magnitude, correlations with the realised spread measure, *NegRSpd*. The index of these price-based proxies, *PriceLiq*, is also positively correlated with the components, with correlation coefficients ranging from 0.36 to 0.85. Hence, within each type of liquidity proxy, the individual proxies are positively correlated.

Interestingly, we do not find evidence that the two classes of bond liquidity proxies are positively correlated with each other. In fact, as shown in Panel C of Table 2, the quantity- and price-based proxies are mostly negatively correlated. In other words, bonds that are more liquid based on the quantity of trading measures are less liquid based on the measures that rely on traded prices. For example, bonds with high dispersion in traded prices, *NegPriceDisp*, are illiquid based on the price measure but trade more often using any of the five quantity-based measures, with correlations ranging from –0.13 to –0.53. The correlation between *NegPriceDisp* and *QtyLiq* is –0.46. Similarly, the bonds with high spreads in monthly high and low prices, *NegSpdMth*, also trade more often, with a correlation of –0.57 with *QtyLiq*. The correlation between the composite indices of quantity- and price-based liquidity measures, *QtyLiq* and *PriceLiq*, is also negative at –0.46. One explanation for the negative relation is that bonds that do not trade often have less traded price observations and consequently fewer, and lower-quality price-based liquidity estimates. Recall that the median bond trades only 1.5 days and has zero returns in 98.6% of the days in the year. A low variation in traded prices or returns because of extreme non-trading makes it difficult to measure price impact (*NegAmihud*), dispersion in prices (*NegPriceDisp*) or proxies using high-low price spread (*NegSpdMth, NegSpdDay, NegRSpd*). Hence, the price-based measures of liquidity for a majority of these bonds are highly unreliable since these bonds are rarely traded.

4.3 Bond-level regressions

We investigate the efficacy of the quantity- and price-based liquidity measures in a multivariate regression setting. Specifically, we regress each of the bond level liquidity measures on the set of bond characteristics, which take the following form:

$$Liq_{i,y} = a + b1 * Size_{i,y} + b2 * Age_{i,y} + c * Remain\ maturity_{i,y} + \varepsilon_{i,y} \quad (1)$$

where *Liq* represents one of the 12 liquidity measures for bond *i* in year *y* (including the two composite indexes of the price- and quantity-based measures). The three independent variables in equation (1) correspond to the bond characteristics: *Size,* measured by the value of the bond outstanding in million Malaysian ringgit, *Age*, the number of years since the bond was first issued and *Remain maturity*, the number of years remaining till the bond matures. We hypothesise that bond liquidity, if correctly measured, should be increasing in *Size* and decreasing in *Age*. Helwege and Wang (2018), for example, show that larger bonds tend to be more liquid.

Long maturity bonds may be actively traded when recently issued (on-the-run bonds) and decline in liquidity as the bond gets older. This is consistent with the common observation that buy and hold investors buy the bonds as a long-term investment until maturity and do not trade in the interim period. However, bonds of varying maturity are issued and this can confound the effect of *Age* on bond liquidity. Consequently, we also control for the effect of *Remain maturity* of the bond in the regression. The key parameters of interest are *b1* and *b2*. If the liquidity proxies measure liquidity, we expect *b1* to be positive and *b2* to be negative. The panel regression model in (1) is estimated with and without year fixed effects (we report those without year fixed effects) and the robust standard errors are clustered by time to account for cross-sectional correlation of the residuals.

The estimates for equation (1) are reported in Table 3. In Panel A of Table 3, we present the regression results for the quantity-based liquidity measures. We find that bigger bonds are significantly positively related to liquidity for all the quantity-based liquidity measures, except for *Turnover*, which has the wrong sign. Bonds that are traded more often (high *TradeNo*, *TradeDay*), have a low percentage of days with zero returns or zero trades (*NegZTD*) or have a short interval between trades (*NegTradeInt*) tend to bigger bonds, consistent with these bonds being more liquid. The composite index of the five liquidity proxies, *QtyLiq*, is also positively related to *Size*. Consistent with being proxies of liquidity, all five quantity-based liquidity proxies and the composite of these proxies are significantly negatively related to *Age*. Controlling for the remaining maturity of the bonds, older bonds are less liquid according to all of the quantity-based liquidity proxies.

Panel B of Table 3 presents the estimates of equation (1) when we use the price-based liquidity proxies. The estimate of *b1* is significantly *negative* for three of the price-based liquidity proxies, *NegPriceDisp, NegSpdMth, NegRSpd*. The only exception is *NegAmihud*, which is positively related to *Size*. The composite index, *PriceLiq*, is significantly negatively related to *Size*. The negative relation between the price-based liquidity proxies is inconsistent with these proxies measuring liquidity of the bonds. This is not surprising given the negative correlation between the price- and quantity-based liquidity proxies we observed in Table 3. Moreover, the relation between *Age* and liquidity is also generally of the wrong sign, as older bonds appear to be more liquid in these regressions. Bonds with low dispersion in traded prices (*NegPriceDisp*) and low spread between their monthly high and low traded prices during the year (eg *NegSpdMth*) are more likely to be bonds that do not trade often and hence are more illiquid rather than liquid. *PriceLiq* is significantly lower for bigger bonds and significantly higher for older bonds, inconsistent with *PriceLiq* being a reliable proxy for bond liquidity.

Table 3 also reports the regression R-squares for each of the liquidity proxies. We find that the goodness of fit for the quantity-based proxies is above that found for the price-based proxies. For example, across the five quantity-based proxies in Panel A, the regression R-square ranges from 7.7% (*Turnover*) to 26.6% (*TradeDay*). The regression R-squares are uniformly higher than those for the price-based proxies, which range from 0.5% (*NegRSpd*) to 6.6% (*NegPriceDisp*). Additionally, the *QtyLiq* regression R-square is higher at 23.9% compared to 14.9% for *PriceLiq*. Taken together, the results in Table 3 confirm that the quantity-based proxies for liquidity in the Malaysian corporate bond market measure liquidity reliably while the price-based proxies do not.

An interesting feature of the Malaysian bond market is that there are two types of bonds traded in the market: Islamic and conventional. As a robustness check, we investigate the relation in equation (1) separately for each type of bond. Table 4 reports the results for Islamic bonds and Table 5 for conventional bonds. Our major findings are almost identical across these two types of bonds. In Panel A of Tables 4 and 5, we find that all quantity-based proxies of liquidity are significantly positively related to *Size* (with the exception of *Turnover*) and significantly negatively related to *Age*. Panels B of Tables 4 and 5, on the other hand, show that the price-based liquidity has the wrong sign for the key parameters of interest: *b1* and *b2* in equation (1).

The efficacy of the quantity-based liquidity proxies in the Malaysian corporate bond market is substantially higher than that of the price-based liquidity proxies. Moreover, the quantity-based liquidity proxies capture liquidity differences among Malaysian corporate bonds equally well for both Islamic as well as conventional bonds. By contrast, price-based liquidity proxies do not measure bond liquidity differences well in either market.

5. Conclusion

We investigate the liquidity of the Malaysian ringgit corporate bond market using data from a trade reporting system that is similar to the TRACE system in the United States. This market is far less liquid than the US market, which itself is considered to be illiquid. Liquidity can be proxied by issue size or age, which are easily obtained measures that do not require a bond transaction database. We estimate various quantity- and price-based measures of liquidity using the data from the reporting system and we relate these to bond size and age. Correlation and regression analysis suggests that quantity-based measures do a better job in capturing bond liquidity differences than price-based measures. These results hold for both Islamic and conventional bonds. Our analysis of liquidity measures will help regulators to focus on the right metrics when evaluating changes over time as they attempt to improve the liquidity of their local currency bond markets.

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Tables

Summary statistics

Table 1

Variable	# of bonds	Mean	Std	p25	p50	p75
Panel A: Quantity-based liquidity measures						
Turnover	3634	0.005	0.019	0.002	0.004	0.006
TradeNo	3636	0.070	0.353	0.020	0.035	0.067
NegZTD	3636	−0.976	0.034	−0.992	−0.986	−0.974
TradeDay	3636	2.571	3.630	0.815	1.489	2.846
NegTradeInt	3276	−95.430	146.140	−112.186	−54.638	−22.406
QtyLiq	3276	0.489	0.168	0.369	0.473	0.595
Panel B: Price-based liquidity measures						
NegAmihud	3636	−8610.985	51280.266	−2840.015	−858.862	−48.779
NegPriceDisp	3636	−2.956	7.458	−1.500	−0.028	−0.003
NegSpdMth	3094	−0.527	4.314	−0.248	−0.076	−0.016
NegSpdDay	2768	−2.728	20.005	−0.103	−0.035	−0.014
NegRSpd	3460	−18.193	371.392	−0.456	−0.042	0.000
PriceLiq	2755	0.450	0.144	0.353	0.448	0.546

Summary statistics

Table 2

Panel A: Correlation of Quantity-Based Liquidity Measures

	Turnover	TradeNo	NegZTD	TradeDay	NegTradeInt	QtyLiq
Turnover	1.000	0.368	0.235	0.239	0.420	0.593
TradeNo		1.000	0.831	0.837	0.562	0.923
NegZTD			1.000	0.993	0.435	0.875
TradeDay				1.000	0.445	0.881
NegTradeInt					1.000	0.700
QtyLiq						1.000

Panel B: Correlation of price-based liquidity measures

	Neg Amihud	Neg PriceDisp	Neg SpdMth	Neg SpdDay	NegRSpd	PriceLiq
NegAmihud	1.000	0.407	0.179	0.069	0.121	0.357
NegPriceDisp		1.000	0.756	0.637	0.274	0.816
NegSpdMth			1.000	0.732	0.283	0.850
NegSpdDay				1.000	0.325	0.799
NegRSpd					1.000	0.522
PriceLiq						1.000

Panel C: Correlation of quantity- vs price-based liquidity measures

	Neg Amihud	Neg PriceDisp	Neg SpdMth	Neg SpdDay	NegRSpd	PriceLiq
Turnover	0.242	–0.130	–0.214	–0.226	0.024	–0.194
TradeNo	–0.119	–0.481	–0.570	–0.387	–0.191	–0.502
NegZTD	–0.282	–0.529	–0.576	–0.331	–0.230	–0.508
TradeDay	–0.280	–0.531	–0.569	–0.331	–0.227	–0.502
NegTradeInt	0.300	–0.283	–0.423	–0.340	–0.030	–0.410
QtyLiq	0.054	–0.462	–0.572	–0.396	–0.169	–0.455

Regression: All bonds

Table 3

Panel A: Quantity-based liquidity measures

Variables	Turnover	TradeNo	NegZTD	TradeDay	NegTradeInt	QtyLiq
Size[1]	–1.35e-06***	0.000182***	6.07e-05***	0.00657***	0.0854***	0.000215***
	(3.05e-07)	(2.18e-05)	(5.08e-06)	(0.000537)	(0.00770)	(8.30e-06)
Age2	–0.000513***	–0.00782***	–0.00112***	–0.135***	–20.12***	–0.0265***
	(3.45e-05)	(0.00114)	(0.000311)	(0.0338)	(1.073)	(0.00159)
Remain maturity[2]	–3.16e-05*	0.000631	0.000269	0.0254	–0.272*	0.000196
	(1.82e-05)	(0.000544)	(0.000160)	(0.0161)	(0.154)	(0.000371)
Constant	0.00449***	0.0144***	–0.996***	0.390***	–35.87	0.445***
	(0.000742)	(0.00221)	(0.00116)	(0.118)	(22.01)	(0.0123)
Observations	8,772	8,774	8,774	8,774	8,128	8,128
R-squared	0.077	0.218	0.254	0.266	0.131	0.239

Panel B: Price-based liquidity measures

Variables	Neg Amihud	Neg PriceDisp	Neg SpdMth	Neg SpdDay	NegRSpd	PriceLiq
Size[1]	–18.90***	–0.00120***	–8.82e-06*	2.85e-06	–0.000487*	–0.000105***
	(3.454)	(0.000332)	(4.45e-06)	(2.31e-06)	(0.000279)	(9.20e-06)
Age[2]	–901.6	0.770***	0.000603*	0.00471***	0.0274	0.0101***
	(551.3)	(0.0876)	(0.000342)	(0.00135)	(0.0200)	(0.00181)
Remain maturity[2]	–1,193***	–0.0416*	–8.04e-05	0.000285**	0.00251	–0.00432***
	(208.0)	(0.0207)	(9.51e-05)	(0.000131)	(0.00631)	(0.000552)
Constant	1,848***	0.0151	–0.00499	–2.001***	–0.0827	0.594***
	(185.8)	(0.0602)	(0.00339)	(0.000407)	(0.0673)	(0.0284)
Observations	8,774	8,774	7,649	6,784	8,321	6,756
R-squared	0.044	0.066	0.007	0.035	0.005	0.149

Robust standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

[1] In millions

[2] In years.

Regression: Conventional bonds

Table 4

Panel A: Quantity-based liquidity measures

Variables	Turnover	TradeNo	NegZTD	TradeDay	NegTradeInt	QtyLiq
Size[1]	–3.64e-07	0.000215***	6.81e-05***	0.00740***	0.0655***	0.000186***
	(5.28e-07)	(3.75e-05)	(7.86e-06)	(0.000801)	(0.00547)	(1.03e-05)
Age2	–0.000564***	–0.0137***	–0.00167**	–0.202***	–19.14***	–0.0251***
	(5.82e-05)	(0.00277)	(0.000593)	(0.0644)	(1.329)	(0.00322)
Remain maturity[2]	–1.29e-05	0.00215*	0.000902**	0.0930**	0.501**	0.00177***
	(9.99e-06)	(0.00103)	(0.000350)	(0.0349)	(0.236)	(0.000594)
Constant	0.00277***	0.00521***	–0.998***	0.147***	–186.0**	0.283***
	(1.27e-05)	(0.00103)	(0.000328)	(0.0341)	(69.53)	(0.0204)
Observations	3,004	3,004	3,004	3,004	2,733	2,733
R-squared	0.099	0.198	0.248	0.262	0.145	0.233

Panel B: Price-based liquidity measures

Variables	Neg Amihud	Neg PriceDisp	Neg SpdMth	Neg SpdDay	NegRSpd	PriceLiq
Size[1]	0.000186***	–0.00212***	–1.63e-05**	7.75e-06	–0.000318*	–0.000109***
	(1.03e-05)	(0.000539)	(7.63e-06)	(4.63e-06)	(0.000177)	(1.19e-05)
Age[2]	–0.0251***	0.522***	0.00130	0.00595***	0.0319	0.00938***
	(0.00322)	(0.0803)	(0.000815)	(0.00158)	(0.0284)	(0.00305)
Remain maturity[2]	0.00177***	–0.115***	–5.26e-05	0.000251	0.00184	–0.00404***
	(0.000594)	(0.0230)	(0.000124)	(0.000307)	(0.00742)	(0.000923)
Constant	0.283***	0.162***	–0.00700	–0.0208**	0.000649	0.492***
	(0.0204)	(0.0187)	(0.00424)	(0.00759)	(0.0350)	(0.0172)
Observations	3,004	3,004	3,004	3,004	2,733	2,733
R-squared	0.099	0.198	0.248	0.262	0.145	0.233

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

[1] In millions.

[2] In years.

Regression: Islamic bonds

Table 5

Panel A: Quantity-based liquidity measures

Variables	Turnover	TradeNo	NegZTD	TradeDay	NegTradeInt	QtyLiq
Size[1]	–2.33e-06***	0.000145***	4.95e-05***	0.00538***	0.101***	0.000244***
	(1.82e-07)	(1.33e-05)	(4.62e-06)	(0.000510)	(0.0101)	(1.27e-05)
Age2	–0.000487***	–0.00605***	–0.00110***	–0.130***	–20.73***	–0.0280***
	(3.26e-05)	(0.000559)	(0.000233)	(0.0267)	(1.726)	(0.00198)
Remain maturity[2]	–2.36e-05	–0.000105	–0.000121	–0.0157	–1.063***	–0.00144**
	(2.86e-05)	(0.000354)	(0.000112)	(0.0121)	(0.281)	(0.000600)
Constant	0.00764***	0.0175***	–0.995***	0.498***	–35.69	0.446***
	(0.000663)	(0.00218)	(0.00134)	(0.137)	(22.30)	(0.0128)
Observations	5,768	5,770	5,770	5,770	5,395	5,395
R-squared	0.080	0.350	0.300	0.306	0.126	0.250

Panel B: Price-based liquidity measures

Variables	Neg Amihud	Neg PriceDisp	Neg SpdMth	Neg SpdDay	NegRSpd	PriceLiq
Size[1]	–6.944**	–0.000220	–1.78e-06*	9.90e-07	–0.000639	–0.000102***
	(3.167)	(0.000347)	(8.53e-07)	(5.41e-06)	(0.000496)	(1.12e-05)
Age[2]	–889.0**	0.926***	0.000226	0.00418**	0.0290	0.0104***
	(309.6)	(0.110)	(0.000165)	(0.00183)	(0.0213)	(0.00240)
Remain maturity[2]	–556.1***	0.0297	–0.000244**	0.000406	0.00216	–0.00425***
	(184.4)	(0.0234)	(0.000107)	(0.000260)	(0.0128)	(0.000690)
Constant	854.8***	–0.111	0.000633	–0.0137**	–0.0198	0.593***
	(289.7)	(0.0861)	(0.000940)	(0.00605)	(0.130)	(0.0288)
Observations	5,770	5,770	5,082	4,521	5,528	4,514
R-squared	0.066	0.078	0.007	0.008	0.007	0.150

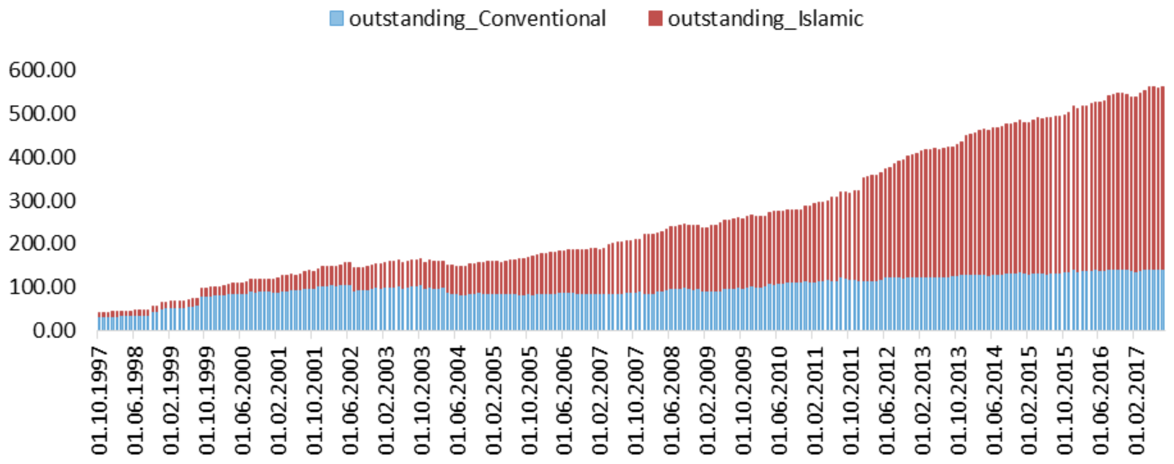
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

[1] In millions.

[2] In years.

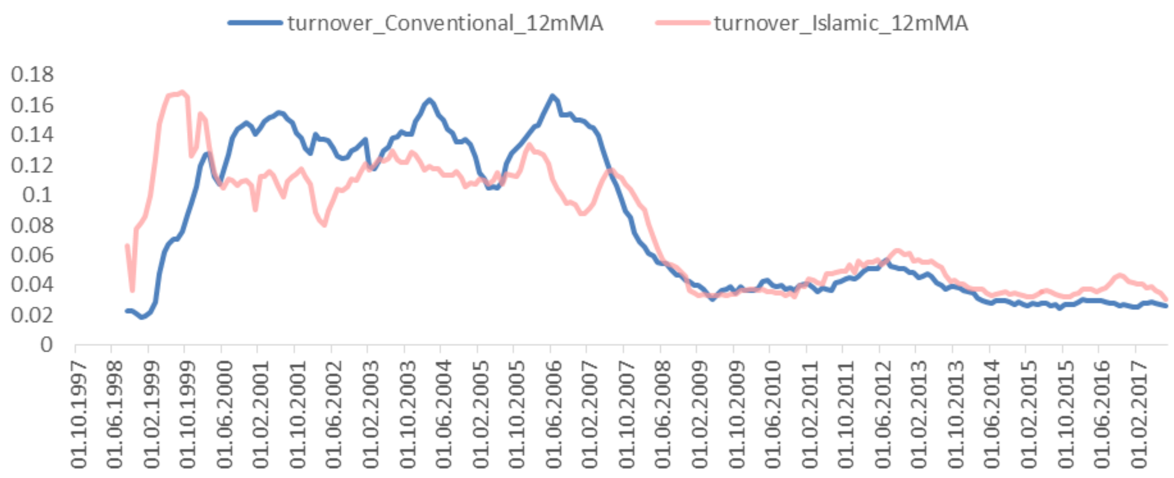
Monthly outstanding of Malaysia corporate bonds (bil MYR)

Graph 1



12-month moving avg of monthly turnover rate of Malaysia corporate bonds

Graph 2



Comments on "Measuring corporate bond liquidity in emerging markets: price- vs quantity-based measures"

By Dragon Yongjun Tang[1]

1. Findings and contributions of the paper

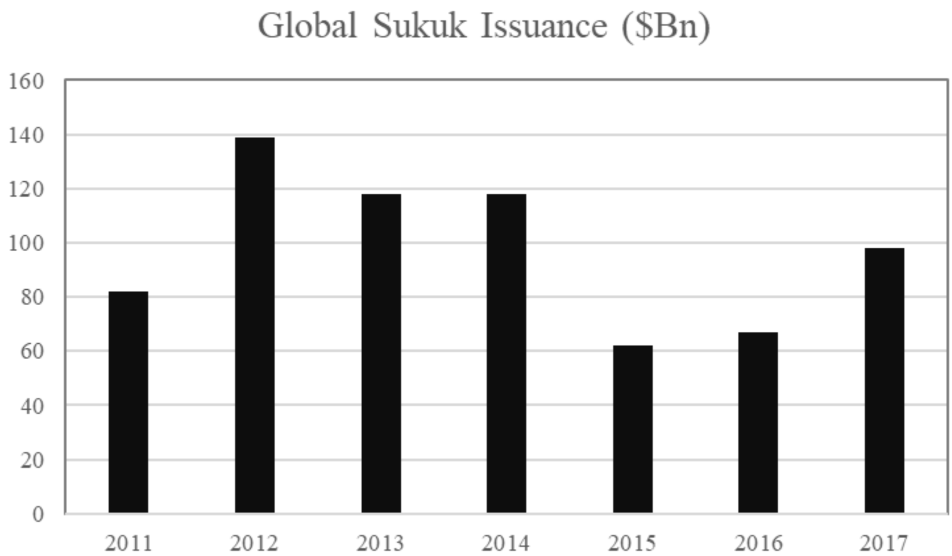
The authors of this paper (Hameed, Helwege, Li and Packer) examine the liquidity of corporate bonds in emerging market economies (EMEs). Their main goal is to identify the most effective measures of corporate bond liquidity in EMEs. Six quantity-based (eg turnover) and six price-based (eg the absolute return over volume ratio or the Amihud measure) measures are studied. Analysing a large sample of corporate bonds from Malaysia during the period 1997–2017 with transactions recorded on an electronic trading platform, the authors find that quantity-based measures are more effective in capturing bond liquidity differences than price-based measures. Their findings are the same for both Islamic and conventional bonds. Overall, the bonds under study are considerably illiquid.

Establishing ways to accurately measure bond liquidity is of interest to traders and policy makers. Bond market makers may demand premiums for liquidity provisions. If liquidity is not measured correctly, market makers will be less able to support the proper functioning of the bond market. Policy makers are also keen to gauge the current liquidity status of the bond market so as to effectively intervene, when necessary, to improve financial conditions and thus benefit society in general. For example, in recent years, central banks worldwide have begun engineering bond purchase programmes to improve bond market liquidity and corporate finance (eg the European Central Bank initiated the corporate sector purchase programme in June 2016).

This paper contributes to the literature by providing evidence showing that quantity-based measures are more appropriate than price-based measures in capturing bond liquidity differences in EMEs. Moreover, it sheds light on the development of the corporate bond market in EMEs. Despite its great potential, the Islamic bond market has not grown much. New issuances have been fluctuating at around $80 billion per year (see Table 1). A potential cause of the stagnation of the market is lack of liquidity. Given that the majority of the sample bonds are Islamic bonds, this study makes a useful contribution to our understanding of the Islamic bond market.

[1] Hong Kong University.

Global new issuance of Islamic corporate bonds	Table 1



2. Comments and suggestions

The paper provides many useful statistics about a valuable dataset. It raises new questions beyond the results discussed in the paper and could pave the road for future studies.

2.1 Islamic versus conventional bonds

Malaysia has the world's largest Islamic bond market. It is the best place to study Islamic finance. However, the paper does not detail the unique aspects of Islamic bonds nor does it outline the differences between conventional and Islamic bonds (one would assume Islamic bonds are substantially different from conventional bonds, hence the needs for different labels).

Chen, Cherian, Shao, and Subrahmanyam (2018) analyse Islamic sovereign bonds in Malaysia. They find that Islamic bonds have higher yield spreads than conventional bonds after controlling for bond characteristics and liquidity. They argue that there is a clientele effect in Islamic bond investments. It is interesting to study how Islamic and conventional bonds obtain the same liquidity features. Johnes, Ongena, Pappas, Tsionas and Izzeldin (2018) study these aspects, while Alzahrani (2019) provides an overview of Islamic finance.

