HONG KONG INSTITUTE FOR MONETARY AND FINANCIAL RESEARCH

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HKIMR Working Paper No.07/2021

April 2021

HONG KONG ACADEMY OF FINANCE
金融學院

Hong Kong Institute for Monetary and Financial Research
香港貨幣及金融研究中心
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Angela Sze
Hong Kong Monetary Authority

Wilson Wan
Hong Kong Monetary Authority

Iris Tang
Hong Kong Monetary Authority

Ip-Wing Yu
Hong Kong Monetary Authority

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Abstract

The USD non-financial corporate debt in the EMEAP economies has been growing rapidly since the outbreak of Global Financial Crisis (GFC). However, bonds in the region have shown deterioration in overall quality and increasing issuance of short-term bonds. These may expose firms to higher rollover risks, especially during stress periods. Our empirical analysis confirms the importance of rollover risk in driving up the default risk of non-financial corporates after controlling financial characteristics of individual firms and country risk factor. The results also show that the risks during periods of financial distress are mainly found in emerging market economies (EMs) of the region. We also find that within the investment grade (IG) universe, BBB rated bonds, which are subject to greater fallen angel risks and account for a higher share of IG bonds after the GFC, would be exposed to higher default risk due to the elevated rollover risks. Our findings have three financial stability implications. First, while the low interest rate environment may provide breathing space for corporates, the accumulation of debts may raise concerns about the debt sustainability problem of corporates in the region. Second, the increasing reliance on shorter maturity bonds may expose firms systemically to a sharp rise in funding cost and rollover risks should US monetary policy tighten. Third, EMs, particularly those with weaker economic fundamentals should stay vigilant to the increasing exposures of their corporate sector to USD bonds and the potential currency mismatch problem, as these vulnerabilities could rise sharply if their economies are under stress.

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* Email: Sze: angela_kw_sze@hkma.gov.hk, Wan: wtswan@hkma.gov.hk, Tang: ytang@hkma.gov.hk and Yu: iwyu@hkma.gov.hk

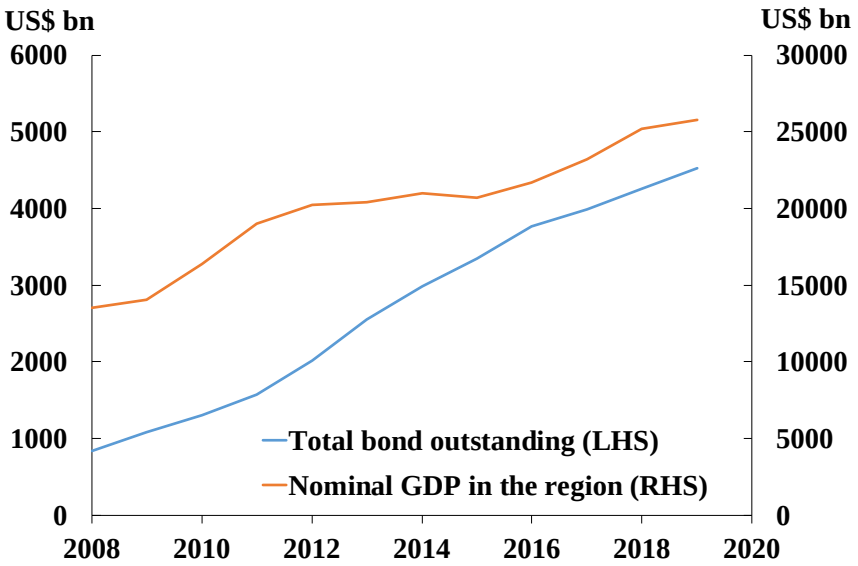
* The authors wish to thank Eric Wong for his invaluable comments and suggestions, and Winnie Li for her excellent research assistance. The views expressed in this paper are the authors' own and do not necessarily reflect those of the Hong Kong Monetary Authority.

(1) Introduction: why is it important to look at this?