2.2 How different are EMEs from advanced economies (AEs)?

Corporate bond liquidity is extensively studied in literature using data from AEs, especially the United States. It is useful to discuss why one may expect different results from EMEs before diving into the data.[2] This discussion is also necessary because Schestag, Schuster, and Uhrig-Homburg (2016), using US data, find that the price-based measures of corporate bond liquidity perform well. The current paper concludes that quantity-based measures are more reliable for EMEs (ie Malaysia), thus raising the question: What drives different results between AEs and EMEs?

2.3 Methodological concerns on the comparison of liquidity measures

This paper uses a regression method to assess the effectiveness of various liquidity measures. Specifically, the authors relate liquidity measures to bond size, age and remaining maturity. They posit that good liquidity measures should be significantly related to those explanatory variables and with the "correct" signs. This method is a reasonable starting point. However, a more rigorous method may provide for a more convincing conclusion. At a minimum, some validation analysis for the method employed by the authors would be helpful. For example, many may agree that sovereign bonds, on average, are more liquid than corporate bonds. For a mixed sample of sovereign and corporate bonds, will quantity- or price-based liquidity measures be better able to identify those bonds that are more liquid?

Constructing new liquidity measures and identifying the best measures remain ongoing research topics. Chernenko and Sunderam (2018) construct a new measure of bond liquidity without using transaction data. Future studies can apply this measure to EMEs.

2.4 Other EMEs such as China

While the authors argue that Malaysia has a well-developed bond market with a high debt-to-GDP ratio, a question remains over whether the findings from this study are applicable to other markets. Many EMEs are substantially larger than the bond market in Malaysia. The first that comes to mind is China. In the last decade, China has developed a large corporate bond market, which may become the world's second largest in 2019. Amstad and He (2019) provide a detailed introduction to the bond market in China.

The corporate bond market in China is worth more attention because it has experienced many reforms. There are plenty of "natural experiments" or "policy shocks" that can be used to test fundamental corporate finance or asset pricing theories. In a study by Chen, Chen, He, Liu and Xie (2018), for example, policy change in China is used to show that bond prices are affected by its pledgeability as collateral.

2 Hund and Lesmond (2008) provide some relevant discussions.

3. Concluding remarks

This paper helps readers understand corporate bond liquidity in EMEs. The authors discuss a large set of liquidity measures and find evidence for the superior performance of quantity-based measures from a sample of Malaysia corporate bonds. Many new promising research questions are raised along these lines. Future studies should focus on the unique features of Islamic bonds, comparing the effectiveness of different liquidity measures in EMEs to that of AEs, employing different methods and looking at different markets such as China.

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The rise of benchmark bonds in emerging Asia

By Eli Remolona and James Yetman[1]

Abstract

The most liquid of bonds – often referred to as benchmarks – serve as the focus of price discovery, and in doing so, help to improve the efficiency of financial markets. In this paper, we summarise our ongoing research to see if benchmark bonds exist in emerging market economies and to assess whether there is a connection between their existence and the maturities where authorities have designated official benchmarks. Can we find bonds that act like benchmarks in terms of their liquidity and price movements? We consider four emerging market economies in Asia: Indonesia, Malaysia, the Philippines and Thailand. These are countries where the governments have actively promoted the development of benchmark bonds and have issued those bonds in size to foster their liquidity. To varying degrees, these authorities have also spread their chosen benchmarks across wide maturity ranges in an effort to build benchmark yield curves. To identify the de facto benchmarks, we propose measures of liquidity and price discovery that are appropriate to the sparse data available for these markets. We find that the existence of de jure and de facto benchmarks often do coincide.

JEL classification: G10, G12, G14

Keywords: benchmark bond, price discovery, liquidity, principal component analysis, re-openings, informational public good

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1. Introduction

Benchmark bonds can play an important role in ensuring that fixed income markets function well. For example, price discovery tends to occur in benchmark bonds: their prices react first to new information, and they serve as a means of conveying that information to other bonds (Dunne et al (2002)). Hence, while the discovery of information may be concentrated in a single bond, the information would be quickly conveyed to prices across the market more broadly (Wooldridge (2001)). This process requires that the benchmark be more liquid relative to other bonds.

How exactly a bond becomes a benchmark is less clear: in some economies, including the ones we focus on, authorities designate specific issues as benchmarks and issue them in size, partly in the hope that they will act like benchmarks. If a bond starts to act like a benchmark, network externalities reinforce its role, ensuring that it is likely to remain a benchmark for some time.

Across the fixed income market as a whole, government securities issued in a given currency are most likely to act as benchmarks for private sector securities issued in the same currency. This is partly because governments are relatively creditworthy borrowers, which simplifies the pricing of their securities. The existence of benchmarks, however, improves the functioning of the wider bond market; hence governments face incentives to encourage their development, and support their continued existence where they are already present. The International Monetary Fund and World Bank (2001) have advised governments to consolidate issuance in a few maturities across the maturity spectrum to support the evolution of a benchmark yield curve. And when some advanced economies were facing shrinking government debt markets on account of large budget surpluses, authorities sought to maintain the volume of gross issuance in certain securities to support the benchmarks (McCauley and Remolona (2000)).

The question we are seeking to address is whether benchmark sovereign bonds exist in the economies we study and whether there is any association between their existence and the official designation of benchmark bonds by authorities. While the authorities in Indonesia, Malaysia, the Philippines and Thailand have officially designated benchmark bonds, and have issued them in size to foster their liquidity, it is market participants who are the final arbiters on whether they will actually serve as benchmarks. In the US Treasury market, the "on-the-run" bond of a given maturity becomes the benchmark without the need for any official designation.

In the largest government bond markets, benchmark bonds seem to have naturally emerged as the market has developed, and generally exist at four maturities: two, five, 10 and 30 years (McCauley and Remolona (2000)). In some emerging market economies (EMEs), by contrast, the authorities seem keen to give markets a helping hand, designating specific issues as benchmark bonds and issuing them in size. Table 1 provides a summary of the maturities the authorities have chosen for their designated benchmarks.

To assess the existence of benchmark bonds, we use daily observations on prices, yields and bid-ask spreads for sovereign bonds in the four economies. We are unable to obtain data on trading activity, and the data we do have are missing for a large number of trading days. Given the sparseness of the data, we propose novel measures of liquidity and price discovery. Overall, we find that the de jure benchmarks are often also the de facto benchmarks.

In the following section, we discuss ways to measure liquidity with the sparsely available data and summarise our preliminary results. In Section 3, we propose a way to measure price discovery and summarise preliminary results. In Section 4, we consider the emergence of benchmark bonds in our sample of Asian EMEs by looking at the success of de jure benchmarks over time. Section 5 then concludes.

De jure benchmark maturities for four jurisdictions

Designated benchmark maturities shaded in green

Table 1

Maturities in years

	2	3	4	5	7	10	15	20	25	30	50
Indonesia (2010-2018)				■		■	■	■			
Malaysia		■		■	■	■	■	■		■	
Philippines	■	■	■	■	■	■		■	■		
Thailand (FY 2016-2018)				■		■	■	■		■	■

Sources: For Indonesia, Ministry of Finance; for Thailand, Public Debt Management Office; for Malaysia and the Philippines, exchanges of emails with regulators and market participants.

2. Liquidity and benchmarks

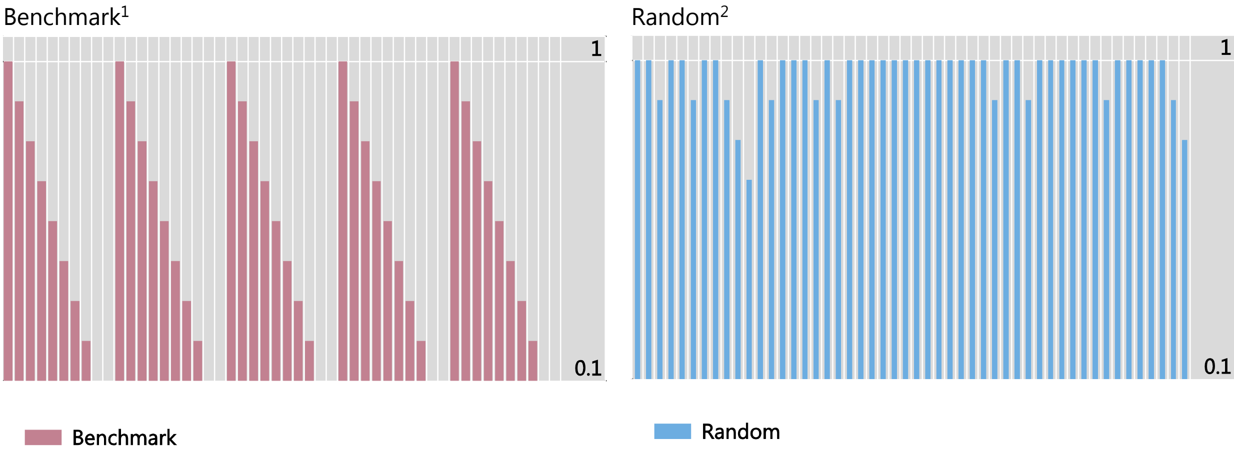
2.1 Measuring liquidity

We first seek to identify possible benchmark bonds based on their relative liquidity properties. We take three different measures of liquidity: the average of each of the bid-ask spread and the yield within a month, and the number of days within the month for which price quotes for the bond are available. A benchmark bond would be expected to have a low bid-ask spread, a low yield (since its liquidity would command a premium) and have quotes available relatively frequently. We then combine these measures by summing their rank orders across these three liquidity measures (from most to least liquid). The most liquid bond is the one with the lowest rank-order sum. We then compare the length of time for which the most liquid bond remains so with what we would expect to occur by chance, taking into account the number of bonds in the maturity and if any are equally most liquid. The underlying idea is that once a bond becomes a benchmark bond, and hence more liquid than comparable bonds, the network externalities of a benchmark should preserve its liquidity for multiple months. We carry out this exercise for each country for eight different symmetric non-overlapping maturity buckets, each centred on one of the maturities listed in Table 1.

We assess how persistently a bond is most liquid by calculating the probability P_t of observing the outcome that we would observe under the null hypothesis that the most liquid bond is randomly assigned each period. If there is a benchmark, we would expect to find a downward-step-function (in logs). Then, when the benchmark switches to a new bond, the probability would jump and the step function would start anew. Graph 1 illustrates this probability under two hypothetical cases: for a bin with four bonds where the benchmark changes every 10th period, and where the most liquid bond is randomly chosen every period (right-hand panel).

Hypothetical probabilities that a bond remains most liquid for multiple periods

Logarithmic scale — Graph 1



[1] P_t for a bin with four bonds under the assumption that a benchmark bond is chosen every 10th period and remains the most liquid as long as it is the benchmark. [2] Example of P_t for a bin with four bonds under the assumption that the most liquid bond is randomly assigned each period.

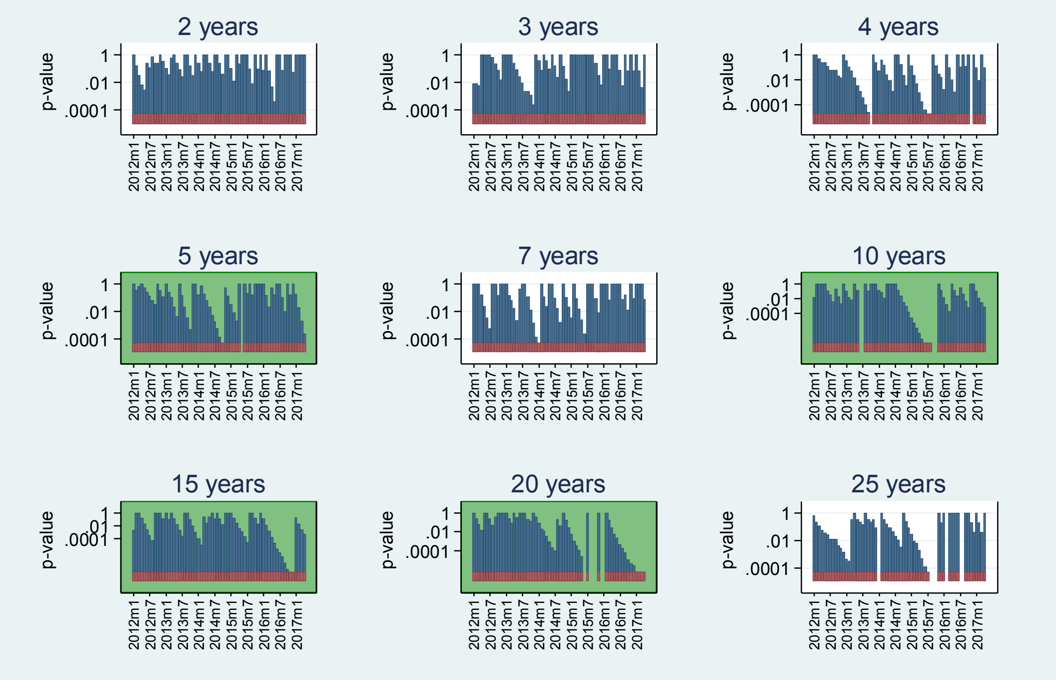
Source: Authors' calculations.

2.2 Results on liquidity

When we apply this test across the different countries and maturity bins, we obtain the results presented in Graph 2. For Indonesia (Graph 2a), liquidity persistence consistent with benchmark behaviour is most evident at the 10-year, 15-year and 20-year maturities. These maturities also happen to be de jure benchmark maturities. However, the 5-year maturity is also a de jure benchmark, but liquidity persistence is less evident here. Graph 2b provides the same visual assessment for Malaysia. Here again there is evidence of benchmark behaviour at most maturities, especially the de jure benchmark maturities. For the Philippines, Graph 2c shows liquidity persistence to be most evident at the 20-year maturity, which is a de jure benchmark. There is also some evidence of benchmark behaviour at the 15-year maturity, which is not a de jure benchmark. Finally, for Thailand, Graph 2d shows considerable evidence of benchmark behaviour at most maturities up to 20 years, whether or not these are de jure benchmark maturities. Taken together, there is limited consistency between the benchmark-like behaviour in terms of liquidity persistence and those maturity bins where there is supposed to be a de jure benchmark bond.

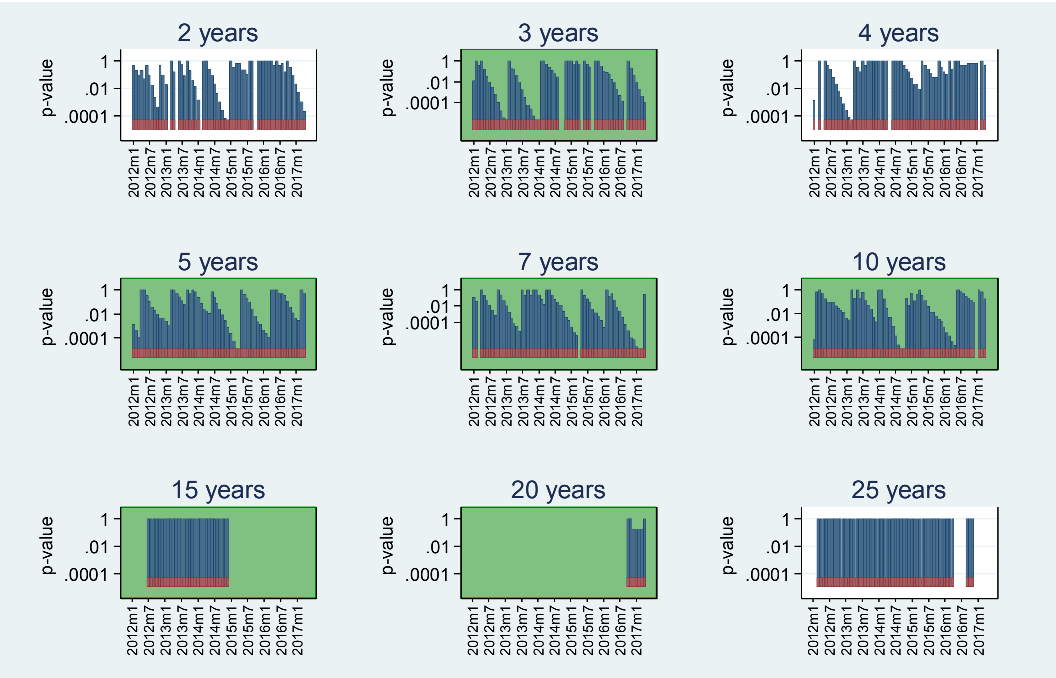
Is the most liquid bond persistent in Indonesia?

Graph 2a



Is the most liquid bond persistent in Malaysia?

Graph 2b

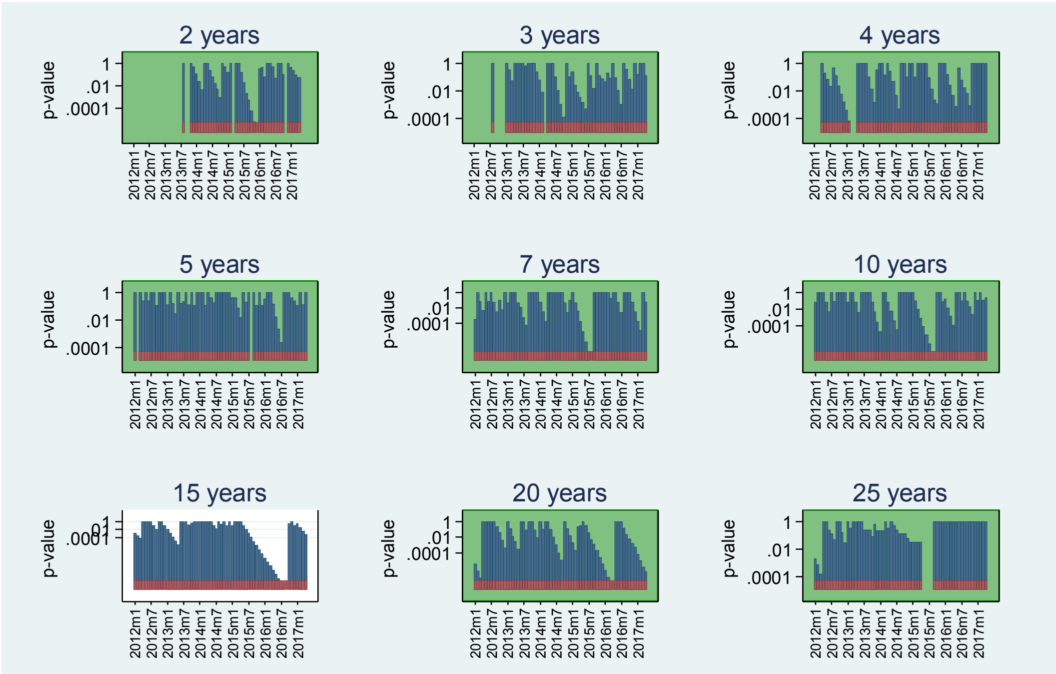


[1] The solid red bar indicates inclusion in the sample (ie at least three bonds in a given maturity bin). The blue bars indicate the probability of the most liquid bond being most liquid for the observed number of recursive periods if this was randomly assigned. Green shading indicates maturities with designated benchmarks. Note the log vertical scale.

Sources: Authors' calculations

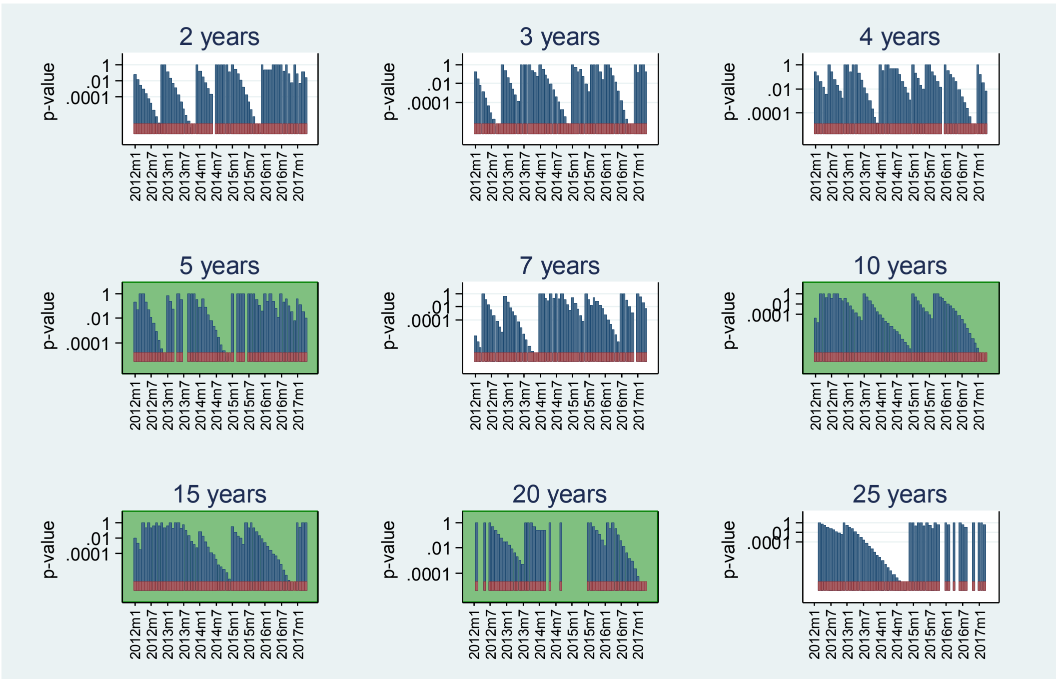
Is the most liquid bond persistent in the Philippines?

Graph 2c



Is the most liquid bond persistent in Thailand?

Graph 2d



[1] The solid red bar indicates inclusion in the sample (ie at least three bonds in a given maturity bin). The blue bars indicate the probability of the most liquid bond being most liquid for the observed number of recursive periods if this was randomly assigned. Green shading indicates maturities with designated benchmarks. Note the log vertical scale.

Sources: Authors' calculations

3. Price discovery and benchmarks

3.1 Measuring a bond's role in price discovery

If a bond acted as a benchmark in the price discovery process, price movements should be disproportionately affected by systematic factors compared with the price movements of other bonds of similar maturity (Dunne et al (2007)). To asses this, we conduct a principal component analysis (PCA) on the daily change in the prices of bonds of similar remaining maturities and interpret the weight on the first PC as a measure of the importance of the systematic factor.

We face one key challenge in implementing the PCA on our data: our panel is unbalanced, with prices unavailable for some bonds on some days in nearly all months. However, a PCA requires a balanced panel. To remedy this, we interpolate the data panel in such a way that the first PC is not affected by the interpolated factors. We do so with the following steps:

(i) replace missing values with the average change in the yield for the bond on other days in the same month;

(ii) run the PCA based on the now-balanced panel, and extract the fitted values based on the first PC for each of the series;

(iii) replace the original interpolated values with the fitted values and repeat step (ii) until the estimation converges (defined by the fraction of the explained variance increasing by less than 0.00001 from one iteration to the next); and

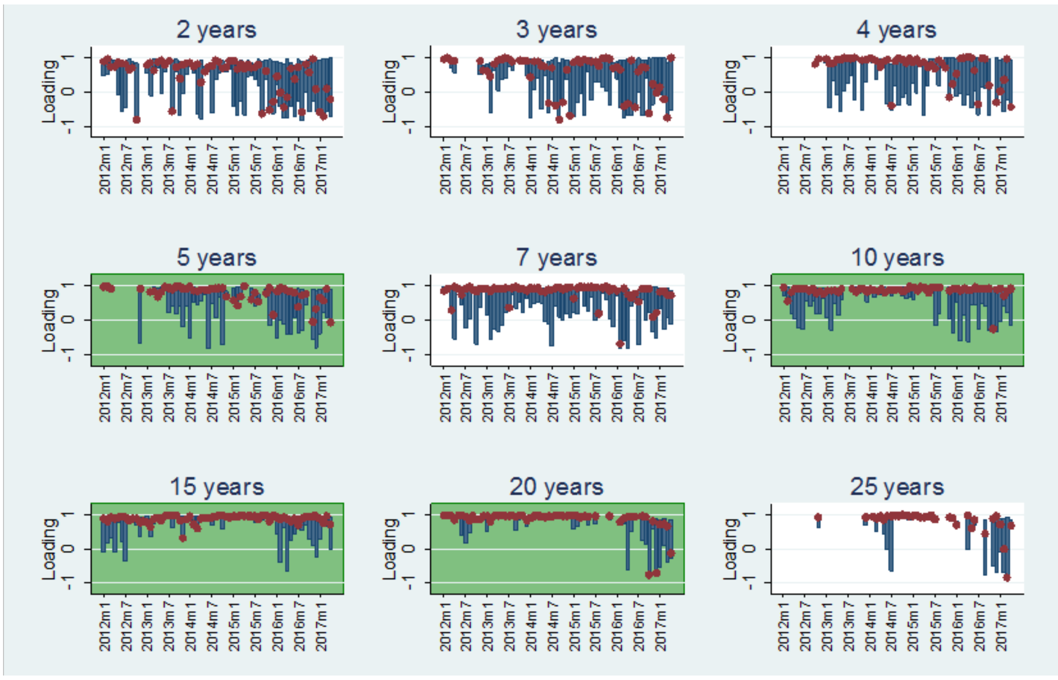
(iv) compute the load on the first PC as the Pearson correlation coefficient between the first PC and the original data series (with missing values left empty).

Once the procedure has converged at step (iii), interpolated values are approximately equal to their fitted values in the final iteration. Given that the influence of a single data point on the PC is a function of the difference between the data series and its fitted value, this ensures that the missing values have virtually no effect on the first PC; its value at each point in time is instead determined by the non-missing values. Also, when we compute the loading on the first PC at step (iv), this is calculated as a function of only the actual available data, and is not affected by the interpolated data.

For each PCA exercise, we compare the loading on the first PC for the candidate benchmark bond identified on the basis of its liquidity characteristics (above) with other bonds in the same PCA. Note that the PCA is based on different, complementary, information than was used to construct the candidate benchmark bond in the previous section. If the candidate benchmark bond identified in the previous exercise also has the highest loading on the first PC, we interpret this as much stronger evidence that a benchmark exists than if the candidate benchmarks differ across the two measures much of the time.

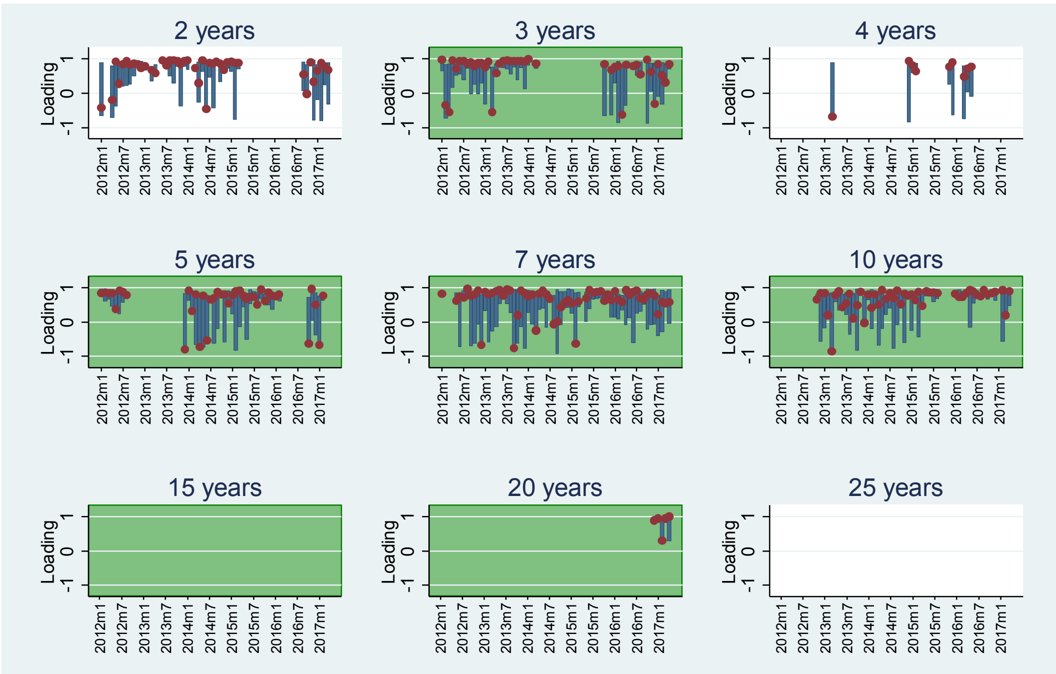
Loadings on first PC for Indonesia

Graph 3a



Loadings on first PC for Malaysia

Graph 3b

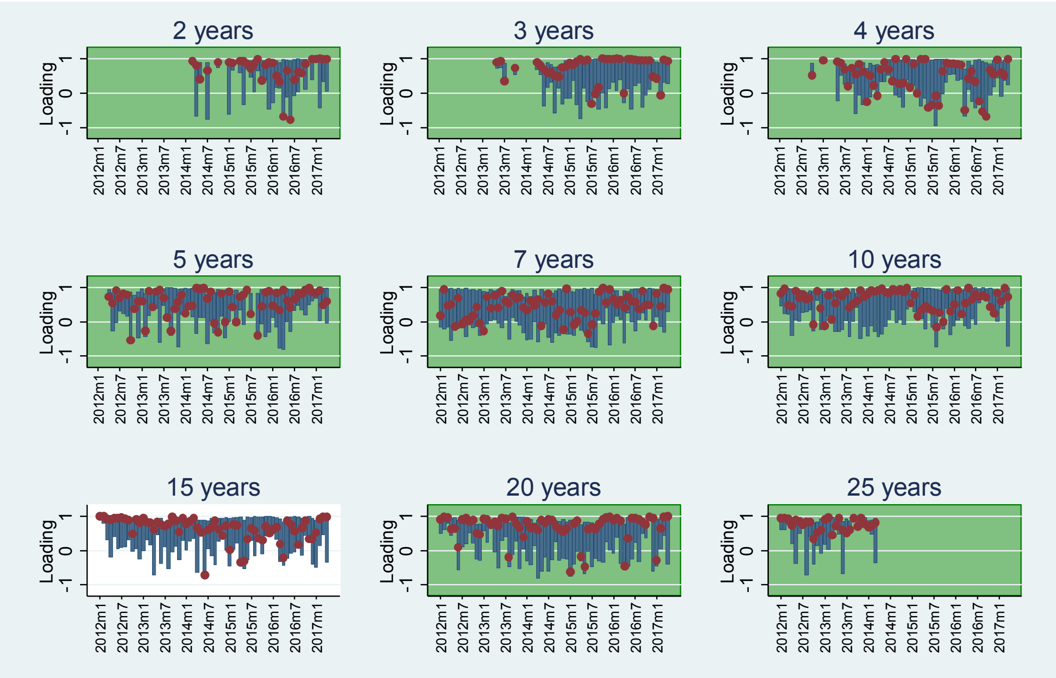


[1] Blue lines indicate the range of loadings on the first principal component. Red dots indicate the loadings of the candidate benchmark bond identified on the basis of liquidity. Green shading indicates maturities with designated benchmarks.

Sources: Authors' calculations

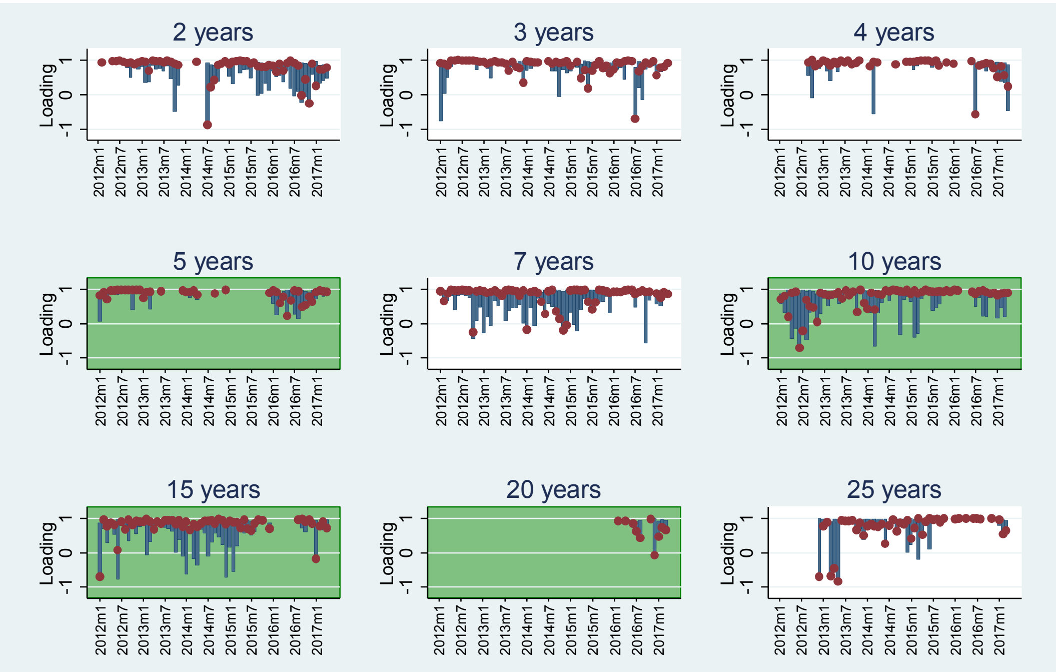
Loadings on first PC for the Philippines

Graph 3c



Loadings on first PC for Thailand

Graph 3d



[1] Blue lines indicate the range of loadings on the first principal component. Red dots indicate the loadings of the candidate benchmark bond identified on the basis of liquidity. Green shading indicates maturities with designated benchmarks.

Sources: Authors' calculations

3.2 Results on price discovery

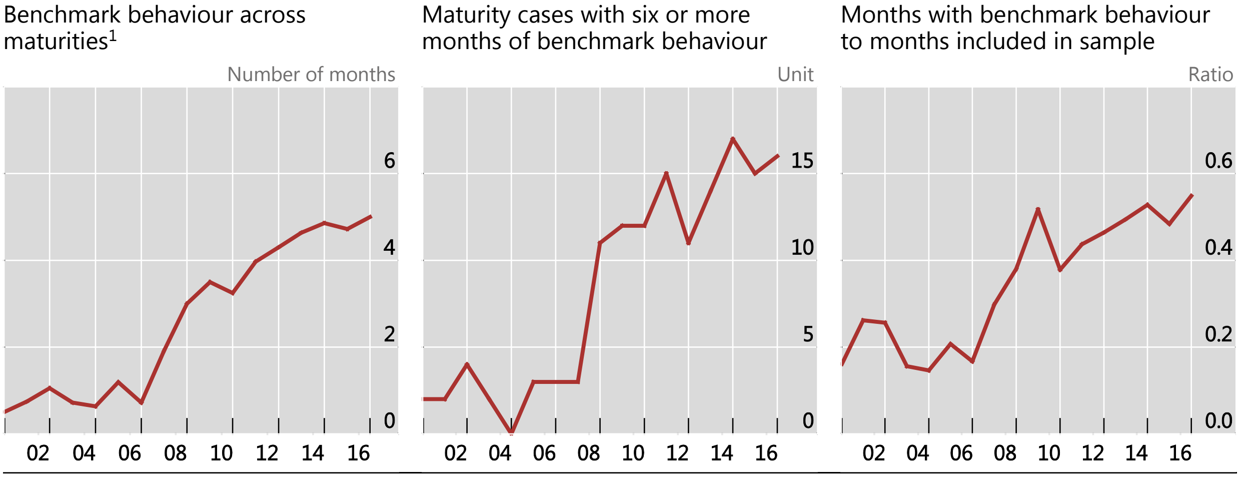
Our results on price discovery are inconclusive, especially when we consider the consistency of these results with those on liquidity. Graph 3 illustrates the results for evidence of price discovery. Blue bars each month display the range of loading on the first PC across all bonds, while red dots indicate the factor loading for the candidate benchmark, identified in terms of its persistent liquidity characteristics. In an ideal world, with a perfectly functioning benchmark, we would expect the red dot to always be at the highest point of the bar, and to have a factor loading of one.

In at least some cases, the candidate benchmark comes close to this ideal. Taking Indonesia, for example, the factor loading for the candidate benchmark has either the highest loading or close to it most months for bonds at the 10- or 15-year maturity. (Both of these are also de jure benchmarks, as indicated by green shading). For Malaysia, the correlation between candidate benchmarks and high loadings is much smaller at all horizons. For the Philippines, the greatest evidence of a link is at the 20-year maturity. Finally, for Thailand, the strongest evidence is at the 10-year maturity.

4. Have benchmarks emerged in emerging Asia?

The primary question of the paper is whether benchmark bonds have emerged in emerging Asia. We provide one piece of tentative evidence that relies on our results on liquidity. We count up the number of months in a given year for which there is a benchmark based on just liquidity characteristics (defined by the probability as displayed in Graph 2 falling below 0.01 for a given benchmark candidate). We also count the number of months for which there is sufficient data to be included in our sample. This latter number reflects the availability of bond information on Bloomberg (our data source) and can be interpreted as a proxy of overall bond market development.

Frequency of benchmark behaviour based on liquidity persistence — Graph 4



[1] Yearly average.

Source: Authors' calculations.

We summarise these counts, by year, in Graph 4. Across all the maturities, the average number of months with benchmark liquidity behaviour is less than 2.0 for all years before 2008, between 3.0 and 4.0 for the following four years, and more than 4.0 thereafter (left-hand panel). Similarly, the number of maturities with benchmark behaviour for at least six months of the year has increased from the low single digits for 2000–2007 to 11-15 for the next four years and 14-17 thereafter (centre panel). One possible explanation for this behaviour is that these counts are biased by the increased availability of bond market data, as markets have developed, since this is the upper bound on the number of months of benchmark behaviour in our study. However, we can demonstrate that this is not the case. Ignoring cases with zero observations in the sample – since the ratio is then undefined – the ratio of months with benchmark behaviour to total months in the sample has a clear upward trend over the sample as well, increasing from around 0.2 before 2007 (indicating that we find evidence of benchmark behaviour for around 20% of months in the sample) to around 0.55 at the end of the sample (benchmark bond behaviour is present in more than half of all months in the sample; right-hand panel). Put differently, the ratio is positively correlated with the number of months present in the sample (ρ =0.45).

We can also compare the evidence of benchmark behaviour against maturities in which there are de jure benchmarks, as listed in Table 1. We focus on the final three years of the panel and compute the average number of months with benchmark behaviour and the average ratio (where this is defined) for all maturities with de jure benchmarks and all other maturities, for each country. With the exception of the country where the data is least informative (ie the Philippines, for which there is only one non-de jure benchmark maturity available for comparison), we find consistent evidence of more benchmark behaviour at maturities where there are designated de jure benchmarks (as seen in Table 2). The average number of months is higher, as well as the ratio, in all other cases. Again, excluding the Philippines, the smallest differences are for Thailand, although in level terms it has the greatest evidence of benchmark behaviour overall.

Comparing across countries more generally, the de jure benchmark maturities of Indonesia and Thailand have de facto benchmark bonds present for a larger number of months each year than the other countries in our sample (6.08 and 7.00 respectively, compared with less than five for Malaysia and the Philippines). Thai non-benchmark maturity bonds generally display more benchmark-like behaviour by these metrics than the de jure benchmark maturities for the other countries.

Comparison of liquidity between de jure benchmark maturities and others

2014–2016

Table 2

	Average number of months		Average ratio	
	De jure benchmark maturities	Other maturities	De jure benchmark maturities	Other maturities
Indonesia	6.08	3.40	0.62	0.36
Malaysia	4.67	1.67	0.48	0.17
Philippines	4.54	5.67	0.43	0.52
Thailand	7.00	6.13	0.63	0.55

[1] "Average number of months" is the average number of months for which there is evidence of benchmark behaviour, as illustrated in Graph 4, for the 2014–2016 period. "Average ratio" is the average ratio of the number of months for which there is evidence of benchmark behaviour to the number of months included in the sample, for the 2014–2016 period. These are each calculated separately across maturities for which there are de jure benchmark bonds (as indicated in Table 1) and other maturities.

Source: Authors' calculations.

5. Conclusions

So what effect does government policy have in creating benchmark bonds? In some EMEs, governments have chosen bonds that they wish market participants would accept as benchmarks. In this paper, we consider four such economies in Asia. The authorities in Indonesia, Malaysia, the Philippines and Thailand, in particular, have each designated specific government bonds as de jure benchmarks and have issued those bonds in size to foster their liquidity.

Given that the markets we are focusing on are still in the process of development, the available data is sparse. We have proposed statistical tools that can be used to assess benchmark behaviour in spite of this. To assess liquidity, we combined rankings based on relative yields, bid-ask spreads and the number of days for which quotes are available. To assess the importance of a bond in price discovery, we conduct a PCA and use the loadings on the first PC as a measure of that importance. We then cross-checked the resulting evidence of benchmark behaviour with whether there was a de jure benchmark at that maturity.

Based on preliminary findings, there is some evidence of the existence of persistently highly liquid bonds around the maturities for which benchmark bonds are officially designated. Further, the identified highly liquid bonds often have high factor loadings on the first PC of returns on bonds with similar maturities, consistent with them playing an important role in price discovery.

In ongoing work, we will look more closely at the evidence of benchmark behaviour at the level of the individual designated benchmark bond. We are working to identify the specific bonds that have been designated as de jure benchmarks and will investigate whether those bonds act like benchmarks in reality.

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Comments on "The rise of benchmark bonds in emerging Asia"

By Terence Tai Leung Chong[1]

This paper investigates whether government policy can speed up the tipping process in the creation of benchmark bonds. The authors (Remolona and Yetman) examine four emerging market economies in Asia where authorities have actively fostered benchmark bonds – Indonesia, Malaysia, the Philippines and Thailand. The question the authors seek to answer is whether creating de jure benchmarks will lead to the creation of de facto benchmarks. To assess this, they use rankings based on relative yields, bid-ask spreads and the number of days for which quotes are available to assess the liquidity of bonds. They conduct a principal component analysis (PCA), using the loadings on the first PC to measure bond importance in price discovery. The liquidity measures are combined with price discovery measures to identify de facto benchmark bonds. The authors compare those bonds with those which the governments have chosen as de jure benchmarks. Their results show that the de jure benchmarks are often also the de facto benchmarks. The identified highly liquid bonds often have high factor loadings on the first PC of returns on bonds with similar maturities, consistent with them playing an important role in price discovery.

We observe from Table 1 below – which details some stylised facts on selected government bond markets – that the ratio of bond market size to GDP is quite stable for Indonesia and Thailand. The authors do not mention, however, how this is related to their finding on Indonesia and Thailand having the greater success in the establishment of benchmark bonds despite having the smallest number of de jure benchmarks among the four countries (ie Malaysia has seven and the Philippines eight as shown in Table 1 of Remolona and Yetman (2019)). The policy implication is that authorities may benefit from focusing on a more limited number of benchmarks.

Stylized facts on selected government bond markets — Table 1

	Size end-2017 (USD billions)	Size end-2005 (USD billions)	Ratio to GDP in 2017	Ratio to GDP in 2005
Indonesia	155.7	40.7	15.3	13.1
Malaysia	167.2	48.2	53.5	32.5
Philippines	89.1	41.1	28.4	39.9
Thailand	135.8	38.2	29.8	20.2
Japan	9470.9	5827.0	194.3	122.5
United States	17583.9	6846.4	90.2	52.5
United Kingdom	2785.3	801.5	106.0	31.7

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Focusing on the designated benchmark bond issues for Indonesia and Thailand, these de jure benchmarks are often also de facto benchmarks in terms of their liquidity and roles in price discovery. However, these positive results are not uniform. By comparison, advanced economies with more highly developed and widely traded bond markets tend to have fewer benchmarks.

The authors also found that, in exchange for larger gaps between benchmarks along the yield curve, focusing debt raising efforts on a smaller number of issues that could then be re-opened more often and/or in larger amounts could support the creation of benchmarks, with all of the concomitant benefits including improved market functioning and reduced debt servicing costs. An implication is that governments' attempts to establish a full yield curve of benchmarks may be counterproductive, while establishing benchmarks at a smaller number of key maturities would be more successful.

This is a very interesting paper. In the study, the authors could benefit from providing further explanation as to why the four countries are selected. They could also mention and compare the rating of the bonds of the four selected countries and control for the rating. Also, more explanation is needed as to why the factor loading magnitudes are used, ie why were other weighted rankings not used? They could also explain the findings in more details. For example, why do Indonesia and Thailand offer the best results? Is it due in part to their economies and debt levels relative to GDP in addition to the number of de jure benchmarked bonds?

They should also discuss the possibility of the crowding out effect; ie in cases where a country has more bonds in the market with different maturities, if the overall demand is not high enough the bonds with close maturity will become substitutes for one another, leading to a lower chance of a de jure benchmark bond becoming a de facto benchmark bond. Another implication is that countries with a bond market that is growing too fast (as shown in Table 1) face more difficulties in making a de jure benchmark bond a de facto benchmark bond.

Local currency bond returns in emerging market economies and the role of foreign investors

By Inhwan So, Giorgio Valente and Jason Wu[1]

Abstract

Foreign investors play a key role in sovereign bond markets in emerging market economies (EMEs), in part because their portfolio flows are sensitive to bond returns and are therefore pro-cyclical in nature. This note discusses the implications of the framework proposed by So et al (2019), which incorporates the risk that arises from the portfolio performance and flows of actively managed bond funds. When the framework is applied to the data, using local currency sovereign bonds of 16 EMEs, preliminary calculations show that local currency sovereign bonds that positively covary with the returns of active funds receive risk premia as compensations for active fund risk. Furthermore, and in line with theory, the price of this risk increases when bond funds experience outflows and the exposure to active funds risk increases with the heightened price of risk. This double effect helps explain why spikes in returns of some EME local currency bonds can be especially large. These results demonstrate how the portfolio performance and flows of actively managed funds help transmit shocks across EMEs.

JEL classification: F31, F34, G15

Keywords: bond excess returns, portfolio flows, institutional investors, conditional asset pricing

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1. Introduction

Local currency sovereign debt instruments issued by emerging market economies (EMEs) have increased dramatically during the past two decades – by 2017, the amount of local currency sovereign debt had reached almost USD 10 trillion. Foreign investors have been a major driver in the growth of such bonds: they now own, for the average EMEs, about 20% of outstanding local currency sovereign debt, with some EMEs experiencing shares as high as 40% (G20, IFAWG (2018)). Foreign institutional investors, in particular, play a substantial role, facilitated by the inclusion of EME debt securities in major tradable benchmarks and improved secondary market liquidity (Arslanalp and Tsuda (2014), Agur et al (2018)).[2]

One important question is how the performance and flows of portfolios actively managed by foreign investors – especially bond funds – affect the pricing of local currency sovereign bonds. To answer this question, we borrow the theoretical and empirical results from the recent work by So et al (2019), who build a conditional asset pricing model that incorporates the portfolio allocation decisions and fund flows of active foreign investors. More specifically, taking the view that the performance of foreign active portfolios may represent a source of risk (active fund risk) for EME sovereign debt, we report and discuss the evidence that risk premia arise from the covariation between the returns of local currency bonds and the ones from foreign bond funds who actively manage their holdings. Our calculations, based on a panel of 16 local currency bonds spanning the sample period July 2007 – March 2018, show that bonds whose returns positively covary with the returns of active funds will see their price drop in bad times, as active funds exert price pressures when they are forced to liquidate their holdings. In addition, the price of active fund risk increases as fund outflows becomes larger;[3] as fund outflows gather pace and as the price of active fund risk increases, the model predicts that the covariation between bond returns and fund returns increases, magnifying its effect on bond expected excess returns. The structure of this note is as follows: Section 2 briefly provides some key statistics related to local currency bond markets and foreign investors' participation in EMEs. Sections 3 and 4 introduces the main features of So et al (2019) asset pricing framework and discusses the implications of their empirical results. Section 5 concludes.

2. Background

In the aftermath of the financial crisis, longer-term yields in advanced economies (AEs) have declined consistently. Together with the fact that EMEs performed relatively well during the financial crisis, this has led AE investors to reach for yield – a behaviour that has manifested in portfolio inflows from AEs to EMEs. At the same time, because of currency mismatches over the past several decades,

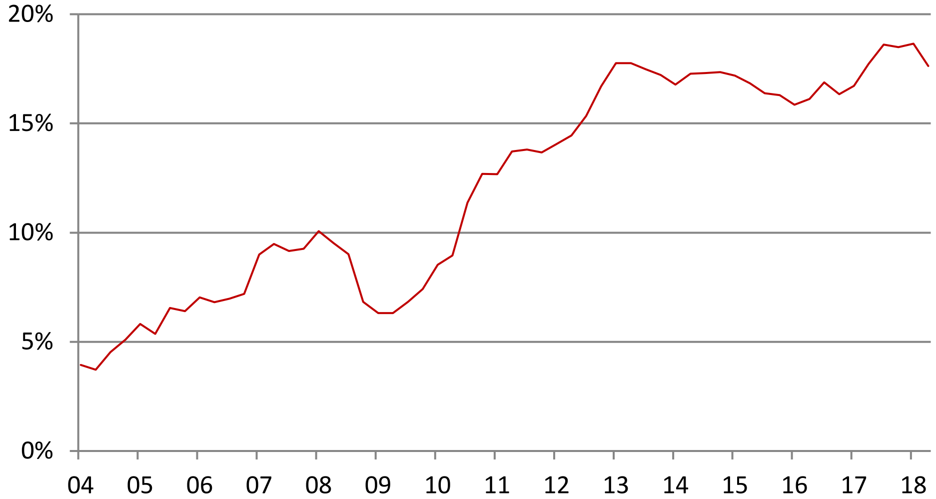
2 Foreign participation is highly heterogeneous across EMEs. While most exhibit a large share of debt owned by non-resident investors, a few countries continue to have a limited participation. We discuss the implications of this heterogeneity in Section 2.

3 This is described by Vayanos and Woolley (2013) as an amplification effect. Shifts in risk sentiments, as in Goldstein et al (2017), may represent an alternative rationalisation of the same stylised fact. The currency risk-taking channel, as in Hofmann et al (2017), is also another possible explanation as currency risk premia represent non-negligible components of local currency bond returns in USDs.

EME authorities have increasingly turned to issuing debt in local currencies as a way to mitigate sovereign default risk. The result of these two developments can be seen in Graph 1, which shows that foreign investors hold an increasing portion of local currency EME bonds.

Foreign investor shares in local currency sovereign bonds, average of 24 EMEs

Graph 1

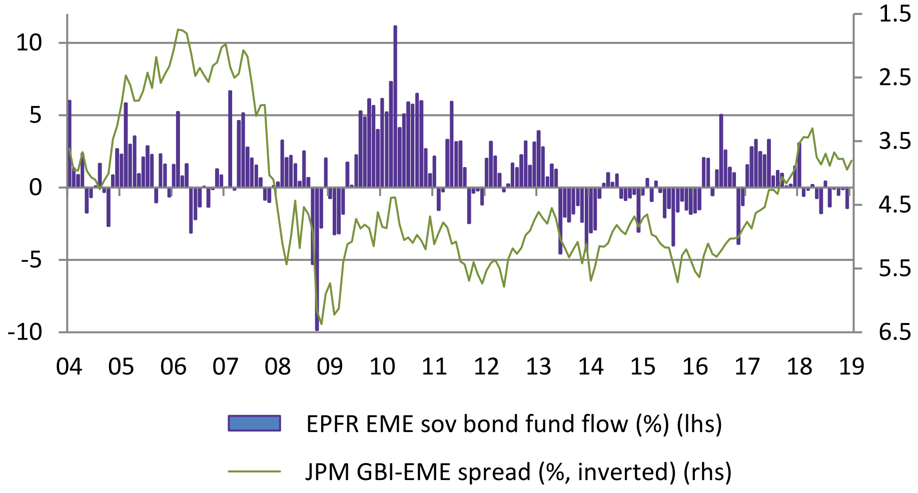


[1] The 24 EMEs are Argentina, Brazil, Bulgaria, Chile, China, Colombia, Egypt, Hungary, India, Indonesia, Latvia, Lithuania, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, Ukraine and Uruguay

Source: Arslanalp and Tsuda (2014).

Much of these local currency bonds are purchased by AE investment funds, such as open-ended mutual funds. As documented in Goldstein et al (2017) for bond funds, the flow-performance relationship displays an asymmetry: outflows are more sensitive to weak performance than inflows to strong performance. In the context of local currency EME bonds, the increased participation of foreign investors in the past decade suggests that the flow-performance relationship may be incorporated in bond returns in the form of higher risk premia. Our goal in this note is to discuss and interpret the evidence related to the extent to which the flows and performance of active funds are priced in the cross-section of sovereign bond returns.

Sovereign bond flows and sovereign bond spreads vis-à-vis US Treasury yields	Graph 2



Sources: EPFR, Bloomberg. Sovereign bond spreads are calculated vis-à-vis US Treasury yields.

3. Theoretical insights

In order to provide some insights regarding the key questions of this note, we seek some guidance from existing theoretical works. More specifically, Vayanos and Woolley (2013) are among the early few who show that in a market where active and passive investors co-exist, excess returns on risky assets are due to exposure to market risk and potential losses originating from assets managed by active investors. So et al (2019) extend this framework to EME's long-term local currency bonds. They document that, under the assumption that active portfolios are mostly comprised of EME local currency bonds, local currency bond returns, adjusted for market risk, contain risk premia compensating for the exposure to active fund risk. In addition, they also show that the flows that generate the time variation in the price of active fund risk are proportional to the overall net capital outflows from EMEs.[4] The key equation in So et al (2019) is:

$$E\left(e_{h,t+1}^{(n)}\right) = \bar{\lambda}_t \bar{\beta}_{h,t}^{A,(n)} + \phi_h^{(n)} var(\lambda_t) \quad (1)$$

where $e_{h,t+1}^{(n)}$, $\bar{\beta}_{h,t}^{A,(n)}$, $\bar{\lambda}_t$ denote the country *h* local currency *n*-year bond excess returns in USDs adjusted for market risk, the average active fund beta (ie the average quantity of active fund risk), the average time varying price of risk associated with the active fund, and $\phi_h^{(n)} = \mathrm{cov}\left(\lambda_t, \beta_{h,t}^{A,(n)}\right)/var(\lambda_t)$, respectively. Equation (1) states that the average bond excess return or, put differently, its risk premium, is due to the product between the average price and quantity of active fund risk. However, both variables change over time. In order to capture this time variation, equation (1) includes an

[4] It is implicitly assumed that active funds invest in various EMEs at once. When there are shocks to these economies (or because of withdrawal from the active fund), investments in EMEs are liquidated jointly and their proceeds repatriated. This joint liquidation causes co-movements across capital flows from EMEs.

additional term containing two variables: the first, $\phi_h^{(n)}$, which is labelled as beta-premium sensitivity, measures the covariation between the price and quantity of active fund risk. The second, $var(\lambda_t)$, captures the variability of the price of active fund risk. The term $\phi_h^{(n)}$is particularly important in this framework as it allows to capture the detrimental effect of capital outflows from EMEs in bad times. In fact, local currency bonds with positive beta-premium sensitivities exhibit high risk precisely when the active fund experiences negative returns and large outflows. This is the time when investors dislike risk and the price of risk is high. Hence, these bonds earn higher average returns than the ones with low or negative beta-premium sensitivity.

4. Preliminary evidence

So et al (2019) bring their empirical framework to the data using empirical proxies for the variables of interest from multiple sources.[5] Their dataset is compiled over the sample period June 2007 – March 2018 [6] and explore the following sample of 16 EMEs: China, Colombia, Czech Republic, Hong Kong SAR, Hungary, Indonesia, Malaysia, Mexico, Peru, Poland, Russia, Singapore, South Africa, South Korea, Thailand and Turkey.

To strengthen the inference on the parameter estimates, So et al (2019) adopt a portfolio approach, conventionally used in much empirical literature in finance, whereby bonds from different countries are bundled together at any given time on the basis of their estimated exposure, or beta, to active fund risk.[7] More specifically, two portfolios are formed at the end of each month: the H and L portfolios including the bond/countries exhibiting the highest and lowest exposure to active fund risk, respectively.[8] This procedure is then repeated until the end of the sample.

Equation (1) suggests that bonds with large and positive betas should command a large risk premium and a higher expected return. This is because those are the assets that experience the largest losses in bad times, ie the active funds that experience negative returns and large outflows. Conversely, bonds exhibiting small positive or negative betas will act as a hedge in bad times, resulting in lower expected returns. In Table 1 we report the estimations of the average excess returns for both H and L portfolios, and their difference, for two bond maturities (one and three years, respectively). The average excess returns exhibited by the H portfolio are positive and significantly higher than the ones recorded for the L portfolio. While excess returns from H portfolio are all statistically significant at the 1% level, excess returns computed for L portfolio are overall insignificantly different from zero. Hence, the

5 For further details on the data sources and the empirical proxies, refer to So et al (2019), Section 4)).

6 Although bond return data are available from an earlier period, reliable data on fund flows are available only from mid-2000s.

7 The conditional betas are estimated in the spirit of Shanken (1990), using an auxiliary regression where the time variation in betas is captured by bond-specific characteristics. The time varying price of active risk is computed using the procedure proposed by Petkova and Zhang (2005) where the time variation of the price of risk is a linear function of the aggregate net capital outflow for bond investments from EMEs and a set of control variables. For further details refer to So et al (2019).

8 The highest and lowest exposure are computed as the top and lowest tercile of the distribution of estimated monthly betas.

resulting return differentials between H and L portfolios are large and significant. These results confirm one of the main predictions embedded in Equation (1): bonds whose returns positively co-move with the ones of the active fund command a substantial premium.

Excess returns and portfolio betas for the H and L portfolios

Table 1

Maturity	Excess returns		Portfolio betas	
	1 year	3 year	1 year	3 year
H portfolio	1.008***	1.406***	2.056***	3.745***
	(0.29)	(0.26)	(0.18)	(0.34)
L portfolio	0.112	0.148	0.268***	0.603***
	(0.16)	(0.14)	(0.06)	(0.14)
Difference	0.895***	1.187***	1.778***	3.141***
	(0.19)	(0.15)	(0.14)	(0.24)

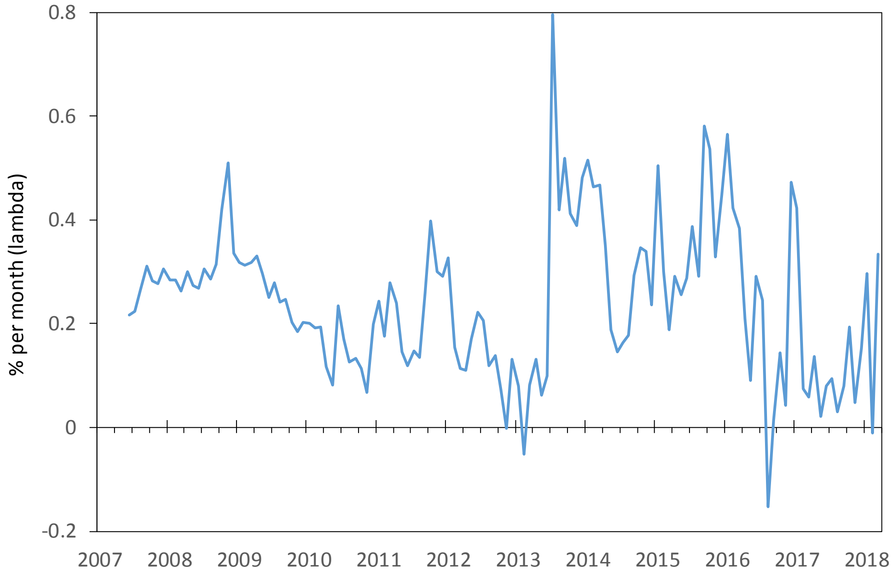
[1] Portfolio returns are reported as percentage points per month and recorded for each month subsequent to the construction of the portfolio. All returns are expressed in USDs. Values in parentheses are serial correlation- and heteroscedasticity-adjusted standard errors. ***, **, * denote statistically significant at the 1%, 5% and 10% levels, respectively.

It is worthwhile to note that the set of countries usually included in the H portfolio tend to have weaker macroeconomic fundamentals than those in the L portfolio. In fact, countries included in the H portfolio record current account deficits, hold less foreign reserve and their exchange rates depreciate significantly against the USD. Meanwhile, countries mostly included in the L portfolio run large current account surpluses, possess larger foreign exchange reserve and their currencies remain relatively stable over the sample period. This evidence suggests that the H portfolio comprises bonds issued by countries that exhibit a larger fragility than the one recorded for the L portfolio, and this fragility affects the reaction of bond returns to active fund risk and, ultimately, impacts bond risk premia.

We plot the time series estimate of the price of risk in Graph 3. The price of active fund risk was relatively flat at around 20 basis points per month (per unit of beta) until the taper tantrum episode in mid-2013. Then the large portfolio net outflows from EMEs shifted the price of risk from a value close to zero to 80 basis points. Since mid-2013 and until 2018, the price of active fund risk has remained higher on average at around 40 basis points per month until 2016 and it decreased afterwards. This pattern is indicative of a potential risk attitude shift around 2013, which led to a more cautious behaviour of market participants over the subsequent three years.

The price of active fund risk

Graph 3



[1] The price of active fund risk is the estimate of λ_t .

As a final statistics of interest, we report in Table 2 the estimates of the beta-premium sensitivity for H and L portfolios introduced in Table 1. We observe a positive relationship between the exposure and price of active fund risk by estimating beta-premium sensitivity. For both maturities, the difference between the two beta-premium sensitivities is positive and statistically significant. This confirms that the time variation of both the price and quantity of active fund risk is important in characterising the expected returns of local currency bonds. In addition, the results also suggest that local currency bonds with positive beta-premium sensitivities have high risk precisely when the active fund experiences negative returns and large outflows. This is the time when investors dislike risk and the price of this risk is high. Hence, these bonds are indeed the ones to earn higher average returns than the bonds with low or negative beta-premium sensitivity. This mechanism offers an alternative reading of the current debate on the occurrence of a global financial cycle. In fact, our model suggests a prominent role played by the time variation of the price of active fund risk in generating higher returns because of large capital outflows in bad times.

Beta-premium sensitivities

Table 2

Maturity	1 year	3 year
H portfolio	1.170*	2.156**
	(0.62)	(1.11)
L portfolio	0.164	0.340
	(0.20)	(0.42)
Difference	1.007*	1.816**
	(0.55)	(0.91)

[1] Values in parentheses are serial correlation- and heteroscedasticity-adjusted standard errors. ***, **, * denote statistically significant at the 1%, 5% and 10% levels, respectively.

5. Conclusions and policy discussion

The growth of local currency bond markets in EMEs is an important institutional development that has accelerated after the 2008 Great Financial Crisis. This note builds upon the empirical implications of theoretical models incorporating portfolio decisions of institutional investors and fund flows, and focuses on the implications of a framework that aims to explain the cross-section of EME local currency bond returns.

We discuss a host of interesting findings: First, there is evidence of a large heterogeneity of exposures to active fund risk in the panel of local currency bond. The portfolio comprising bonds with the largest exposure exhibits average excess returns, adjusted for market risk, that are higher than the ones recorded for the portfolio comprising bonds with the smallest exposure. Second, bonds contained in the portfolio with the largest exposure to active fund risk are issued by countries that exhibit weaker fundamentals over the sample period. Third, the portfolio containing bonds with the highest exposure to active fund risk exhibits a positive and statistically significant beta-premium sensitivity. Put differently, when outflows ensue, not only does the price of active fund risk increase, but also the exposure to active risk, meaning that certain countries suffer from a double and mutually reinforcing negative effect with bond prices dropping substantially and expected returns increasing to a larger extent.

The results discussed in the note help identify several important policy insights as local currency bond markets in EMEs develop further. First, as local currency bonds are increasingly included in traded benchmarks and as foreign investment funds gain more interests on local currency bonds, countries should be aware of the associated risks, namely the increased exposures of local currency bonds to the performance of active funds. Second, the development and expansion of local currency bond markets should be associated with the strengthening of the underlying macroeconomic fundamentals, or those that could "get one's house in order". In fact, we see that countries with good economic fundamentals are likely to have lower exposure to active fund risk. Third, policies aimed at minimising the negative externalities associated with first-mover advantages, namely the investor incentives that make portfolio flows to EMEs more volatile, could be a logical way to reduce the likelihood of large spikes in the price of active funds risk and the associated risk premia accruing to local currency bonds.

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Comments on "Local currency bond returns in emerging market economies and the role of foreign investors"

By Jie (Jay) Cao[1]

1. Summary

Emerging market economy (EME) bonds include sovereign bonds, quasi-sovereign bonds and corporate bonds. They can also be divided into local currency and US dollar-denominated bonds. This paper specifically focuses on local currency-denominated sovereign bonds. The issuance of such bonds has experienced a phenomenal growth, having reached USD 10 trillion by 2017. These bonds have relatively low default risk and better liquidity; however, they might still be subject to exchange rate risk.

The authors (So, Valente and Wu) study the cross-sectional risk-return relation of these bonds. Interest rate risk can be immunised by matching duration. The concerns relating to default risk and liquidity are already low for these bonds. In addition to the exchange rate risk, this paper also looks at new systemic risk originating from foreign (institutional) investors' portfolio return. Foreign investors hold, on average, 20% of EME local currency sovereign bonds. Institutional investors account for the majority of foreign investors, who usually look for higher yields or portfolio diversification.[2]

This paper asks the following:

- How do foreign institutions' participation affect the cross-sectional return variation in EME local currency bond markets?
- Will a change in risk appetite or the monetary policy of advanced economies (AEs) transmit to EME local currency bond markets?
- How can we quantify the risk premia driven by the fund flows of foreign investors actively managing portfolio holdings?

Specifically, the paper builds a theoretical model to incorporate the portfolio management decisions of foreign institutional investors and fund flows and proposes a conditional asset pricing model to explain the cross-section of EME local currency bond returns. Empirically, it tests the model using 16 EMEs[3] and five different maturities (1–5 years) of zero coupon bond, over the 2007–2018 period. The authors define the (passive) bond market portfolio using the JP Morgan GBI Global Traded

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2 These foreign institutional investors can be passive ETF funds such as iShares JP Morgan EM Local Govt Bond UCITS ETF (ticker: IEML), or actively management mutual funds such as BlackRock Emerging Markets Local Currency Bond Fund.

3 These include: China, Colombia, Czech Republic, Hong Kong SAR, Hungary, Indonesia, Korea, Malaysia, Mexico, Peru, Poland, Russia, Singapore, South Africa, Thailand and Turkey.

Index, which contains local currency bonds in both AEs and EMEs. The JP Morgan GBI-EM Broad Index, which only contains EME local currency bonds, serves as a proxy for the active bond market portfolio. They use the Emerging Portfolio Fund Research (EPFR) sovereign bond fund flows to and from EMEs as a proxy for the aggregate net outflows from the active fund.

The findings show that there exists a large variation in beta-to-active fund risk. High beta (country) bonds earn high expected returns and show weak fundamentals. Moreover, the portfolio with high beta bonds has a positive beta-premium sensitivity.

2. Comments

This paper raises an important question given the rise of EME local currency sovereign bonds. It studies the relationship between risks and returns for those bonds under a conditional asset pricing model and incorporating foreign institutions' portfolio decisions. The theoretical framework is carefully designed. The empirical implications are also well defined. This paper contributes to the literature on intermediary asset pricing and the role of institutions on financial markets. It also contributes to the literature on the cross-section of bond returns.

In terms of policy implications, this paper provides an explanation into why fragile countries' local currency bonds experience high expected return. It could be due to the high exposure to active fund risk. The positive beta-premium sensitivity suggests that the risk exposure also increases when the risk premium goes up during periods of stress. Such change in the risk premium is related to capital outflows from EMEs. This research could help bring about a better understanding of the causes of the Great Financial Crisis. In particular, the growth of bond exchange-traded funds (ETFs) raises the concern of commonalties among bonds held together. If flow is also affected by such commonalties, risk premia also increase under this paper's prediction. Therefore, EMEs with high exposure to active fund risk might want to mitigate foreign institutions' decisions to actively sell during periods of market stress.

The authors may need to better clarify active vs passive fund risk. This paper uses the framework of Vayanos and Woolley (2013). A passive index fund has no cost; an active fund tracks true market portfolio with a cost. In the context of the paper, active means only investing in EME bonds rather than in bonds from both AEs and EMEs, which is merely a choice of asset allocation. Therefore, it needs a better proxy for active funds – eg mutual funds or ETFs. It also needs a better proxy for fund flows of active funds. For example, a shock to foreign investors could cause outflows from both market funds and active funds. Empirically, are market fund returns also related to capital flows? If so, the risk exposure to market fund risk might also be significant.

Other issues:

1. This paper could look at US dollar-denominated EME sovereign bonds. This would help to avoid exchange rate risk. However, market segmentation may exist between different fund investors.[4]

[4] For example, BlackRock offers both foreign currency-denominated and local currency EME sovereign bond information: iShares JP Morgan USD Emerging Markets Bond ETF (EMB) vs iShares JP Morgan EM Local Govt Bond UCITS ETF (IEML).

2. This paper could also extend the empirical analysis to EME local currency corporate bonds rather than just sovereign bonds. It could provide more observations and increase statistical powers for cross-sectional tests. For example, the authors could select a sample of corporate bonds with reasonably low default risk and high liquidity, eg quasi-sovereign bonds.
3. The channel of active fund risk could be due to liquidity. Naturally, the price impact from outflows is due to block sales and fire sales. Therefore, EME local currency bonds with low liquidity would have high risk exposure.
4. The authors could also compare their research to the literature relating to the common factor approach on the cross-section of bond returns, in addition to the traditional consideration of idiosyncratic credit risk, downside risk and liquidity risk measures etc.
5. The current framework in this paper cannot exclude the impact of exchange rate (currency) risk. Given this imperfection, how to capture the cross-sectional variation in currency risk is worthy of further investigation. For example, when outflows can be induced by exchange rate changes, then the exposure to exchange rate risk could affect the risk premia to active funds.

3. Conclusion

This is an interesting paper with promising policy implications. It studies an important question given the increased issuance of EME local currency sovereign bonds. Specifically, it investigates the risk-return relationship between those bonds under a conditional asset pricing model and incorporating foreign institutions' portfolio decisions. The theoretical framework is carefully designed, while the empirical implications are also well defined.

The paper contributes to the literature on intermediary asset pricing and the role of institutions on financial markets. It also contributes to the literature on the cross-section of bond returns. For policymakers' consideration, it provides an explanation into why fragile countries' local currency bonds can experience high expected returns.

The paper could be further enhanced by conducting additional empirical analyses. This includes, for example, defining active bond fund returns more precisely, constructing more direct measures of fund flows on active bond funds, and by conducting a deeper investigation into the liquidity channel.

Reference

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Corporate bond use in Asia and the United States

By Greg Duffee and Peter Hördahl[1]

Abstract

We examine the determinants of Asian firms' decisions to participate in the corporate bond market and the determinants of the magnitude of bond debt for firms that do issue bonds. We compare the behaviour of Asian firms with US firms and investigate what drives differences in their financing decisions. We also analyse how firms alter their mix of bank and bond debt as their demand for cash varies. Our results show that firm characteristics account for only a very small portion of the difference in corporate bond use between Asian and US firms. Asian firms are simply less likely to issue bonds than US firms. The wedge in bond use between US and Asian firms is primarily driven by the likelihood that a firm issues bonds, rather than the magnitude of bond debt conditional on issuance. These results point to weak infrastructure, ie markets and institutions, as an important factor behind much of the lower use of bond financing in Asia. However, while policies aimed at facilitating the use of bond debt by Asian firms may result in increased bond issuance, it may not necessarily give firms more flexibility in meeting their financing needs. Even firms with a substantial presence in the corporate bond market primarily adjust their bank debt rather than their bond debt as demand for cash varies.

JEL classification: G30, G32

Keywords: Corporate bonds, capital structure, firm financing, firm characteristics

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1. Introduction

We study the financing of firms in Asia through corporate bonds and compare their financing decisions with those of firms in the United States. This is an important issue from a public policy perspective, since a robust corporate bond market has the potential to help dampen macroeconomic fluctuations by providing an alternative source of funds in case bank financing dries up.

Following the 1997–98 Asian financial crisis, policymakers in the region encouraged the development of local bond markets. The primary goal was to increase the issuance of local currency bonds relative to foreign currency bonds, in an effort to better insulate domestic economies from the effects of large exchange rate swings. Thus, much of the emphasis and resulting growth was concentrated in the government bond sector. But efforts were also made to improve conditions for corporate bond issuance in Asia. Partly as a result of these efforts, the total value of local currency corporate bonds across all nine Asian countries we study increased from US$36.5 billion in 1995 to US$3,795 billion in 2015, or as a percentage of GDP from 1.6% to 23.3% of combined GDP.

Nevertheless, on average, firms in Asia rely much more on banks for their financing needs than on bonds. For the nine Asian economies we study, less than a quarter of publicly traded non-financial firms in the region had corporate bonds outstanding, whereas most such firms in the United States had corporate bond liabilities. A key question is therefore why Asian firms' use of corporate bonds is so low.

One possibility is that the bond infrastructure is weak in Asian economies. In other words, the institutions needed to support a robust corporate bond market are weak. This includes information disclosure rules, accounting standards, corporate governance, bankruptcy rules and secondary market trading mechanisms. A weak financial infrastructure is problematic from a policy perspective because it limits the options for firms to find alternative funding sources outside the banking system in times of stress. Adverse shocks to the banking sector could therefore lead to greater financial distress in the corporate sector, magnifying the adverse effects on the economy as a whole.

However, weak bond infrastructure may not be the only, or even the main, driver behind the low use of corporate bonds among Asian firms. It is instead possible that intrinsic properties of Asian firms could result in them relying less on bond financing. For example, firms in Asia tend, on average, to be smaller than in the United States, and smaller firms are more likely to finance themselves via banks rather than bonds because informational asymmetries are greater for small firms than large ones.

In addition, it is not clear how beneficial the development of corporate bond markets is from an economic stability point of view. For example, financially strong firms may treat bank and bond financing as substitutes, but firms in financial distress may rely on banks for quick cash even if they have access to the bond market.

We investigate both aspects of the infrastructure problem; the role that infrastructure plays in the low use of corporate bonds in Asia, and the potential importance of bond market development for financial and economic stability.

To get at the first aspect, we study the variation in capital structure among US and Asian corporations using firm-specific variables. This follows the spirit of Rajan and Zingales (1995), although they study total debt while we focus on bond leverage. The use of firm-specific data allows us to address three questions. First, what determines the probability that a firm uses bonds to finance itself? Second, what determines the magnitude of bond financing once firms have decided to use bonds? Third, to what extent do firm-specific variables explain differences in bond leverage between Asian and US firms?

To get at the second aspect – the role of bond market development for financial and economic stability – we analyse how firms change their levels of bond and bank debt as the demand for financing changes. This follows the spirit of Shyam-Sunder and Myers (1999) and Frank and Goyal (2003), who study changes in firm's total debt as financing demand varies.

A number of key results emerge from our empirical analysis. First, the large difference in bond use between the United States and Asia is mainly due to the likelihood that a firm has issued bonds in the first place, rather than the magnitude of bond debt it has issued. The difference is therefore primarily driven by the extensive margin rather than the intensive margin. Second, small firms account for much of the difference between the bond use in the United States and bond use in Asia, with around half of US firms having bond debt compared with less than 10% of Asian ones. Third, firm characteristics other than size account for little of the difference between average bond leverage of US and Asian firms. This suggests that weak infrastructure in Asian economies is largely behind the difference in bond leverage. Finally, we find that both US and Asian firms with substantial bond leverage tend to rely mainly on banks rather than the bond market for marginal financing to offset variations in cash from operations. In addition, Asian firms with a substantial presence in the bond market tend to use bank debt as marginal financing of investment. This suggests that banks play a special role in the financing of firms, and that the potential for the corporate bond market to play a stabilising role in Asia may be limited even if the market expands.

2. Data

Our analysis requires international firm-level data on both bank and bond debt obligations as well as information on other firm-specific characteristics. The S&P Capital IQ Premium Financials (Capital IQ) database contains all of this relevant information.

The Capital IQ data is gathered from financial statements (income, balance and cash flows) that firms file with regulators. Our sample consists of data for firms in China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand, as well as the United States. Although accounting standards differ among countries, Capital IQ reports data on a harmonised basis, making it possible to compare the data. The data is reported on a consolidated basis, allowing us to capture bond issuance by both parent firms and subsidiaries. All reported amounts are converted to US dollars, and we use the US Consumer Price Index to convert the current dollars to end-2017 dollars. As is typical in the literature, we focus on non-financial firms, given that financial and non-financial firms differ qualitatively in how they use debt.

Finally, we include only data for firms that have publicly traded equity. This allows us to avoid a sampling bias whereby firms enter the data set because they have decided to issue bonds and therefore become subject to regulatory filing. All firms with publicly traded equity will appear in Capital IQ, regardless of their use of bond financing, and hence their presence in the dataset does not convey information about any future bond issuance. Including non-public firms, in contrast, would effectively oversample privately held firms that issue corporate bonds (the so-called backfilling problem).

While Capital IQ includes data for most countries from the early 1990s, we include data only as of 2003. The reason is that the data gathered by Capital IQ did not, with very few exceptions, distinguish between different types of debt before 2000. The coverage of bank and bond debt increased substantially through 2003, when it appears to have reached stable levels.

Table 1 reports summary information about bond and bank leverage for the firm years in our data.[2] On average, Asian firms' total leverage (the sum of bond and bank leverage) is similar to the total leverage for US firms. The average book leverage for Asian firms is 0.25, whereas the corresponding figure for US firms is slightly higher at 0.28. The mean leverage based on market assets is slightly higher for Asian firms (0.23) than for US firms (0.19). Although the average total leverage is similar in Asia and the United States, Asian firms make much greater use of bank debt than bond debt. The average bank leverage for Asian firm years is 0.22, measured using book assets, and 0.19 using market assets, while for US firm years the corresponding values are 0.15 and 0.10 respectively. US firms have roughly as much bond debt as bank debt, while the typical firm in Asia uses no bond debt at all. The median bond leverage is zero for all Asian economies in our sample, while the mean values (using book assets) range from 0.01 to 0.06.

Summary statistics for leverage ratios — Table 1

		Leverage using book equity				Leverage using market equity			
	Number	Bond		Bank		Bond		Bank	
	of obs	Mean	Median	Mean	Median	Mean	Median	Mean	Median
China	19803	0.02	0.00	0.22	0.20	0.01	0.00	0.14	0.10
Hong Kong SAR	6258	0.03	0.00	0.16	0.13	0.03	0.00	0.18	0.13
India	23797	0.01	0.00	0.26	0.24	0.01	0.00	0.28	0.25
Indonesia	1870	0.04	0.00	0.26	0.23	0.03	0.00	0.24	0.19
Malaysia	8074	0.02	0.00	0.20	0.17	0.02	0.00	0.22	0.18
Philippines	1003	0.03	0.00	0.17	0.14	0.02	0.00	0.15	0.11
Singapore	3441	0.01	0.00	0.20	0.17	0.01	0.00	0.20	0.16
South Korea	10348	0.06	0.00	0.18	0.15	0.05	0.00	0.19	0.14
Thailand	4458	0.04	0.00	0.22	0.19	0.04	0.00	0.20	0.15
All Asia	79052	0.03	0.00	0.22	0.19	0.02	0.00	0.21	0.16
United States	29102	0.13	0.04	0.15	0.08	0.09	0.02	0.10	0.05

The table reports means and medians for bond and bank leverage of non-financial firms with publicly traded equity. The observations are firm years, where fiscal years range from 2003 to 2016. Bond leverage is total bond debt to assets. Bank leverage is total bank debt to assets. Assets are either book value of assets or market value of assets, measured as book liabilities plus the market value of equity.

[2] Firm year data are included in our data set only if book assets exceed zero and all of the firm's leverage ratios (total, bond and bank) are between zero and one.

3. Variation in bond financing

We take a reduced form approach in trying to understand what explains the differences among countries in terms of firms' use of corporate bonds. We follow the spirit of the analysis in Rajan and Zingales (1995) and Lemmon, Roberts and Zender (2008) in assuming that leverage (in our case bond leverage) for a firm in a given year is a linear function of observable firm-specific characteristics and a residual.

We want to understand why the typical bond leverage ratio for an Asian firm differs from the typical ratio for a US firm, ie drivers of the population difference between bond leverage in Asia and in the United States. This difference in bond leverage is determined by differences in probability distributions of the firm-specific characteristics or fundamentals, differences in mappings from those fundamentals to the firm's choice of bond leverage, and regional differences that do not show up in firm fundamentals.

We can write the total difference in bond leverage between the United States and Asia, call it Z, as the sum of three terms: Z_1 – the difference across regions in the probability of having issued bond debt, conditional on firms' characteristics; Z_2 – the cross-region difference in the magnitude of bond leverage of firms in the bond market, given their firm characteristics; and Z_3 – the difference in bond leverage created by the cross-region difference in the distribution of firm characteristics.[3]

In implementing this decomposition, we consider the distribution of US firm characteristics as the benchmark. As a result, we can think of Z_1 and Z_2 as the combined effect on a firm's choice of bond leverage if we were to take a random firm out of Asia and put it in the United States. This part can therefore be attributable to infrastructure: features of markets and institutions that facilitate or impede the use of corporate bonds. The third term, Z_3, captures the wedge in bond leverage created by the difference between the fundamental properties of firms.

In order to obtain estimates of the components Z_1, Z_2 and Z_3 we assume that the conditional probability that a firm's bond leverage exceeds zero is linear in the firm's characteristics (denoted s). We estimate the parameters of this relationship by defining a dummy variable $I_{i,t}$ for firm i, which takes a value of one if the firm's bond leverage exceeds zero at t, and regressing it on the characteristics s of that firm:

$$I_{i,t} = b_0 + b_1 s_{i,t} + e_{i,t}.$$

This regression is run separately for US and Asian firms. Similarly, we estimate the firm's bond leverage (the ratio of corporate bonds outstanding to its market assets), $x_{i,t}$ as a linear function of firm characteristics:

$$x_{i,t} = c_0 + c_1 s_{i,t} + e_{i,t}.$$

Again, this regression is estimated separately for US and Asian firms. Differences in the estimated parameters b_0, b_1, c_0, and c_1 between Asia and the United States, along with differences in the distribution of s, will allow us to identify the components Z_1, Z_2 and Z_3 discussed above.

A key question is which firm characteristics to include in the vector of fundamental economic determinants of bond leverage. We follow Lemmon, Roberts and Zander (2008) and include a measure of firm size (book assets), market-to-book

[3] See the full version of the paper for details on the derivation of this decomposition.

assets, profitability, and tangibility (measured by the ratio of net property plant and equipment (PPE) to book assets)). Firm size proxies for the magnitude of asymmetric information about a firm's future cash flows. The informational sensitivity of a firm's debt is proxied by tangibility. Market to book and profitability proxy for the economic health of the firm.[4]

In preliminary regressions we checked whether the relation between our size variable – book assets – and the probability of non-zero bond leverage is accurately described by a linear function. We find substantial evidence that the relation is non-monotonic, and we therefore proceed to use dummy variables to define five size buckets that we use as our size variable. These quintiles are defined on total book assets for the combined universe of US and Asian firm year observations.

Asian firms differ from their US counterparts along a number of dimensions. Asian firms are, on average, smaller than US firms: 66% of Asian firm years (75% of Asia ex China) are in the bottom three quintiles of size, while 43% of US firm years are in the bottom three quintiles. Asian firms have lower average ratios of market assets to book assets, while the mean net income for Asian firms is slightly larger than for US firms. Finally, the average ratio of tangible assets to market assets is higher for Asian firms than for US firms. Given that Asian and US firms systematically differ in firm characteristics, it is possible that part of the gap in the use of bond financing could be explained by aggregate differences in these characteristics.

Conditional probability that a firm's bond leverage exceeds zero

Table 2

	United States		Asia		Asia ex China	
Largest size	0.81***	0.68***	0.65***	0.58***	0.76***	0.70***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Size Q1	–0.36***	–0.30***	–0.60***	–0.59***	–0.69***	–0.67***
	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Size Q2	–0.43***	–0.38***	–0.50***	–0.48***	–0.57***	–0.56***
	(0.04)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)
Size Q3	–0.48***	–0.42***	–0.47***	–0.45***	–0.49***	–0.49***
	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)
Size Q4	–0.34***	–0.32***	–0.36***	–0.35***	–0.34***	–0.33***
	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)
$(MA/BA)_{t-1}$	0.00	0.00	–0.00	–0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$(NI/MA)_{t-1}$	–0.17*	–0.06	–0.43***	–0.32***	–0.50***	–0.42***
	(0.09)	(0.09)	(0.07)	(0.06)	(0.07)	(0.07)
$(PPE/MA)_{t-1}$	0.23***	0.00	0.05**	–0.06**	–0.02	–0.09***
	(0.05)	(0.05)	(0.02)	(0.02)	(0.02)	(0.02)
$(Debt/MA)_{t-1}$		0.81***		0.34***		0.25***
		(0.06)		(0.03)		(0.03)
R^2	0.17	0.24	0.19	0.21	0.22	0.24

The table reports parameters of the equation specifying the conditional probability that a firm's bond leverage exceeds zero. This regresses a dummy variable equal to one if the firm's bond leverage exceeds zero at t on the explanatory variables listed in the table. Observations are firm years, from 2003 to 2016. Standard errors (in parentheses) are constructed as the mean of the standard errors obtained by running year-by-year regressions. Statistical significance at the 10th, 5th, and 1st percentiles is denoted with one, two, and three asterisks.

4 In the full version of the paper, we also present results for an expanded set of firm-specific characteristics. In this "persistence version" of the model, we also include a lagged indicator variable for non-zero bond leverage, and the lagged bond leverage itself, treating these as firm characteristics.

The regression results are presented in Tables 2 and 3. We report results for US firms, for all Asian economies combined, as well as for a second group of Asian economies that excludes China. It is possible that financing of firms in China may differ in important ways from firm financing in other Asian economies, given the special features of the world's largest economy. We present results including and excluding total leverage as an explanatory variable.

Table 2 shows that size is the strongest determinant of whether a firm has issued corporate bonds: all size variables are highly significant. Among the largest firms, US firms are more likely to have issued corporate bonds (0.81) than Asian firms (0.65) or firms in Asia-ex China (0.76). Moreover, the relation between size and probability of non-zero bond debt is monotonically increasing in Asia, but U-shaped in the United States. As a result, while US firms in the smallest quintile have a probability of bond debt of around 0.45, the corresponding probability for Asian firms in the smallest quintile is below 0.1.

Focusing first on the specification excluding total leverage, Table 2 shows that profitability is inversely related to the probability of bond debt in both Asia and the United States. This is in line with the results in Harris and Raviv (1991), who show that total leverage is inversely related to profitability. While the asset tangibility of US firms is strongly positively related to the probability of bond debt, this relationship is much weaker in Asia. And the point estimate is negative for Asia ex China; a surprising result.

Conditional expectation of firms' bond leverage

Table 3

	United States		Asia		Asia ex China	
Largest size	0.13***	0.06***	0.11***	0.07***	0.13***	0.08***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Size Q1	–0.06***	–0.04***	0.02	0.02	0.00	0.01
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Size Q2	–0.08***	–0.07***	0.00	0.00	–0.01	–0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Size Q3	–0.08***	–0.07***	–0.00	–0.00	–0.01	–0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Size Q4	–0.03**	–0.03***	–0.00	–0.00	–0.01	–0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$(MA/BA)_{t-1}$	–0.00	0.00	–0.01***	–0.01	–0.01***	–0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$(NI/MA)_{t-1}$	–0.14***	–0.07**	–0.09**	–0.06	–0.10**	–0.07
	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)
$(PPE/MA)_{t-1}$	0.15***	0.04**	0.02	–0.02	0.01	–0.02
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
$(Debt/MA)_{t-1}$		0.40***		0.13***		0.12***
		(0.03)		(0.02)		(0.02)
R^2	0.14	0.38	0.04	0.08	0.02	0.06

The table reports parameters of the equation specifying firm bond leverage (when greater than zero) on the explanatory variables listed in the table. Observations are firm years, from 2003 to 2016. Standard errors (in parentheses) are constructed as the mean of the standard errors obtained by running year-by-year regressions. Statistical significance at the 10th, 5th, and 1st percentiles is denoted with one, two and three asterisks.

Decomposition of difference in bond leverage between US and Asian firms

Table 4

	United States	Asia	Asia ex China
Expected bond leverage	0.105	0.038	0.046
Difference to US bond leverage		0.067	0.059
Component Z_1		0.035	0.023
Component Z_2		0.011	0.028
Component Z_3		0.022	0.007

The table reports the model-implied expected bond leverage (total outstanding bonds to market assets) and the decomposition of the difference in bond leverage between US and Asian firms into the three components described in the text. The first component, Z1, measures the wedge in the probability of bond issuance in the United States and Asia given a set of firm characteristics s. The second term, Z2, measures the wedge in the magnitude of leverage conditional on issuance. The third term, Z3, captures the wedge in bond leverage created by the difference between the distribution of characteristics *s* in the United States and the distribution in Asia.

The literature has shown that size, profitability, and tangibility are all related to total firm leverage. To investigate whether total leverage also matters for firms' decision to financing themselves in the bond market, we include total debt to market assets as an explanatory variable. However, strictly speaking, total leverage is not a firm characteristic but an outcome of the interaction of firm characteristics and external financing environment. As expected, Table 2 shows that firms with higher total leverage are more likely to have bond debt. A one standard deviation increase in total leverage (around 0.2) raises the probability of bond debt by about 0.16 for US firms and by 0.07 and 0.05 for firms in Asia and Asia ex China, respectively.

Table 3 shows regression results for the conditional expectation of firms' bond leverage among firms that have issued corporate bonds. In the specification that excludes total leverage, we see that almost all of the variation in bond leverage among Asian firms is unexplained by firm characteristics. Only 4% of bond leverage variation among Asian firms and 2% for firms in Asia ex China is explained by firm-specific characteristics. Firm size does not matter for Asian firms. Market to book and profitability are significant, but their overall contribution is small. This is in contrast to US firms, where size, profitability, and tangibility are all important determinants for bond leverage.

When we add total leverage as an explanatory variable, market to book and profitability drops out as significant variables for Asian firms. In this specification, higher total leverage is associated with somewhat higher bond leverage among Asian firms with bond debt, while all other variation in bond leverage among these Asian firms is unexplained. By contrast, including total leverage for US firms does not change the statistical significance of the other firm characteristics.

Given these results, we can proceed to evaluate the components Z_1, Z_2 and Z_3 that make up the total difference in bond leverage between US and Asian firms. Table 4 presents the results. The first row shows that there is a gap in bond leverage between US and Asian firms of around 6-7 percentage points to be explained: the estimated unconditional bond leverage for US firms is just above 0.10 while it is around 0.04-0.05 for Asian firms. The first component (Z_1) explains roughly half of the difference. This term captures the difference in the probability that firms issue bonds in the United States and Asia, conditional on US firm characteristics. The second component (Z_2), which measures the difference in bond leverage conditional on bond issuance, explains only around 1 percentage point of the difference when comparing US firms with firms in all of Asia. But if we exclude China, the contributions from the two components are more evenly divided. The third component (Z_3), finally, captures the difference in bond leverage due to discrepancies in the distribution of firm characteristics in Asia and the United States. This component explains just over 2 percentage points of the difference in bond leverage. However, this is largely driven by Chinese firms, and once we exclude these firms, this component plays essentially no role in explaining the wedge in bond leverage.

To sum up, the results from Table 4 suggest that firm-specific characteristics play a very limited role in explaining differences in corporate bond leverage across Asia and the United States. This suggests that infrastructure – institutions and markets – account for the bulk of the lower reliance on bonds among Asian firms, compared to their US counterparts. And Tables 2 and 3 show that this difference in bond use is primarily driven by the likelihood that firms issue bonds, rather than the magnitude of bond debt among firms that have issued bonds.

4. The substitutability of bank and bond financing

Consider a firm that has considerable access to the bond market. Where would such a firm raise money – in the bond market or from banks – in the event that it experiences a cash crunch due to a revenue shortfall? Bond and bank financing differ in two important ways. First, bank financing provides greater flexibility than bond financing, in that it allows firms to renegotiate terms in times of financial distress. Second, bank debt, unlike bond debt, is tightly bundled with state-contingent control rights.

To specify regressions that can address this issue, we first start from an accounting identity, which states that the change in a firm's cash holdings equals cash from operations plus cash from investment plus cash from financing. Equivalently, cash from financing (change in debt and net equity issuance) equals change in cash minus cash from operations plus net investment. Now, instead of focusing on total debt, we disaggregate it into bank debt and bond debt, which, ignoring net equity issuance, will make up the dependent variables in two sets of regressions. The explanatory variables are then the change in cash, cash from operations, and two components of net investment: the change in PPE and in intangible assets. The change in PPE captures investment in physical assets and the change in intangible assets proxies for merger and acquisition activity. Finally, we scale all variables by the firm's market value of assets to not have the largest firms dominate the results.

In order to capture firms that have "considerable access to the bond market", we include data only for firms with substantial bond debt – specifically, a ratio of bond debt to book assets of at least 0.13 in the previous year. Given this criterion, the mean firm year in the three regions we consider here – the United States, China and Asia ex China – all have bond leverage exceeding bank leverage.

Changes in debt explained by demand for cash

Table 5

Region	Debt type	Component of demand for cash				R^2
		Change in cash	Negative cash from operations	Change in PPE	Change in intangible assets	
China	Bank	0.22**	0.27***	0.43***	0.37***	0.27
		(0.10)	(0.09)	(0.07)	(0.14)	
	Bond	0.12**	0.13**	0.12**	0.08	0.06
		(0.05)	(0.06)	(0.05)	(0.15)	
		[–0.95]	[–1.29]	[–3.58]	[–1.42]	
Other Asia	Bank	0.14***	0.22***	0.33***	0.27***	0.19
		(0.04)	(0.03)	(0.02)	(0.04)	
	Bond	0.18***	0.08***	0.14***	0.17***	0.07
		(0.04)	(0.02)	(0.02)	(0.03)	
		[0.66]	[–3.70]	[–6.22]	[–1.90]	
United States	Bank	0.05*	0.16***	0.24***	0.22***	0.16
		(0.03)	(0.02)	(0.03)	(0.02)	
	Bond	0.20***	0.06***	0.26***	0.18***	0.16
		(0.03)	(0.02)	(0.02)	(0.02)	
		[3.70]	[–3.85]	[0.56]	[–1.35]	

The table reports parameter estimates from panel regressions. The dependent variables are changes in either bank debt or bond debt, scaled by a firm's market value of assets. The explanatory variables are four sources of a firm's demand for cash. The term PPE refers to net property, plant, and equipment. Data for firm *i* in year *t* is included only if the firm has a (bond debt)/(book assets) ratio of at least 0.13 in year $t-1$. Heteroskedasticity-consistent standard errors are in parentheses. Statistical significance at the 10th, 5th, and 1st percentiles is denoted with one, two and three asterisks. Brackets contain an asymptotic t-test of the hypothesis that the coefficients are equal across the bank and bond debt regressions.

The results, as shown in Table 5, highlight three main results. First, these firms, which have a considerable presence in the corporate bond market, primarily rely on banks rather than the bond market to offset variations in cash from operations. The sensitivity of bank financing to cash from operations is more than twice the corresponding sensitivity for bond financing in all three regions. Second, while US firms use slightly more bond debt than bank debt to fund changes in long-term assets (PPE), Asian firms overwhelmingly rely on bank debt. Third, when firms simply want to increase their holdings of cash, they rely less on bank financing. US firms rely almost exclusively on bond financing, while Asian firms use bank and bond debt in roughly equal proportions (we cannot reject the hypothesis that they increase bank debt and bond debt evenly).

To sum up, bank debt is marginal financing for Asian firms that need to raise cash for operations or for acquiring long-term assets. Note that this result applies to firms with a considerable presence in the corporate bond market. While the conclusions for US firms are not as clear cut, they still rely heavily on bank financing when funding long-term assets. Hence, bank debt plays a disproportionately large role in marginal financing decisions for both US and Asian firms.

5. Conclusions

We ask why firms in Asia use less corporate bond debt than firms in the United States. From a policy perspective, this is an important issue because a robust corporate bond market has the potential to help dampen macroeconomic fluctuations by providing an alternative source of funds in case bank financing dries up.

Our analysis shows that firm characteristics are not important in explaining the difference in the use of bonds between Asian and US firms. Much of the gap in reliance on bond financing is due to a higher frequency in Asia of firms that have no corporate bonds at all. But even for those firms that issue corporate bonds, Asian firms have lower average bond leverage than US firms. Our results suggest that weak infrastructure – institutions and markets – account for the much of the lower use of bonds among Asian firms, relative to US firms.

However, Asian and US firms with substantial corporate bond leverage share an important property. They tend to rely mainly on banks rather than the bond market for marginal financing to offset variations in cash from operations. In addition, Asian firms with a substantial presence in the bond market tend to use bank debt as marginal financing of investment. This evidence suggests that bank financing is the marginal source of debt for firms, even when they apparently can turn to the bond market. Banks, therefore, seem to play a special role in the financing of firms, suggesting that the potential for the corporate bond market to play a stabilising role in Asia may be limited even if the infrastructure is strengthened and the market expands.

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Comments on "Corporate bond use in Asia and the United States"

By Vidhan K Goyal[1]

1. Introduction

Gregory Duffee and Peter Hördahl examine the use of corporate bond financing by firms in the United States and Asia with a view to understanding both the decision to issue corporate bonds and the magnitude of bond financing conditional on having bond debt. Many economists consider the low use of corporate bonds by Asian firms as an infrastructure problem arising from poor institutions. The lack of access to corporate bond markets makes it difficult for firms in Asia to switch to non-bank sources and renders them more vulnerable to bank credit supply shocks. The major strength of the Duffee-Hördahl paper is its focus on understanding the infrastructure problem, since policies that aim to strengthen bond market infrastructure and stimulate corporate bond supply are rooted in the idea that access to corporate bonds would dampen the effect of macroeconomic fluctuations on real activity.

Duffee and Hördahl break new ground by constructing measures of the bond and bank leverage of firms in the United States and Asia and by decomposing cross-regional differences in bond leverage into those due to (i) cross-regional differences in the probability of a firm using bonds, conditional on firm characteristics, (ii) cross-regional differences in the amount of bonds a firm has, conditional on firm characteristics, and (iii) cross-regional differences that arise due to variations in the types of firms that operate in Asia and the United States. Thus, the empirical setup in the Duffee-Hördahl paper can decompose differences in bond leverage into those due to bond infrastructure (markets and institutions) and those due to firm characteristics.

Their conclusion is that fewer Asian firms than US firms have corporate debt. Many Asian firms do not access corporate bond markets and the differences are stark for small firms – Asian small firms are much less likely to have corporate debt than US small firms. And, even among firms that do use corporate debt, bond leverage is lower in Asia than in the United States. They point out that firms in Asia largely rely on bank debt to fund external financing needs, while US firms rely on both bank loans and public debt.

2. Comments

Although Duffee and Hördahl document several useful stylised facts about the use of corporate bonds in Asia and the United States, they cannot make causal inferences about the effect of supply-side frictions on the debt structure of firms. It is somewhat

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challenging to tease out the supply-side effects from demand considerations. Thus, even as we find that firms in Asia use less public debt than those in the United States, we do not know whether it reflects difficulties in issuing corporate debt (due to supply-side frictions) or simply firms' desire not to issue public debt even though they could (due to demand-side considerations).

The demand-side explanations for the low use of corporate bonds by Asian firms deserve serious consideration. It is plausible that Asian firms prefer bank loans because of the advantages banks offer. Banks have superior monitoring ability and can produce information at a lower cost as they have access to a firm's transaction accounts. Banks are also good at keeping proprietary information confidential. Furthermore, banks can resolve distress more efficiently and have greater flexibility in renegotiating contracts with borrowers.

Duffee and Hördahl's approach to disentangling the supply and demand considerations is to control for firm characteristics that drive demand for bond leverage. This approach to dealing with differences in demand is insufficient in convincing the reader that the variation in the use of public debt (or the mix of public and bank debt) is caused by, not simply correlated with, variations in supply-side frictions (i.e. infrastructure problems). Do the types of industries and, thus, the kinds of assets that back up the debt differ across countries? Do institutions that affect both the demand for and supply of public debt differ across markets, either because of the development of the financial market or because liquidation costs in bankruptcy differ across jurisdictions?

The literature has made some progress on this issue by focusing on shocks to supply frictions, which are otherwise uncorrelated with demand for corporate bonds. An example of such shocks would be changes to bankruptcy laws or improvements in information architecture that exogenously change the monitoring and screening costs of bondholders or their recovery in default. These shocks, however, have complex redistributive effects that are often hard to disentangle. Vig (2013), for example, examines how firms altered their debt structures in response to a strengthening of creditor rights in India. The securitisation reform strengthened the rights of secured creditors, thereby increasing secured debt capacity and lowering the cost of borrowing. It also exposed firms to the threat of premature liquidation. Thus, the change in bond infrastructure has mixed welfare implications. It could affect both the supply of and the demand for credit.

In a recent paper, Goyal, Urban and Zhao (2019) examine changes to the information environment of firms that accompany the exogenous addition of their stocks to equity indexes. They show that the improvement in the information environment results in an increase in public debt issuances and improves the ratio of bond-to-bank financing. Goyal, Urban and Zhao also find that the effect of index membership on public debt issuances is larger in markets with weaker bond infrastructure. Thus, there is support for the Duffee-Hördahl argument that information frictions prevent firms from accessing corporate bond markets and increase their reliance on bank financing.

Duffee and Hördahl also present results from a second empirical approach where they examine incremental financing through bank loans or bonds in response to financing deficits in a setting similar to those in Shyam-Sunder and Myers (1999) and Frank and Goyal (2003). As these other papers show, it is important to ensure that the cash flow identity holds in the sample.

Importantly, it would seem that changes in working capital are a part of cash flow from operations. If so, then I am not surprised that firms turn to banks to offset variations in cash flow from operations. We know that firms engage in the matching of maturities and often finance short-term working capital needs with bank loans. If much of the variation in cash flow from operations is driven by working capital needs, then bank financing would be highly sensitive to fluctuations in operating cash flows. This would be true for both Asian and US firms, and the evidence is not strong enough to justify Duffee and Hördahl's conclusion that "firms with substantial corporate debt primarily adjust their bank debt as demand for cash varies". One would expect firms to do so since short-term liabilities should fund variations in short-term assets. Thus, I disagree somewhat with the paper's implicit conclusion that improving access to bond markets may not improve welfare since firms rely on bank financing to adjust variations in cash flows. What I find more interesting is the evidence on how fixed assets are financed and the greater reliance on corporate debt in the United States than on bank debt in Asia. Here, it would be useful to perform a cross-sectional analysis to understand which types of US firms are financing long-term assets via bank debt.

The broader point of this discussion is that we need to directly confront the issue of bond infrastructure problems as an explanation for the low corporate bond use in Asia. We need to understand what the supply-side frictions are and if corporate bond use is cross-sectionally related to the strength of these frictions. I would also encourage Duffee and Hördahl to document bond issuance costs and provide more information on measures of frictions that restrict access to bond markets in Asia.

In summary, the bond infrastructure problems such as differences in accounting standards, information disclosure rules, bankruptcy laws, corporate governance and secondary market trading platforms do indeed matter in determining the supply of corporate bonds. The evidence in Duffee and Hördahl's paper supports the notion that reducing these frictions would result in a greater issuance of publicly traded bonds to finance long-term assets. Given this evidence, policymakers should aim to reduce debt supply frictions and provide firms with greater flexibility in substituting bank loans with public debt. This would dampen the adverse consequences of macroeconomic shocks on corporate investment, growth and employment.

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The role of different institutional investors in Asia-Pacific bond markets during the taper tantrum

By David Ng, Ilhyock Shim and Jose Maria Vidal Pastor[1]

Abstract

Emerging markets have grown rapidly over the past two decades, and sovereign and corporate borrowers are increasingly reliant on bond financing. Given widespread concern over what will happen to emerging market bonds as central banks in major advanced economies start to unwind quantitative easing policies and raise interest rates, this paper examines the behaviour of different investors buying and selling emerging market government and corporate bonds around the 2013 taper tantrum. Using detailed security-level data on bond holdings by institutional investors from Thomson Reuters eMAXX, we find that mutual funds – which are subject to outflow pressures – tended to liquidate their bond holdings of emerging Asian bond markets, while insurance companies, annuities and pension funds – all of which are not subject to outflow pressures – bought extra bonds in these markets. We also find some evidence of global retrenchment during the taper tantrum. In particular, local (Asia-domiciled) funds bought emerging Asian bonds, and global (US-, UK- and Europe-domiciled) funds sold these bonds. These results suggest that policymakers need to foster a stable domestic investor base and make efforts to better understand the behaviour and incentives of different bond investors.

JEL classification: G11, G15, F21

Keywords: Asia-Pacific, asset managers, fixed income investment, institutional investors, taper tantrum

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1. Introduction

Emerging markets (EMs) are playing an increasingly prominent role in global finance. Many governments and firms in these economies have become increasingly reliant on bond financing. At the same time, there is widespread concern over what may happen to global emerging bond markets as central banks' quantitative easing policies reverse and interest rates rise.

One such scare happened in the summer of 2013 during the taper tantrum. Prompted by concerns that US interest rates might rise, bond prices dropped suddenly and violently throughout EMs. On 3 May 2013, upbeat news coverage on US employment triggered a bond market sell-off, which reverberated globally to both advanced economy (AE) and EM assets. On 22 May 2013, Federal Reserve Chairman Ben Bernanke issued a statement on tapering. This led high-yield bonds and equities to join the sell-off. Between 3 May and 5 July 2013, the 10-year US Treasury yield increased by 100 basis points, while the 10-year sovereign yields of Japan, Germany and the United Kingdom went up by around 30, 50 and 75 basis points, respectively. The yield on the composite EM high-yield index rose by 130 basis points. To alleviate market-induced tightening of funding conditions, the Federal Reserve, European Central Bank and Bank of England issued forward guidance in June and July 2013, but yields remained at elevated levels until the end of 2013. In this paper, we study the roles of different institutional investors during the taper tantrum.

Our goal in this paper is to comprehensively characterise the roles of different institutional investors during the taper tantrum by examining which investors were selling or buying bonds during this major sell-off period. In particular, we focus on the differences between mutual funds – which are subject to outflow pressures – and insurance companies, annuities and pension funds – which are not subject to outflow pressures. We also examine the differences between local and foreign investors, which may react differently during a crisis.

Using new, detailed data sets from Thomson Reuters eMAXX that show the level of institutional bond holdings, we examine how different investors bought and sold Asia-Pacific government and corporate bonds around the taper tantrum. According to BIS debt securities statistics, Asia-Pacific bond markets – both domestic and international – have grown tremendously, from USD 8.3 trillion in Q1 2000 to USD 33.9 trillion in Q1 2018. This large bond market setting provides rich opportunities for researchers to observe the action of market participants.

The focus of our paper is to investigate the distinctive actions of different types of institutional investors. Building on evidence in previous literature that is based on a cross-section of different mutual funds, institutional investors are classified in this paper by types (ie mutual funds vs insurance companies / pension funds / annuities). Building on previous evidence on country-level flow patterns, we are able to classify institutional investors by (i) fund domicile (local, regional foreign or global foreign), (ii) managing company domicile (local, regional foreign or global foreign) and (iii) by mandate (funds investing in a country, in a region or globally).[2] We examine how these investors bought and sold bonds during the taper tantrum.

Prior research has examined various channels in which institutional investors play a role in perpetuating a financial crisis. The first channel is via an institutional fire sale due to pressure from mutual fund outflows (Feroli et al (2015), Morris, Shim and Shin (2017), Karolyi and McLaren (2017) and Goldstein, Hao and Ng (2017)). During a crisis, mutual funds face mounting outflows from end investors. These end investors may withdraw from the mutual funds due to irrational fear, or due to rational first mover advantage since the remaining shareholders may have to bear the liquidation cost of the illiquid assets. Faced with such outflows, mutual funds are forced to sell their assets to meet redemption demands, despite the fact that fund managers may want to keep the holdings or take advantage of the lower prices to buy more assets.

The second channel is through a global retrenchment process during crises (Broner et al (2013), Forbes and Warnock (2012), Giannetti and Laeven (2016) and Caballero and Simsek (2017)). Observing country-level flow patterns, these authors suggest that during expansions, foreigners invest more domestically while domestic investors invest more abroad. They propose that investors' main objective is to reach for yield during normal times. However, during a crisis they reach for safety. During such a period, there is retrenchment in both gross inflows by foreigners and gross outflows by domestic investors.

Another possibility is that the selling behaviour of bond investors is not fundamentally different during a crisis. Under a traditional international capital asset pricing model (CAPM) framework with homogeneous investors across the world, all investors sell a portion of their assets as risk premiums rise during a crisis. Under this scenario, there is no difference in buying and selling among different types of institutional investors.

Such different channels imply different responses from different institutional investors. Among institutional players in the Asia-Pacific bond markets, the largest are mutual funds, insurance companies, pension funds and endowments. Mutual funds have different geographic mandates and domiciles. These different investors face different constraints, which may dictate their responses to a market sell-off situation such as the taper tantrum.

Under the global retrenchment hypothesis, domestic investors would retrench in a crisis. This implies that non-Asia-Pacific domiciled funds would sell Asia-Pacific bonds and buy home-country bonds, while Asia-Pacific domiciled funds would buy their own country (or regional) bonds. Geographical mandates of funds may also affect the extent of their flight home bias. In a crisis, regional bond funds may be less likely to retreat from the overall Asia-Pacific region than global bond funds.

Under a fund-flow driven fire sale hypothesis, institutional investors facing outflows would sell their bond holdings, while those not facing outflow pressure would not sell. Flow pressure applies very differently across various institutional investors. Mutual funds have to meet outflow demands every day. Other institutional

2 We can view a fund's domicile as a proxy for an investor base or a fund residence, and a fund's managing company's (ultimate) domicile as a proxy for a fund manager base or fund nationality. For example, a fund managed by PIMCO in California domiciled in Hong Kong SAR is a Hong Kong fund by fund domicile but a US fund by fund nationality.

investors, such as insurance companies, pension funds and endowments, do not face such daily outflow pressures. By the nature of their business, insurance companies invest in bond portfolios to meet long-term obligations coming out of insurance contracts. Similarly, pension funds and endowments invest in long horizons to match the liabilities (ie the needs of their constituents).

The final hypothesis is that bond investors are not fundamentally different during a crisis. Under this hypothesis, there should be no difference in buying and selling across institutional investor types nor across countries.

To test the aforementioned hypotheses, we investigate the differences across investor types by using detailed individual bond-level holdings data from Thomson Reuters eMAXX, supplemented by data from Lipper IM. Specifically, we formulate our research questions as follows:

1. Which investors sold or bought Asia-Pacific government and corporate bonds during the taper tantrum?
2. How does global entrenchment work on the fund level? Does fund domicile matter in flight home bias? Does managing company domicile matter? Do fund mandates matter?
3. Was the sale of bonds due to investor redemptions or discretionary selling?

Our paper contributes to international finance literature by bringing new fund-bond holding level evidence to the table. Previous evidence on global retrenchment is documented at the country level (Broner et al (2013), Forbes and Warnock (2012) and Caballero and Simsek (2017)). Our paper provides evidence on global retrenchment on the fund level. In particular, we document how fund mandate and fund domicile matter in flight home bias. Previous evidence on fund outflows only focuses on mutual funds (eg Feroli et al (2015), Giannetti and Laeven (2016), Morris, Shim and Shin (2017) and Goldstein, Hao and Ng (2017)). Our paper provides detailed evidence on how different institutional investor types face different constraints. Lastly, our paper has important practical implications for policymakers in Asia-Pacific economies who have regulatory and supervisory authority over different institutional investors and bond markets.

Recent literature has highlighted liquidity mismatch facing mutual funds holding illiquid assets such as corporate bonds. As Goldstein, Hao and Ng (2017) point out, corporate bond funds tend to hold illiquid assets. Compared to equities that trade multiple times throughout the day, corporate bonds may not trade for weeks and trading costs can be substantial. At the same time, corporate bond funds quote their net asset values daily and allow investors to redeem their money daily, despite the illiquidity of the underlying assets. This results in a significant mismatch between the illiquidity of the fund's holdings and the liquidity that investors holding the fund shares expect. This liquidity mismatch also implies a first mover advantage: investors redeeming today may impose large externalities on those investors who remain invested in the fund. Funds with a country mandate may sell but only due to flows. Other institutions (eg insurance companies) have little flow pressure and have a long-term horizon. Our paper provides evidence on these differences in the context of a crisis.

The paper proceeds as follows: Section 2 describes data and summary statistics used in this paper; Section 3 presents empirical questions and design; Section 4 provides empirical results; and Section 5 concludes with discussions on policy implications.

2. Data and summary statistics

We construct our dataset from various databases. The main database we use is Thomson Reuters eMAXX, which has been used in several papers (Becker and Ivashina (2015) and Bodnaruk and Rossi (2016)) but is still a relatively new source in international finance literature. The eMAXX database has been employed mostly in analysing portfolio allocations in developed economies. This database provides a comprehensive coverage of fixed income holdings by asset managers and institutional investors around the world. It contains quarterly data on the holdings at the security level, the characteristics of individual bonds and issuers, and details on funds and their managing firms.[3]

Our paper focuses on Asia-Pacific corporate and government bonds held by asset managers and other institutional investors domiciled all over the world. The Asia-Pacific economies we examine include Australia, China, Chinese Taipei, Hong Kong SAR, India, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore, Thailand and Vietnam.

To select the funds used in the analysis, we first identify all distinct funds (including mutual funds, insurance funds, pension funds and annuity funds) holding at least one bond issued by an entity in the aforementioned Asia-Pacific economies. Next, we consider the funds that had consistent bond holdings data around the taper tantrum.

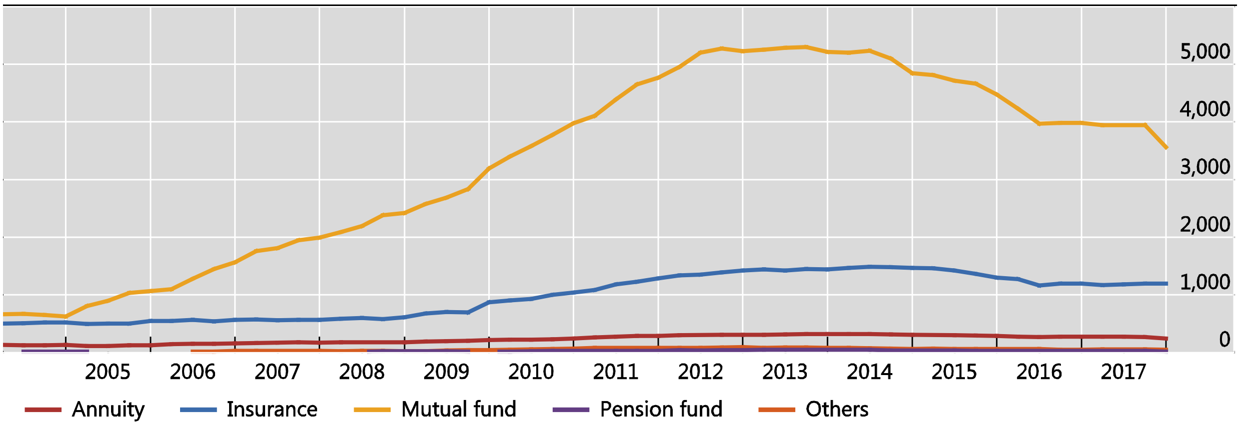
As a result, we carry out our empirical analysis with the following two samples of funds. The first sample contains information on 8,374 funds that have data at least for 14 quarters over the 20-quarter period from Q1 2011 to Q4 2015. During this period, the observations on mutual funds were 73% of the sample, while those on insurance companies accounted for 20% (Graph 1). The majority of all non-mutual fund investors (ie insurance companies, annuities, pensions and others[4]) were domiciled in the United States and Canada. In particular, in terms of the US dollar value of corporate bond holdings, mutual funds accounted for 59%, while insurance companies for 39%. In the case of government bonds, mutual funds held over 90% of the total US dollar value of the bonds in our sample (Graph 2).

[3] The BIS has access to this database for the period from Q1 2004 to Q4 2017. The eMAXX dataset is compiled by Thomson Reuters from regulatory filings around the world. eMAXX has relatively good coverage of bond holdings by US and Europe-domiciled mutual funds and US insurance companies, modest coverage of bond holdings by mutual funds domiciled outside the US and Europe, and poor coverage of insurance companies outside the United States. Unfortunately, it has a relatively poor coverage of bond holdings by local/domestic mutual funds and institutional investors in smaller Asia-Pacific economies due to lack of reporting requirements at the security level.

[4] Others include hedge funds, foundations, endowments and governments.

Number of institutional investor by type

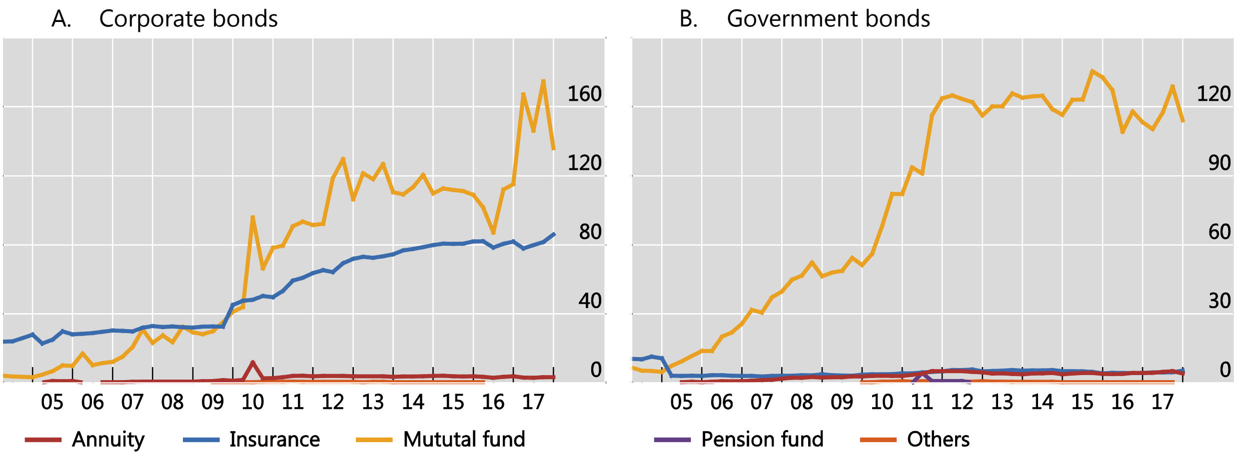
Full sample of funds Graph 1



Sources: eMAXX; authors' calculations.

Size of institutional investors by investor type in Asia-Pacific issued bonds

In billions of US dollars; full sample of funds Graph 2



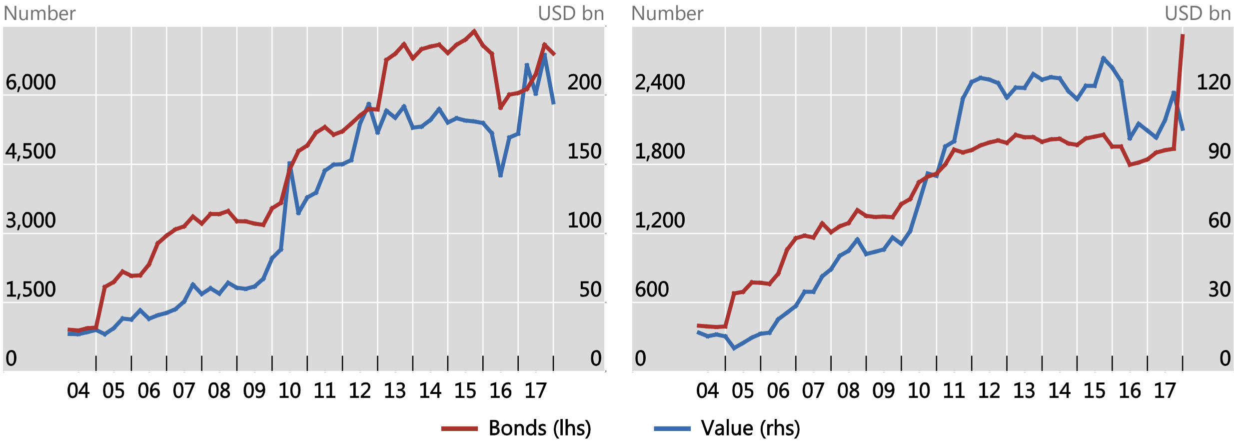
Sources: eMAXX; authors' calculations.

During the sample period, all funds in the full sample held 6,342 distinct corporate bonds and 1,985 distinct government bonds on average (Graph 3). Regarding the currency denomination of the bonds, US dollar-denominated bonds dominated the sample of corporate bonds, accounting for 60% of total dollar value, while Asia-Pacific local currencies accounted for 34% on average (Graph 4). In the case of government bonds, Asia-Pacific currencies were 85% of the total dollar value, while US dollar-denominated bonds were about 15% on average.

Total number and market value of distinct Asia-Pacific bonds

Full sample of funds | Graph 3

A. Corporate bonds | B. Government bonds

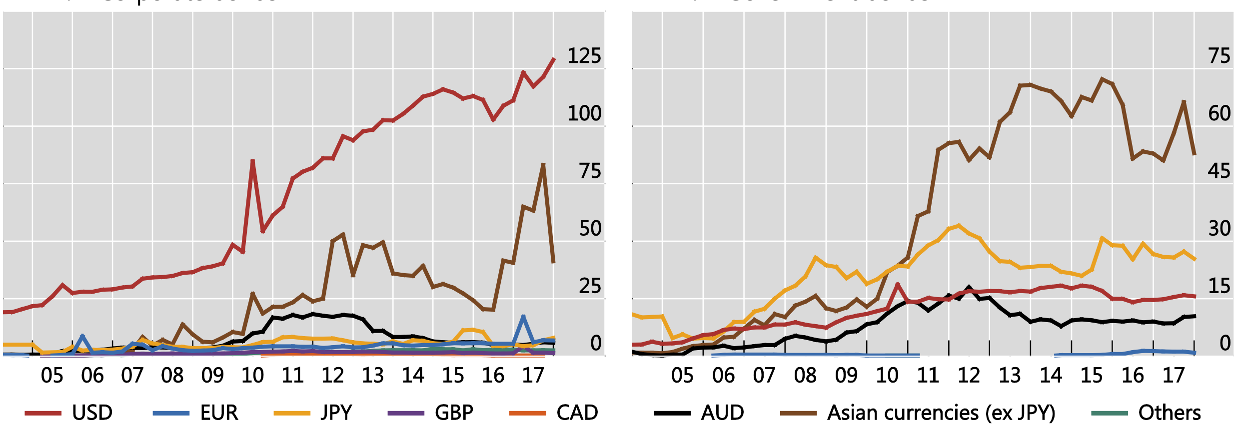


Sources: eMAXX; authors' calculations.

Size of Asia-Pacific bond holdings by currency of issue

In billions of US dollars; full sample of funds | Graph 4

A. Corporate bonds | B. Government bonds

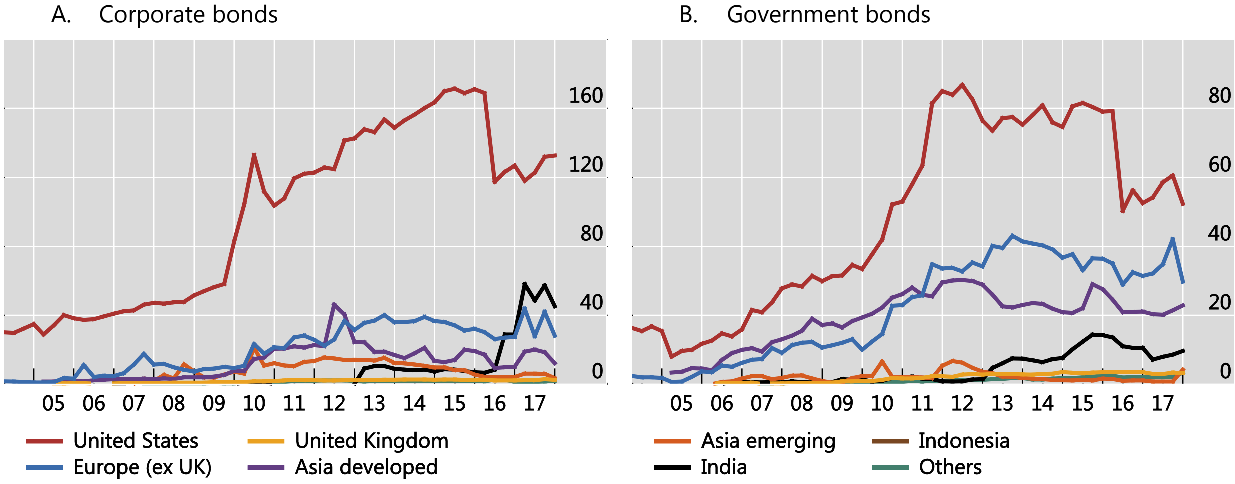


Sources: eMAXX; authors' calculations.

Graph 5 shows the US dollar amount of bond holdings by institutional investor domicile. At the end of Q4 2015, 70% of the total holdings of corporate bonds were held by US-domiciled funds, while Asia-Pacific domiciled funds held around 13%. In the case of government bonds, US-domiciled funds held about 52% of the total value, and Asia-Pacific domiciled funds 21%.

Size of Asia-Pacific bond holdings by fund domicile

In billions of US dollars; full sample of funds — Graph 5



Sources: eMAXX; authors' calculations.

Table 1 shows the distribution by issuer nationality of bonds held by the funds in our full sample as of Q4 2015. Panel A shows that US corporate issuers accounted for 73% of the total dollar value in our sample, while corporate issuers in China, Hong Kong SAR, India, Japan and Korea summed up to 1% of the total value of corporate bonds held by the funds in our sample. Regarding government bonds, Panel B shows that the United States accounted for 62% in terms of US dollar value. Among most notable Asia-Pacific issuer countries in the sample, China, Hong Kong SAR, India, Indonesia and Japan accounted for 4% of the total US dollar value. Finally, Panel C shows the number of funds and managing firms in our sample holding bonds issued by entities in each economy as of Q4 2015.

For the second sample, we supplement the eMAXX dataset with global mutual fund data from Lipper, a source that provides investor flows, fund-level returns, fund mandates, fund domiciles, total net asset value and other information related to the funds. As a result of name-matching the list of funds in both databases, we obtain our second sample comprising data for 1,770 funds. Table 2 provides descriptive statistics of the full sample and the matched sample.

Finally, we complement our database with various macroeconomic and financial control variables from different sources such as Bloomberg, Moody's, Standard & Poor's, the International Monetary Fund's World Economic Outlook, the BIS and national data sources. In particular, we consider country factors such as GDP growth, exchange rates, current account/GDP and sovereign credit ratings, as well as global factors such as the VIX Index.

For the construction of the change in holdings of bond i by fund j as the dependent variable in Tables 3–8, we use the par amount of bond holdings provided by eMAXX. The eMAXX data are based on regulatory disclosures by asset managers and institutional investors. In the case of the United States, the data on insurance companies come from the regulatory disclosures to the National Association of Insurance Commissioners, while the data on mutual funds come from the disclosure to the Securities and Exchange Commission. Disclosure by institutional investors in other jurisdictions and sectors is less comprehensive and, in many cases, voluntary. Given this fact, not all the funds report consistently every quarter.

To overcome this issue, we assume that if a fund holds a bond in a quarter that does not appear in the database in the next quarter but appears again in the near future, we carry over the amount of bond holdings to compute the correct change over the interim period. In addition, we control for funds that are co-managed by different firms to avoid double-counting of bond holdings. To avoid data errors present in the database, we winsorise the data at the 1% level on each tail.

When we construct the dependent variable used in Table 9, we normalise the amount of each bond held by each fund by the total amount of holdings of Asia-Pacific issued bonds held by that specific fund in the given quarter. To construct the independent variable based on flow data from Lipper IM, we normalise investor flows to a fund during a given quarter by the total net asset value of the fund at the beginning of the quarter. We winsorise this ratio at the 1% level on each tail. In addition, we generate different dummy variables to control for the type of institutional investor, fund location (domicile) and the taper tantrum period.

3. Empirical hypotheses and design

3.1. Empirical hypotheses

We aim to test three hypotheses based on the implications for institutional investors' behaviour during the taper tantrum. In our empirical work, we examine on an aggregate level what types of institutions bought and sold Asia-Pacific government and corporate bonds during the taper tantrum. Under a fund-flow driven fire sale hypothesis, institutional investors facing outflows would sell their bond holdings, while those not facing outflow pressure would not sell. Flow pressure applies very differently across various institutional investors. Mutual funds have to meet outflow demands, while insurance companies, pension funds, annuities and endowments do not face such daily outflow pressures. The main hypothesis we examine is whether during the taper tantrum mutual funds sold more Asia-Pacific bonds, while insurance companies, pension funds and annuities bought Asia-Pacific bonds.

In investigating the flow-driven hypothesis, we also examine whether mutual funds may also assess the impact of country-level market liquidity on the choice of purchases and sales. If meeting outflows is the only reason, then mutual funds may not only sell all bonds equally to meet their outflows, but may sell the more liquid countries first. In particular, driven by a fire sale the mutual funds may withdraw their investment from more liquid countries first (such as Korea) than from less liquid countries (such as Thailand). However, if mutual funds are reaching for safety as they meet outflows, then they may sell emerging Asian bonds first and may not sell or even buy developed Asia-Pacific bonds. Mutual funds selling only to meet outflows may sell developed Asian bonds first, while mutual funds that are also reaching for safety may sell emerging Asian bonds during the taper tantrum. Since insurance companies, annuities and pension funds are not subject to investor outflows, they may not be affected by flows concerns during the taper tantrum.

A global retrenchment process during crises suggests that during expansions, foreigners invest more domestically while domestic investors invest more abroad. The main objective of the investors is to reach for yield. However, during a crisis, investors reach for safety. During such a period, there is retrenchment in both gross inflows by foreigners and gross outflows by domestic investors. The main question is whether during the taper tantrum global investors sold Asia-Pacific bonds and bought their home-country bonds while Asia-Pacific investors bought Asia-Pacific bonds and sold non-Asia-Pacific bonds. We examine the country/region domiciles of the buyers/sellers during the taper tantrum, eg domestic-domiciled, Asia-Pacific domiciled or US-/Europe-domiciled mutual funds. We also examine how important the funds' nationality (ie the domicile of the fund management companies) is compared to or in addition to the funds' domicile in explaining their purchase and sale behaviour.

A traditional international CAPM framework with homogeneous investors across the world predicts that all investors sell a portion of their assets as risk premiums rise during a crisis. Under this scenario, there is no significant difference across investor types and investor domiciles in their purchase/sales patterns of Asia-Pacific bonds during the taper tantrum.

3.2. Empirical design

We begin with a simple regression framework to examine international portfolio allocations. In particular, for Question 1 in Section 1, we first look at which types of investors sell Asia-Pacific bonds. The basic regression equation is:

$$I_{i,j,t} = \alpha + \gamma_1 C_{j,t}^1 + \cdots + \gamma_n C_{j,t}^n + \varepsilon_{i,j,t},$$

where the dependent variable $I_{i,j,t}$ is defined as the "change of holdings" by investor j in bond i in quarter t. The independent variables, denoted by $C_{j,t}$, represent various explanatory and control variables, and include a taper tantrum dummy (which is equal to 1 for Q2–Q4 2013, and zero otherwise), mutual fund dummy, and the interactions term, 'taper tantrum dummy x mutual fund dummy'. In another specification, we have a taper tantrum dummy, insurance/annuity/pension dummy, and the interaction terms, 'taper tantrum dummy x mutual fund dummy' and 'taper tantrum dummy x insurance/annuity/pension dummy'. In all specifications, we include investor j fixed effect and year-quarter t fixed effect in our regressions, and cluster the standard error by investor.

Next, we consider which domiciles of investors sell Asia-Pacific bonds. Now, the independent variables include a taper tantrum dummy, global fund dummy (for US-, UK- and Europe-domiciled funds), Asia-Pacific domiciled regional fund dummy, domestic fund dummy and their interaction with a taper tantrum dummy. As before, we include investor j fixed effect and year-quarter t fixed effect in our regressions, and cluster the standard error by investor. When we consider fund nationality instead of fund domicile, we use a global fund company dummy, Asia-Pacific regional fund company dummy and domestic fund company dummy.[5]

4. Empirical results

Table 3 documents the net purchases of emerging and developed Asia-Pacific economy bonds by different types of investors during the taper tantrum. Developed Asia-Pacific includes Australia, Hong Kong SAR, Japan, Korea, New Zealand and Singapore, while emerging Asia includes China, Indonesia, Malaysia, the Philippines, Thailand, Vietnam and Chinese Taipei.[6] The institutional fire sale hypothesis suggests that during the taper tantrum, mutual funds, which are subject to flow pressure, would sell more bonds while insurance, annuity and pension funds, which are not subject to flow pressure, would not sell or may even buy bonds.

The first four columns in Table 3 show the results for emerging Asian corporate and government bond purchases. Examining the interaction term between the mutual fund and taper tantrum period dummy, we find that mutual funds were net sellers of emerging Asian government bonds during the taper tantrum relative to other times. In contrast, insurance companies, annuities and pension funds were net buyers of emerging Asian government bonds during the taper tantrum relative to other times. This confirms our hypothesis that mutual funds – which are more subject to outflow pressures – would reduce their bond holdings in the relatively risky emerging Asian government bond markets, while insurance companies, annuities and pension funds – which are not subject to outflow pressures – would increase their bond holdings in these markets. The results for emerging Asian corporate bonds are in the same direction but not significant. These results suggest that the institutional fire sale hypothesis, under which fund outflows drive institutional demands for bonds, seems to be observed in more risky emerging Asian markets.

Turning to the results for developed Asia-Pacific corporate and government bonds in the last four columns of Table 3, we find that mutual funds were net buyers of developed Asia-Pacific corporate bonds during the taper tantrum, while insurance companies, annuities and pension funds were net sellers. These results suggest that mutual funds moved into safer developed Asia-Pacific corporate bonds, while insurance companies, annuities and pension funds moved out of such assets. There is no statistically significant change of bond holdings in developed Asia-Pacific government bond markets during the taper tantrum.

Table 4 shows more specifically the net purchases of foreign currency bonds (mostly in US dollars) and local currency bonds in these economies. We find that the differential bond purchase patterns reported in Table 3 primarily occurred in the foreign currency bond markets (Table 4, columns 1–8). During the taper tantrum, we find that (i) mutual funds reduced their holdings of emerging Asian foreign currency government bonds while insurance companies, annuities and pension funds

[5] In the regression analysis in Section 4, we imposed symmetry between bond purchases and sales. In the future, we may consider bond purchases and sales separately. We may also use different variables for investor inflows and investor outflows to see if there is any asymmetry.

[6] India issued bonds are not included in emerging Asia bonds since the eMAXX dataset contains predominantly India local currency bonds held by India domestic mutual funds.

increased their holdings of such bonds; and that (ii) mutual funds actually increased their purchases of developed Asia-Pacific corporate bonds, which are considered safer, while insurance companies, annuities and pension funds decreased their purchases. We do not observe any significant pattern in local currency bonds (Table 4, columns 9–12).

Turning to our next hypothesis of global retrenchment, we examine whether the geographical locations of institutional investors affect their bond purchases. In particular, we examine the net purchases of Asia-Pacific bonds by local, regional and global investors during the taper tantrum. We classify institutional investors (or funds) based on the country of domicile of the managing firm. The global retrenchment hypothesis suggests that during a crisis, investors would reach for safety and that there is retrenchment in both gross inflows by foreign investors and gross outflows by domestic investors.

Table 5 reports the results. The first six columns document the purchases of emerging Asian bonds, while the last six columns document those of developed Asia-Pacific bonds.[7] We find that global funds were net sellers of emerging Asian corporate bonds, while they were net buyers of developed Asia-Pacific corporate bonds. At the same time, local funds tended to buy emerging Asian corporate bonds. Overall, we find some evidence of global retrenchment: local funds buy risky emerging Asian bonds, and global funds sell these bonds during crises. We also find that regional funds tended to reduce their holdings of developed Asia-Pacific government and corporate bonds during the taper tantrum.

As a robustness check, we have defined country domicile in terms of the domicile of the institutional investor (or fund). In that case, we find similar results, but the coefficients are slightly smaller in absolute size and less statistically significant than those from the regressions using firm domicile.

Next, we investigate our results further by examining foreign currency vs local currency bond markets. Table 6 presents results for foreign currency bonds only. We find that regional funds tended to sell emerging Asian foreign currency government bonds. Other than that, there is no statistically significant pattern for foreign currency bond purchases of local, regional and global funds during the taper tantrum.

Table 7 shows the results for local currency bonds only. The results are broadly similar to those reported in Table 5, with some signs of global retrenchment. In emerging Asian local currency bond markets, global funds were strong sellers during the taper tantrum, while local funds bought emerging Asian corporate bonds and Asia-Pacific regional funds bought emerging Asian government bonds.

Among developed Asia-Pacific local currency bond markets, regional funds sold both corporate and government bonds, while local funds bought corporate bonds during the taper tantrum. So far, the evidence we present suggests that the global retrenchment story is applicable in Asia-Pacific bond markets, particularly relevant to local currency bonds.

In Table 8, we examine the evidence of net bond purchase patterns by focusing on different country-domiciled investors (or funds). Instead of using one dummy for each bond issuer country, we group bond issuer countries into the following three

[7] Notice that for EM country bonds, there are relatively few global funds in this sample, and we focus on local and regional funds.

categories: (i) developed countries (Australia, Europe excluding the United Kingdom (Europe ex UK), Japan, the United Kingdom and the United States)); (ii) relatively advanced Asia EMs (Chinese Taipei, Hong Kong SAR, Korea and Singapore); and (iii) Asia EMs (China, Indonesia, Malaysia, the Philippines, Thailand and Vietnam).

Panels A, B and C show the change of bond holdings for US-, UK- and Europe ex UK- domiciled funds. These funds are considered global funds. Panel A shows that during the taper tantrum, US-domiciled funds purchased developed country corporate bonds. Panel B shows that UK-domiciled funds sold emerging Asian government bonds and purchased developed country government bonds. Panel C shows that Europe ex UK-domiciled funds sold emerging Asian government bonds and purchased developed country government bonds and relatively advanced Asia EM bonds. Overall, Panels A, B and C of Table 8 suggest that there was a strong selling pattern for emerging Asian government bonds, and strong buying for developed country government bonds among these global funds during the taper tantrum.

Panel D shows the results for Australia- and Japan-domiciled funds, while Panel E shows the results for funds domiciled in Chinese Taipei, Hong Kong SAR, Korea, Malaysia and Singapore. These are essentially Asia-Pacific regional funds. Panel D shows that Australia- and Japan-domiciled funds purchased developed country government and corporate bonds during the taper tantrum. Panel E shows that funds domiciled in other Asian economies tended to sell Asian emerging market government bonds and advanced Asian emerging market corporate bonds during the taper tantrum. Overall, Panels D and E of Table 8 suggest that Asia-Pacific regional funds exhibited similar behaviour to global funds. It should be noted that in Panel E, the coefficients on the two interaction terms involving relatively advanced Asia EMs and Asian EMs, respectively, capture the behaviour of both regional and local funds as defined in the regressions reported in Tables 5–7. In future work, we plan to investigate the behaviour of Asia-Pacific domiciled funds in their local bond markets (ie local funds) and Asia-Pacific regional markets (ie regional funds) separately.

Last, we examine how much investors shift from Asian to non-Asian bonds in their portfolios when they have inflows/outflows. To do so, we need to match the eMAXX dataset with fund flows data, which is available from Lipper. After merging the datasets, we have a final sub-sample of 1,770 funds, and almost all of them are mutual funds.

In Table 9, we examine how fund inflows may affect their holding of Asia-Pacific bonds. The dependent variable is the change in the ratio of the book-value of a specific Asia-Pacific bond held by a fund to the sum of the book value of all Asia-Pacific bonds held by the fund. The standardised flow is defined as the ratio of investor flows during a quarter to the total net assets at the beginning of the quarter.

A positive coefficient on the term means that when standardised flows increase, the share of a specific Asia-Pacific bond held by a fund out of the total Asia-Pacific bonds held by the fund increases. This indicates that when the standardised flows are positive, the share of a specific Asia-Pacific bond held by a fund out of the total Asia-Pacific bonds held by the fund increases, and that when the standardised flows are negative, the share of a specific Asia-Pacific bond held by the fund out of the total Asia-Pacific bonds held by the fund decreases.

For the interaction term, "taper period x standardised flows", a positive coefficient on the interaction term means that when standardised flows decrease, during the taper tantrum period the share of a specific Asia-Pacific bond held by a fund out of the total Asia-Pacific bonds held by the fund decreases more than during the non-taper tantrum period. We expect a positive coefficient on the interaction term.

We find that as mutual funds faced outflows during the taper tantrum, they decreased their allocations to the holdings of corporate bonds in developed Asia-Pacific economies in both foreign and local currencies and increased their allocations to the developed Asia-Pacific local currency government bonds. Overall, the evidence seems to suggest that mutual funds facing outflow pressure tended to invest more in relatively safe assets and less in risky assets.

There is no official starting and ending dates for the taper tantrum. In all our regressions so far, we define the period as Q2–Q4 2013. We also examined results when we define the taper tantrum period more narrowly as Q2 and Q3 2013. The results are generally similar, although overall less statistically significant.

5. Conclusion

Using security-level bond holdings data from eMAXX, this paper examines the behaviour of different institutional investors in Asia-Pacific bond markets during the taper tantrum. We find that mutual funds – which are subject to outflow pressures – liquidated their bond holdings in the relatively risky emerging Asian bond markets, while insurance companies, annuities and pension funds – which are not subject to outflow pressures – bought extra bonds in these markets. We also find some evidence of global retrenchment, where local funds bought local bonds, and regional/global funds sold these bonds during the taper tantrum. Finally, we show that mutual funds tended to invest more in relatively safe assets (developed Asia-Pacific local currency government bonds) and less in relatively risky assets (developed Asia-Pacific corporate bonds).

This paper provides the following policy implications. Different types of investors in bond markets face different regulatory and economic constraints. In particular, mutual funds face investor redemptions, which is a cash flow constraint. Furthermore, mutual fund managers are averse to becoming the worst performer in their categories for fear of losing fund flows, and may further impose on themselves internal risk limits that lead to reach for safety-type behaviour during a crisis situation. In contrast, insurance companies, annuities and pension funds do not face such cash flow constraints (although admittedly insurance companies face regulatory capital constraints). Therefore, it is important that more stringent internal risk management or regulation be in place to avoid distress selling by investors facing more heavy constraints. Such stringent risk management or regulation may come with a cost during normal times when mutual funds bring in much liquidity.

During the taper tantrum, we also find that global asset managers sold emerging Asian bonds. This has generated bond price falls and additional investor redemptions. In order to mitigate the impact of such behaviour of global asset managers on bond markets, policymakers should consider fostering a truly domestic and stable institutional investor base such as domestic pension funds and insurance companies, who could act as a natural buyer of bonds when foreign investors sell and dampen market volatility during market stress.

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Tables

Number and US dollar value of corporate bonds

By country of issuer, as of Q4 2015 Table 1A

eMaxx universe			8,734 funds sample		
Country	Value (USD bn)	Number of bonds	Country	Value (USD bn)	Number of bonds
United States	3865.48	41826	United States	3380.04	36068
Cayman Islands	107.50	6244	Cayman Islands	85.17	5591
United Kingdom	318.99	5278	United Kingdom	245.08	4201
Canada	334.71	3500	Canada	219.16	2926
The Netherlands	147.43	2769	The Netherlands	113.93	2190
France	111.46	2627	Japan	14.13	2092
India	10.42	2541	France	79.72	2012
Japan	20.62	2317	Australia	79.10	1346
Germany	38.76	1765	Luxembourg	57.48	1285
Australia	89.62	1511	Germany	24.92	1202
Luxembourg	75.85	1508	India	4.98	1103
Norway	28.60	1489	Korea	5.41	948
China	6.63	1450	China	4.16	801
Korea	7.62	1335	Ireland	23.01	769
Sweden	29.84	1205	Italy	19.95	651
Ireland	30.88	1072	Hong Kong SAR	4.23	599
Italy	31.50	832	Switzerland	8.80	552
Others	322.20	10229	Others	248.68	6885

Sources: eMaxx; authors' calculations.

Number and US dollar value of government bonds

By country of issuer, as of Q4 2015 — Table 1B

eMaxx universe			8,734 funds sample		
Country	Value (USD bn)	Number of bonds	Country	Value (USD bn)	Number of bonds
United States	1730.12	8826	United States	1291.4	6742
Japan	80.62	1709	Japan	32.4	1593
Canada	74.90	699	Canada	25.9	421
Germany	107.17	470	Germany	44.3	315
Korea	17.81	311	Korea	13.6	260
Italy	140.03	291	Israel	11.7	210
France	63.77	265	China	3.2	199
China	3.91	254	Italy	48.0	171
Israel	13.92	250	France	24.8	170
India	22.25	227	India	18.1	141
Mexico	72.25	209	Mexico	48.4	115
Spain	46.54	136	Indonesia	30.4	101
United Kingdom	124.63	132	Spain	18.9	96
Sweden	20.41	112	United Kingdom	46.8	95
Brazil	156.98	107	Switzerland	5.3	80
Indonesia	35.20	101	Sweden	3.8	80
Switzerland	17.49	85	Hong Kong SAR	1.0	75
Others	584.60	2521	Others	408.0	2145

Sources: eMaxx; authors' calculations.

Institutional investors and managing firms that hold Asia-Pacific bonds

As of Q4 2015, full sample of funds — Table 1C

Corporate bonds			
Country of the issuer	Number of distinct bonds	Number of funds	Number of managing firms
Japan	1970	1812	450
Australia	1246	3733	837
India	949	690	279
Korea	920	1362	396
China	750	1517	458
Hong Kong SAR	494	1398	426
Singapore	338	1026	340
Malaysia	137	589	191
New Zealand	101	947	317
Thailand	70	229	128
Chinese Taipei	70	86	51
Indonesia	61	563	229
Philippines	58	354	168
Vietnam	16	64	52
Others	93	1262	614
Government bonds			
Country of the issuer	Number of distinct bonds	Number of funds	Number of managing firms
Japan	1028	805	210
Korea	217	850	250
China	144	262	138
India	110	371	138
Indonesia	100	990	301
Philippines	72	573	230
Hong Kong SAR	71	33	28
Australia	52	754	207
Malaysia	49	414	154
Singapore	36	411	122
Thailand	36	251	132
Chinese Taipei	23	22	16
New Zealand	21	448	198
Vietnam	16	211	123
Others	142	1659	747

Sources: eMaxx; authors' calculations.

Descriptive statistics

Table 2

Full sample	N	Max	Min	Mean	Std. Dev	25th	Median	75th
Change in bond holdings	5,241,000	366,986	–286,106	122	5,013	0	0	1
Par amount of bond holdings	5,159,000	7,465,000	0	2,151	18,154	3	92	1,000
Matched sample	**N**	**Max**	**Min**	**Mean**	**Std. Dev**	**25th**	**Median**	**75th**
Change in bond holdings	519,920	296,989	–243,700	185.9	7,077	–1	0	1
Change in bond holding i / total holdings of Asia-Pacific bonds	518,246	100	–2,079	0	10	-0.017	0	0.043
Fund flows / total net assets	457,466	56,109	–36,283	0	488	-0.051	0	0.046
Fund flows	458,429	14,848	–11,999	–4	205	–4	0	2
Par amount of bond holdings	518,891	2,191,000	0	2842	21,569	1	141	1,448
Total holdings of Asia-Pacific bonds	519,920	1,780,0000	0	206370	842,245	2119	12,357	68,859

Notes: The full sample contains 8,374 funds and the matched sample 1,770 funds. Par amount of bond holdings and change in bond holdings are in thousands of US dollars. Fund flows are in millions of US dollars.

Sources: eMaxx; authors' calculations.

Change of bond holdings by type of investors during the taper tantrum

Table 3

	Emerging Asia				Developed Asia			
	Corporate		Government		Corporate		Government	
Taper period x MF	–134.886		–203.341***		80.411**		141.538	
	(168.925)		(74.326)		(38.602)		(98.458)	
Taper period x Ins/Ann/PF		138.574		204.424***		–82.730**		–105.691
		(168.794)		(74.682)		(39.271)		(112.607)
Fund fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Year-quarter fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Bond fixed effects	NO	NO	NO	NO	NO	NO	NO	NO
Observations	176,090	176,090	197,808	197,808	1,089,312	1,089,312	1,052,552	1,052,552
Within R-squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared overall	0.157	0.157	0.0319	0.0319	0.0269	0.0269	0.0582	0.0582

MF = Mutual funds. Ins/Ann/PF = Insurance/Annuity/Pension funds.

Numbers in brackets are standard errors, clustered by investor. ***, ** and * denote the significance levels of 1%, 5% and 10%, respectively.

Change of bond holdings by type of investors during the taper tantrum

In foreign and local currencies

Table 4

	Foreign currency								Local currency			
	Emerging Asia				Developed Asia				Emerging Asia		Developed Asia	
	Corporate		Government		Corporate		Government		Corp	Gov	Corp	Gov
Taper period x MF	–36.911 (54.551)		–116.804* (66.206)		174.477*** (39.768)		23.163 (117.836)		–165.259 (431.775)	–93.184 (163.683)	–219.654 (257.540)	86.670 (153.518)
Taper period x Ins/Ann/PF		37.074 (54.597)		118.102* (66.392)		–176.061*** (40.067)		–23.764 (117.870)				
Fund fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year-quarter fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bond fixed effects	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Observations	114,922	114,922	89,220	89,220	661,964	661,964	45,392	45,392	61,168	108,588	427,348	1,007,160
Within R-squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared overall	0.0209	0.0209	0.0256	0.0256	0.0267	0.0267	0.0449	0.0449	0.186	0.0505	0.0391	0.0729

MF = Mutual funds. Ins/Ann/PF = Insurance/Annuity/Pension funds.

Numbers in brackets are standard errors, clustered by investor. ***, ** and * denote the significance levels of 1%, 5% and 10%, respectively.

Change of bond holdings by global, regional and local funds during the taper tantrum

Table 5

	Emerging Asia						Developed Asia					
	Corporate			Government			Corporate			Government		
Taper period x local firm	578.953***			−220.764			36.318			−51.255		
	(221.529)			(331.996)			(26.053)			(95.380)		
Taper period x regional firm		189.212			73.943			−285.400**			−181.613**	
		(198.124)			(73.148)			(128.312)			(82.178)	
Taper period x global firm			-552.911**			−66.866			72.509**			135.622
			(266.737)			(76.002)			(33.702)			(145.359)
Fund fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year-quarter fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bond fixed effects	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Observations	187,867	187,867	187,867	210,930	210,930	210,930	1,146,116	1,146,116	1,146,116	1,102,413	1,102,413	1,102,413
Within R-squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared overall	0.158	0.158	0.158	0.0340	0.0340	0.0340	0.0250	0.0251	0.0250	0.0594	0.0594	0.0594

Numbers in brackets are standard errors, clustered by investor. ***, ** and * denote the significance levels of 1%, 5% and 10%, respectively.

Change of bond holdings by global, regional and local funds during the taper tantrum

In foreign currencies

Table 6

	Emerging Asia						Developed Asia					
	Corporate			Government			Corporate			Government		
Taper period x local firm	38.729 (45.672)			117.543 (155.188)			75.608 (114.276)			–420.140 (428.704)		
Taper period x regional firm		30.122 (116.587)			–157.533* (92.508)			–59.744 (91.567)			–124.108 (180.505)	
Taper period x global firm			–76.150 (105.706)			125.681 (84.669)			–11.643 (77.636)			185.142 (163.587)
Fund fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year-quarter fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bond fixed effects	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Observations	124,254	124,254	124,254	94,520	94,520	94,520	699,159	699,159	699,159	47,009	47,009	47,009
Within R-squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared overall	0.0183	0.0183	0.0183	0.0242	0.0243	0.0243	0.0234	0.0234	0.0234	0.0433	0.0433	0.0433

Numbers in brackets are standard errors, clustered by investor. ***, ** and * denote the significance levels of 1%, 5% and 10%, respectively.

Change of bond holdings by global, regional and local funds during the taper tantrum

In local currency

Table 7

	Emerging Asia						Developed Asia					
	Corporate			Government			Corporate			Government		
Taper period x local firm	1,585.423* (869.854)			−103.027 (403.564)			420.947*** (109.224)			−70.118 (100.886)		
Taper period x regional firm		452.729 (450.426)			326.478*** (116.067)			−971.591*** (333.816)			−177.337** (83.843)	
Taper period x global firm			−2,462.394* (1,473.178)			−335.318*** (125.401)			−39.952 (94.082)			174.054 (163.848)
Fund fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year-quarter fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bond fixed effects	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Observations	63,613	63,613	63,613	116,410	116,410	116,410	446,957	446,957	446,957	1,055,404	1,055,404	1,055,404
Within R-squared	0.001	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared overall	0.189	0.188	0.190	0.0523	0.0523	0.0523	0.0389	0.0390	0.0387	0.0738	0.0738	0.0738

Numbers in brackets are standard errors, clustered by investor. ***, ** and * denote the significance levels of 1%, 5% and 10%, respectively.

Global retrenchment: evidence from US-domiciled funds

Table 8A

	All bonds	Corporate bonds	Government bonds
Developed country bonds	164.128***	94.849***	970.574***
	(13.478)	(9.919)	(98.346)
Advanced Asian EM bonds	187.514***	83.495***	599.408***
	(42.244)	(17.794)	(173.346)
Asian EM bonds	213.120***	367.867**	–22.370
	(59.054)	(168.079)	(59.890)
Taper tantrum x developed country bonds	41.427***	42.500***	34.933
	(14.176)	(11.328)	(86.121)
Taper tantrum x advanced Asian EM bonds	–5.604	–22.647	27.903
	(75.209)	(29.093)	(343.569)
Taper tantrum x Asian EM bonds	–17.889	–19.563	–75.489
	(53.574)	(144.931)	(99.458)
Fund fixed effects	YES	YES	YES
Year-quarter fixed effects	YES	YES	YES
Bond fixed effects	NO	NO	NO
Observations	19,368,716	17,294,822	2,073,894
Within R-squared	0.000	0.000	0.001
R-squared overall	0.00629	0.00733	0.0148

Numbers in brackets are standard errors, clustered by investor. ***, ** and * denote the significance levels of 1%, 5% and 10%, respectively.

Global retrenchment: evidence from UK-domiciled funds

Table 8B

	All bonds	Corporate bonds	Government bonds
Developed country bonds	69.744***	71.017***	253.215**
	(15.468)	(12.850)	(127.065)
Advanced Asian EM bonds	125.632***	38.225***	275.590**
	(39.229)	(13.660)	(130.045)
Asian EM bonds	57.236*	86.189**	–75.332
	(33.485)	(43.142)	(83.182)
Taper tantrum x developed country bonds	24.704	–13.020	197.118*
	(21.060)	(19.358)	(101.378)
Taper tantrum x advanced Asian EM bonds	–90.893	18.044	–225.168
	(58.285)	(38.124)	(143.146)
Taper tantrum x Asian EM bonds	–146.080**	12.950	–210.496**
	(58.834)	(77.080)	(91.482)
Fund fixed effects	YES	YES	YES
Year-quarter fixed effects	YES	YES	YES
Bond fixed effects	NO	NO	NO
Observations	1,304,498	1,114,085	190,413
Within R-squared	0.000	0.000	0.000
R-squared overall	0.00646	0.0125	0.0139

Numbers in brackets are standard errors, clustered by investor. ***, ** and * denote the significance levels of 1%, 5% and 10%, respectively.

Global retrenchment: evidence from Europe-domiciled funds

Table 8C

	All bonds	Corporate bonds	Government bonds
Developed country bonds	50.210**	33.455***	283.945***
	(19.754)	(7.257)	(63.970)
Advanced Asian EM bonds	75.033**	18.443*	360.677**
	(38.171)	(10.858)	(154.888)
Asian EM bonds	108.088*	273.076*	–113.129
	(59.049)	(141.382)	(80.892)
Taper tantrum x developed country bonds	32.072	9.122	138.252*
	(33.770)	(16.683)	(82.179)
Taper tantrum x advanced Asian EM bonds	106.880**	29.134	315.844
	(49.489)	(26.480)	(208.022)
Taper tantrum x Asian EM bonds	–242.979***	–196.623	–335.256***
	(81.879)	(145.762)	(104.317)
Fund fixed effects	YES	YES	YES
Year-quarter fixed effects	YES	YES	YES
Bond fixed effects	NO	NO	NO
Observations	6,551,408	5,132,068	1,419,340
Within R-squared	0.000	0.000	0.000
R-squared overall	0.0149	0.0177	0.0238

Numbers in brackets are standard errors, clustered by investor. ***, ** and * denote the significance levels of 1%, 5% and 10%, respectively.

Global retrenchment: evidence from Australia- and Japan-domiciled funds

Table 8D

	All bonds	Corporate bonds	Government bonds
Developed country bonds	–28.378**	–31.896*	–24.036**
	(12.028)	(18.596)	(11.734)
Advanced Asian EM bonds	–1.018	–16.743	3.242
	(8.006)	(24.518)	(6.561)
Asian EM bonds	0.660	109.216*	–19.527
	(10.767)	(57.012)	(12.268)
Taper tantrum x developed country bonds	74.368**	127.790*	53.676*
	(32.438)	(68.492)	(32.481)
Taper tantrum x advanced Asian EM bonds	11.013	17.569	12.544
	(24.479)	(50.290)	(21.924)
Taper tantrum x Asian EM bonds	–23.949	–74.193	–19.900
	(45.089)	(202.344)	(34.579)
Fund fixed effects	YES	YES	YES
Year-quarter fixed effects	YES	YES	YES
Bond fixed effects	NO	NO	NO
Observations	3,549,299	1,010,818	2,538,481
Within R-squared	0.000	0.000	0.000
R-squared overall	0.00358	0.00253	0.00481

Numbers in brackets are standard errors, clustered by investor. ***, ** and * denote the significance levels of 1%, 5% and 10%, respectively.

Global retrenchment: evidence from HK- KR- SG- TW- and MY-domiciled funds — Table 8E

	All bonds	Corporate bonds	Government bonds
Developed country bonds	–30.056	–69.683***	59.168
	(23.810)	(26.639)	(43.244)
Advanced Asian EM bonds	57.900*	30.941	115.274***
	(29.601)	(37.658)	(34.435)
Asian EM bonds	41.014***	2.801	131.263***
	(15.448)	(21.395)	(27.776)
Taper tantrum x developed country bonds	–19.948	46.801	–234.430
	(79.735)	(98.818)	(153.642)
Taper tantrum x advanced Asian EM bonds	–156.561*	–241.768**	–20.707
	(81.459)	(112.868)	(118.241)
Taper tantrum x Asian EM bonds	–74.452*	8.311	–303.070***
	(41.255)	(55.153)	(79.043)
Fund fixed effects	YES	YES	YES
Year-quarter fixed effects	YES	YES	YES
Bond fixed effects	NO	NO	NO
Observations	177,744	119,552	58,192
Within R-squared	0.000	0.000	0.000
R-squared overall	0.0150	0.0242	0.0314

Numbers in brackets are standard errors, clustered by investor. ***, ** and * denote the significance levels of 1%, 5% and 10%, respectively.

Impact of investor flows on Asia-Pacific bond holdings

Table 9

	Foreign currency				Local currency			
	Emerging Asia		Developed Asia		Emerging Asia		Developed Asia	
	Corporate	Government	Corporate	Government	Corporate	Government	Corporate	Government
Standardised flow	0.0217	–0.0145***	–0.0518**	–0.0840***	–0.0237	–0.0715***	–0.0031***	0.1419***
	(0.0338)	(0.0044)	(0.0211)	(0.0084)	(0.0239)	(0.0207)	(0.0009)	(0.0427)
Taper period x standardised flow	–0.0730	5.1028	0.0465**	–0.3699	4.3363	–1.3018	0.0314***	–0.2080***
	(0.0457)	(5.0731)	(0.0211)	(1.8172)	(3.2128)	(3.3000)	(0.0026)	(0.0501)
Fund fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Year-quarter fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Bond fixed effects	NO	NO	NO	NO	NO	NO	NO	NO
Observations	24,163	21,521	97,986	8,468	7,515	25,155	89,135	176,873
Within R-squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
R-squared overall	0.165	0.138	0.121	0.124	0.0708	0.0521	0.0790	0.0595

Using the matched sample of 1,770 funds.

Numbers in brackets are standard errors, clustered by investor. ***, ** and * denote the significance levels of 1%, 5% and 10%, respectively.

Comments on "The role of different institutional investors in Asia-Pacific bond markets during the taper tantrum"

By Johan Sulaeman[1]

Ng, Shim and Pastor examine the dynamics of bond prices during the 2013 taper tantrum. During times of high uncertainty, bond markets can become illiquid as some of the investors experience funding liquidity shocks. This can lead to sharp drops in bond prices, ie sharp increases in bond yields, beyond what are warranted by the changes in fundamentals.

The authors analyse the markets for bonds issued by countries and corporates of Asia-Pacific countries. Such sovereign and corporate bonds have increased significantly over the past two decades. Given the still relatively low trading volumes in these markets, they seem particularly vulnerable to shocks in funding liquidity to the bondholders.

Studies of bondholders typically focus on the durations of their fixed income assets. In contrast, the authors focus on the variation in the durations of bondholders' liabilities, and how these can affect prices in the bond markets. Due to the long duration of their liabilities, insurance companies and pension funds can hold bonds until maturity, and do not have to react to changes in market conditions. In contrast, bond mutual funds tend to have short liability durations, as they are likely to face fund outflows, ie redemptions, particularly during adverse market conditions. These short-duration bondholders can have a disproportionate effect on bond prices in the absence of sufficient capital from long-duration bondholders. This can end up exacerbating adverse market conditions and lead to downward spirals in bond prices.

The goal of the authors' study is to characterise the roles of different types of bond investors during the taper tantrum. Their data allows for an examination of who were the sellers and buyers in bond markets during this period. Using detailed security-level data on bond holdings by institutional investors from Thomson Reuters eMAXX, they find that short-duration bondholders, eg mutual funds, were more likely to liquidate their bond holdings during this period. The sell-off was concentrated among bonds issued by corporations and governments of emerging countries in Asia, for which long-duration bondholders are the likely liquidity providers. To finance this provision, long-duration bondholders tended to sell their holdings of bonds issued by more developed Asian countries.

Another set of liquidity providers in the market for emerging Asian corporate bonds are local (Asia-domiciled) funds. In contrast, global (US-, UK- and Europe-domiciled) funds tend to sell these bonds. This provides some early evidence of global retrenchment by bond mutual funds during this adverse market condition.

The authors' study is related to the line of research on fire sale by mutual funds in the equity market. Coval and Stafford (2007) and Frazzini and Lamont (2008) document that trading pressure emanating from extreme fund flows into and out of

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equity mutual funds can result in significant price impact. This is subsequently followed by return reversals that take place over a relatively long period of time. These studies argue that this type of mispricing is likely to stem from wide-spread fund-level liquidity problems rather than the fundamentals of the underlying securities themselves. Several studies have also documented similar effects in the bond market, including Goldstein et al (2017) and Morris et al (2017).

This flow-driven fragility in asset markets can have a significant effect on real investment decisions. Recent studies document that mutual fund flow-driven mispricing in the equity market can affect various corporate activities ranging from mergers and acquisitions, secondary equity offerings (SEOs) to corporate investments (Edmans et al (2012), Khan et al (2012) and Hau and Lai (2013)). As such, it is important to understand the liquidity provision by other market participants that can mitigate the potentially negative effect of flow-driven fragility. Unfortunately, while some sophisticated investors may be able to recognise the source of large price movements following fund flow-driven trading pressure, many of these investors are often constrained by limits of arbitrage due to correlated capital flows, margin calls, and risk limits (Ben-David et al (2012)).

It would also be useful to develop an infrastructure of information production that reduces the uncertainty regarding the source of large price movements. Sulaeman and Wei (2019) identify security research from equity analysts as a potential source of such information; developing a similar infrastructure for the bond market may prove effective in mitigating the flow-driven fragility and other types of liquidity-driven mispricing events. It is important to note that while the authors' study examines a large set of bondholders with varying liability duration, the data does not allow the authors to capture the full set of bondholders. It would be quite useful to examine the variation in the dataset coverage as that would allow the readers to get a sense of the potential liquidity provisions by other groups of bondholders, eg sovereign wealth funds, with relatively long liability duration.

It is also important to note that the results in the paper seem to indicate a flight to quality by institutions with short duration, ie bond mutual funds: they sell emerging Asian bonds and buy developed Asian bonds during the taper tantrum. This pattern is likely to be due to their relatively short liability duration, and therefore their preference for assets that can be liquidated more easily to fulfil redemption requests. This again indicates the importance of developing an information production infrastructure to improve liquidity in the emerging Asian markets and mitigate the need for such flight to quality in the future.

Unfortunately, it is quite difficult to measure the effect of such flight to quality on the prices of both the source (emerging Asian bonds) and the target (developed Asian bonds) of the flight, due to the scarcity of pricing data for Asian bond markets. Adding this piece of the analysis to the study would be very useful in deriving strong policy implications.

In conclusion, market regulators and other policy makers should consider the distribution of investor characteristics not only in each market but also for each security, eg the liability duration of the holders of each bond. The authors' study can be extended to a cross-sectional analysis focusing on the variation of dominant investors in each bond. Presumably, bonds whose ownership structure is dominated by mutual fund investors should see steeper declines in their price around the taper tantrum, or even more generally, during periods of outflows from the bond mutual fund sector.

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Emerging market bond funds: flow-performance relationship and long-term institutional investors

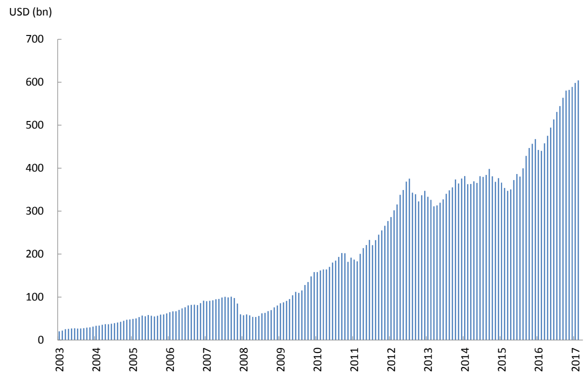
Remarks on the policy panel

By Cho-Hoi Hui[1]

1. Introduction

Mutual funds investing in emerging market economy (EME) bonds have increased almost seven-fold since the 2008 Great Financial Crisis (Graph 1). This development has raised two questions from a financial stability perspective. Firstly, how important is it to understand the fund-flow performance relationship in which overperforming funds encourage inflows and underperforming ones outflows? And secondly, can long-term institutional investors (LTII) such as pension funds and insurance funds be considered a stabilising force during market sell-offs?

Total net assets of EME bond funds — Graph 1



Source: EPFR Global.

2. Flow-performance relationship

It is well known that overperforming funds attract inflows and underperforming ones outflows. An important question that often goes unanswered, however, is whether this positive relationship asymmetric. There are two possible answers to this question. First, the relationship is concave; ie there is more outflow in response to fund

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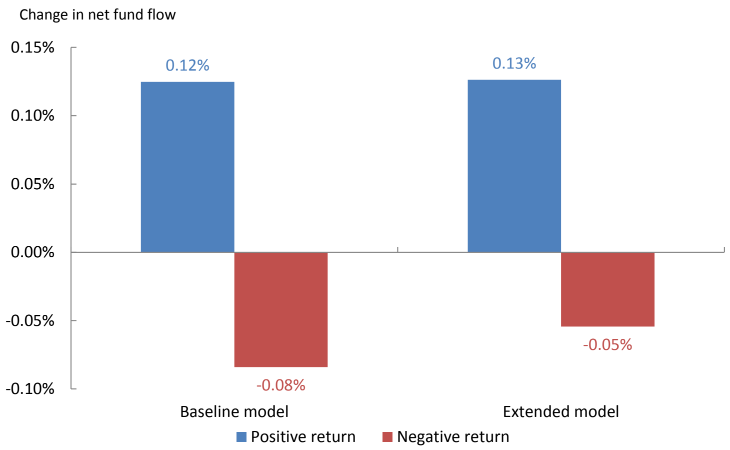
underperformance than inflow during overperformance. Second, the relationship is convex; ie there is less outflow in response to fund underperformance than inflow during overperformance. This relationship is important to understand, as without this knowledge there is a tendency to underestimate or overestimate the potential capital flow reversal when market conditions change abruptly.

Recently published research by Leung and Kwong (2018)[2], who use a fixed effect panel data model with samples consisting of 1,784 EME bond funds domiciled around the world, suggest a convex flow-performance relationship for EME bond funds.[3] Fund flow sensitivities with respect to positive and negative performance are shown in Graph 2, showing that there is less outflow in response to underperformance than inflow to overperformance. This relationship remains unchanged in the extended model where other control variables are added.

Sensitivities of net fund flow toward positive and negative returns — Graph 2



[1] The bars represent the corresponding changes in the net fund flow when the fund return increases (deceases) by one percentage point.

Broadly speaking, there are three possible scenarios that may influence the shape of the asymmetric flow-performance relationship in EME bond funds:

1. *The practices taken by asset management companies to pre-empt a fire sale risk*. As the assets held by EME bond funds are generally low in liquidity, managers of these funds have adopted practices to pre-empt fire sales. One of them is the precautionary holding of cash that could help avoid selling its underlying illiquid assets at deep discounts when there are large redemptions. A higher level of cash holding is expected to alleviate investors' concerns about fire sales. The higher cash holding ratio of EME bond funds seems to support this conjecture (Table 1). Another practice to mitigate the fire sale risk is the swing pricing mechanism, which is the adjustment of a fund's net asset value to pass on the dilution costs

[2] See D Leung and M Kwong, "The flow-performance relationship in emerging market bond funds", *HKIMR Working Paper*, January 2018, no 04/2018.

[3] For each fund, data about its net fund flow, net asset value, fund return and other fund-specific details are retrieved from the Morningstar database at a monthly frequency. The data of market-level explanatory variables are obtained from Bloomberg. Subject to data availability, the sample period runs from January 2000 to December 2016.

of trading to investors associated with purchasing or redeeming the fund.[4] The mechanism can internalise the transaction costs and liquidation costs incurred by investors who redeem their shares, and neutralise their first-mover advantage from redeeming earlier than others.

Cash holding positions of US and EME bond funds

Table 1

Cash holding position (2016)	EME bond funds	US bond funds
Mean (%)	13.86	9.52
Median (%)	6.88	5.46
SD (%)	10.89	7.91
Count	1251	1360

[1] Cash holding position is the proportion of fund assets held in cash in percent. Cash encompasses both actual cash and cash equivalents (fixed-income securities with a maturity of one year or less) held by the portfolio plus receivables minus payables.

[2] EME bond funds cover funds categorised as "emerging markets fixed income" according to Morningstar Global Category Classifications (MGCC). US bond funds cover funds under MGCC "US fixed income".

Source: Morningstar

2. *Biased media coverage, notably mutual fund advertisements, towards outperforming funds.*[5] As these advertisements serve as powerful drivers for inflow into the advertised funds, the attention of fund investors is driven towards the top-performing funds, whereas the worst-performing funds are often overlooked, leading to a convex relationship.
3. *Higher participation costs of EME bond funds*. A rational investor would invest in a fund only if its expected return exceeds participation costs. As the expected return of a fund is often based on its past performance, mutual funds with higher participation costs can attract inflow only when they have a track record of outperforming returns. On the other hand, higher participation costs reduce the incentive of existing investors to unwind their positions in reaction to underperformance.

3. Long-term institutional investors

The contributions of LTIIs to financial stability are debatable in literature. On the one hand, LTIIs could behave pro-cyclically (ie rebalancing their portfolios away from riskier assets and towards safer ones) in the face of financial market turbulence to meet regulatory requirements or short-term liquidity needs. Such a flight-to-quality strategy can overvalue short-term investment returns and undervalue long-term returns, which can cause or exacerbate financial instability. On the other hand, LTIIs could rebalance their portfolios away from safer assets and towards riskier ones to

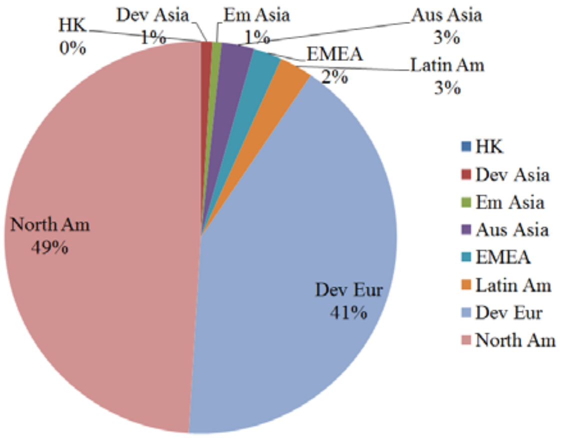
[4] Mutual funds domiciled in the United States have been allowed to adopt swing pricing only starting from 2018, which is beyond the sample period. For details, refer to https://www.sec.gov/rules/final/2016/33-10234.pdf.

[5] For the powerful influence of mutual fund advertisement on fund flow, see Jain and Wu (2000), "Truth in mutual fund advertising: evidence on future performance and fund flows", *Journal of Finance*, vol 55, no 2, pp 937–58.

chase long-term investment returns during market downturns; such a value-trading strategy can temper movements in asset prices, contributing to a countercyclical impact to financial systems.

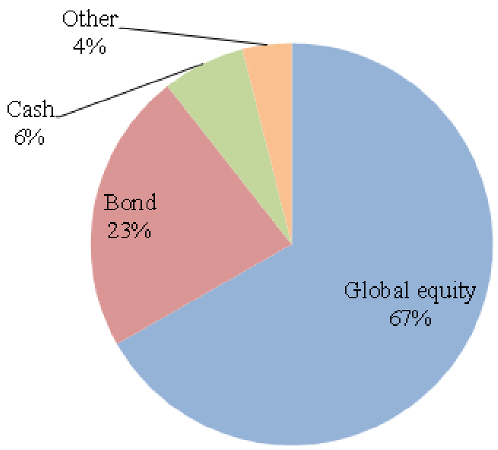
Because of insufficient EME bond allocation in insurance and pension funds as shown in Graph 3, Fong et al (2018) [6] answer the question on whether LTII could be a stabilising force during market sell-offs by using 1,010 pension and insurance funds in advanced economies (AEs) and EMEs. The funds invested in the equity markets between the first quarter of 2001 and the first quarter of 2017. At the end of 2016, these LTIIs had two thirds of their assets invested in global equities (Graph 4), reflecting that equities were their primary investment assets.

Bond allocation in global insurance and pension funds in 2017 — Graph 3



Sources: Morningstar and HKMA staff calculations.

LTIIs' exposure to global financial markets in 2016 — Graph 4

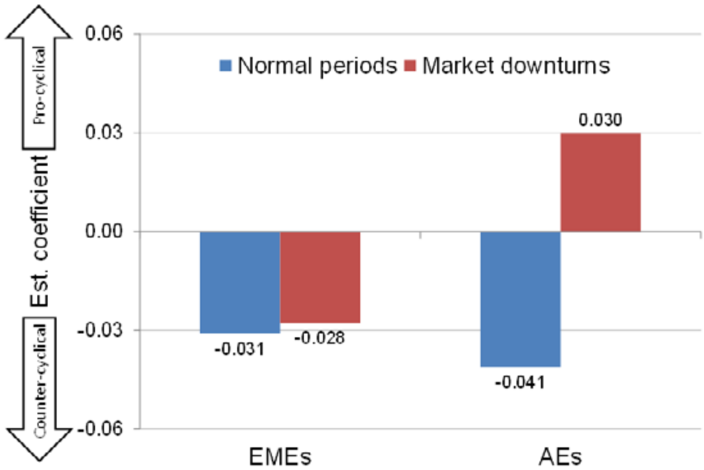


Sources: Morningstar and HKMA staff calculations.

6 See T Fong, A Sze and E Ho, "Do long-term institutional investors contribute to financial stability? – Evidence from equity investment in Hong Kong and international markets", *HKIMR Working Paper*, September 2018, no 22/2018.

As shown by the results in Graph 5, Fong et al (2018) find that LTIIs contribute to a countercyclical effect to stock markets in EMEs in general.[7] Such a value-trading strategy can temper drastic movements in asset prices and have a positive contribution to financial stability in these economies. By comparison, the LTIIs will be pro-cyclical for equities in AEs in times of financial turbulence. Given that AEs were the epicentre of several major stock market crashes triggered by events including recessions in Europe and the United States in the early 2000s, the 2008 Great Financial Crisis, as well as the multi-year European debt crisis that has been taking place since 2009, the findings suggest the pro-cyclical effect depends on where the shock originates.

Responsiveness of the fund flows to past market returns in EMEs and AEs — Graph 5



[1] These EMEs and AEs cover seven regions including developed Asia, emerging Asia, Australasia, EMEA, developed Europe, Latin America and North America. Their stock market returns are measured by the corresponding MSCI regional indices. The coefficients of EMEs and AEs are the average values of the underlying regions.

Source: HKMA staff estimates.

4. Concluding remarks

EME bond funds display a convex flow-performance relationship. On the one hand, the potential concavity of these funds is mitigated by practices taken by fund management companies to dampen fund investors' incentives to redeem in reaction to underperformance. On the other hand, biased media coverage towards outperforming funds and the relatively high participation costs of EME bond funds increase the convexity of the relationship. While the findings might, to some extent,

[7] Graph 4 summarises the regression coefficients of flows on past market returns for EMEs, which cover stock markets in emerging Asia, Latin America, emerging Europe, and the Middle East and Africa (EMEA), as well as on past returns for AEs, which cover stock markets in North America, developed Europe, developed Asia and Australasia. These coefficients are as a group average for ease of reference.

relieve concerns about the fragility of EME bond funds, it is crucial to note that such a convexity critically depends on government regulations, investor base, policies of fund management companies etc.

LTIIs contribute to a countercyclical effect to stock markets in EMEs in general. Such a value-trading strategy can temper drastic movements in asset prices and have a positive contribution to financial stability in these economies. To attain such a stabiliser, policy makers could provide tax and policy incentives conducive to a larger presence of LTIIs in both equity and bond markets.

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