The world has witnessed an unprecedented build-up in non-financial corporate debt since the outbreak of Global Financial Crisis (GFC) in 2009 when most central banks in major developed economies adopted unprecedented accommodative monetary policy and quantitative easing.[1] According to Celik et al. (2020), a recent report published by OECD, the global outstanding of non-financial corporate bonds reached a historical high of US$13.5 trillion by December 2019. The report also highlighted a deterioration in the overall quality of bond issuance recently. For example, bonds rated at BBB accounted for more than half of all investment grade issuance in 2019 compared with an average of 38.9% during the period 2008-2019, pointing to higher fallen angel risks (see a summary of main findings for the report in Appendix 1).

For member economies of the Executives' Meeting of Asia-Pacific Central Banks (EMEAP) as a whole[2], the corporate bond outstanding increased from US$1.09 trillion in 2009 to US$4.53 trillion in 2019, an increase of more than 300% that far exceeded the growth of nominal GDP (around 84%) over that period (Chart 1). The rapid growth in USD corporate bonds in the Asia-Pacific region was partly due to the global environment of low USD interest rate, which incentivises non-financial corporates in the region to actively tap funds from the USD bond market.

Chart 1: EMEAP non-financial corporate bond market and economic growth



Sources: CEIC, Dealogic and staff estimations.

[1] One exception is the US Federal Reserve, which exited from the zero lower bound policy rate for a period of three years starting from December 2015 and has returned to a more accommodative monetary policy and slashed the interest rate to zero after the outbreak of COVID-19 in March 2020.

[2] Throughout this study, Asia-Pacific economies refer to member economies of EMEAP. They are Australia, China, Hong Kong, Indonesia, Japan, Malaysia, New Zealand, the Philippines, Singapore, South Korea, and Thailand.

Given the emerging risk identified by Celik et al. (2020) and the unprecedented growth in the region's USD corporate bond market in recent years, it is important to assess comprehensively whether and to what extent vulnerabilities have increased in the bond market along with the strong growth.[3]

To shed light on this, this note, based on the bond issuance data and the rating information of individual firms in the region over the period 2008Q1-2020Q3 from Dealogic and Bloomberg, will first detail the trend of USD corporate bonds in the region in the next section. In Section 3, we provide a risk assessment and find evidence that USD corporate bonds in the region have shown deterioration in the average credit quality and rising rollover risk (i.e. the risk that corporates fail to rollover their matured debts into new ones). Anecdotal evidence shows that high rollover risk could be a potential trigger for a sudden rise in default risk or even a default, especially during financial crisis when market liquidity evaporates and credit supply is scant. To quantify to what extent rollover risk of USD corporate bonds in the region may translate into higher default risks during stress times, econometrics analysis will be conducted in Section 4. The final section concludes.

(2) Key Observations on Recent Trends

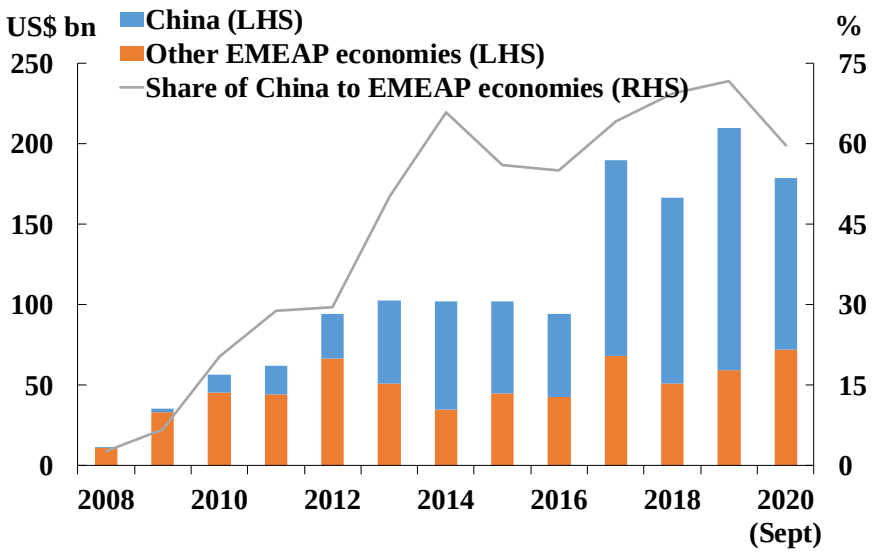
This section highlights some key characteristics of recent trends in the USD corporate bond market in the region:

a) Issuance:

USD bond issuance by corporates expanded steadily in the first few years after 2009, from US$56.8 billion in 2010 to US$94.3 billion in 2012, and then held steady until 2016. By 2019, the size of issuance had doubled from 2016, mostly boosted by the increase in issuance by Mainland China corporates, with their collective share of total issuance surging from about 20.4% in 2010 to more than 71.6%. In the first nine months of 2020, USD corporate bond issuance in the region continued to grow at a record pace (a rise of 9.7% from the first three quarters of 2019), as many corporates tried to strengthen their liquidity buffers against financial stresses arising from the outbreak of COVID-19 (Chart 2).

Chart 2: Issuance of USD bonds by EMEAP corporates

[3] It should be noted that the accumulation of bonds by emerging market firms might not necessarily imply a financial stability issue if such increase simply reflects the decision of some cash-rich firms that want to use USD funds from bond proceeds to benefit from interest rate differentials and currency appreciation. In Bruno and Shin (2016), for example, emerging market firms with high cash holdings are found to be more likely to issue US dollar-denominated bonds to benefit from interest rate differentials and currency appreciation. In the sampled firms of this study, however, there is little evidence to suggest the use of the USD proceeds for carry trade as the correlation between cash-to-asset ratio of the firm at time t -1 and its USD bond issuance at time t is very small (0.077).

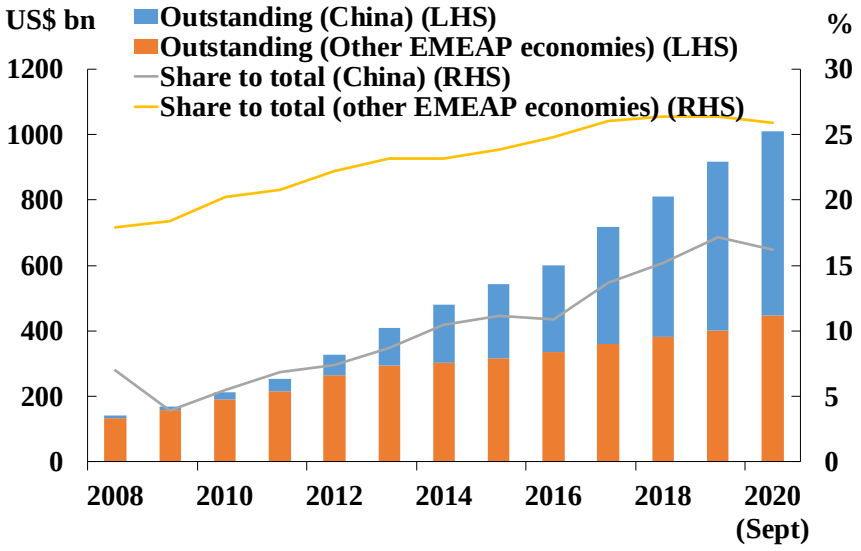


Sources: Dealogic and staff estimations.

b) Outstanding:

The annual gross issuance of USD bonds by corporates in EMEAP economies has outpaced the total amount matured or retired in that year since 2010, resulting in a continued growth in bond outstanding in the region. By September 2020, the outstanding amount was US$1,010 billion, almost five times the US$212 billion in 2010. The growth was particularly notable in China, surging from about US$21 billion in 2010 to US$563 billion by 2020Q3. Despite the strong growth, USD corporate bonds accounted for only 16.2% and 25.9% of the total bond outstanding in China and other EMEAP economies respectively (Chart 3).

Chart 3: Outstanding of USD corporate bonds and its share to total outstanding

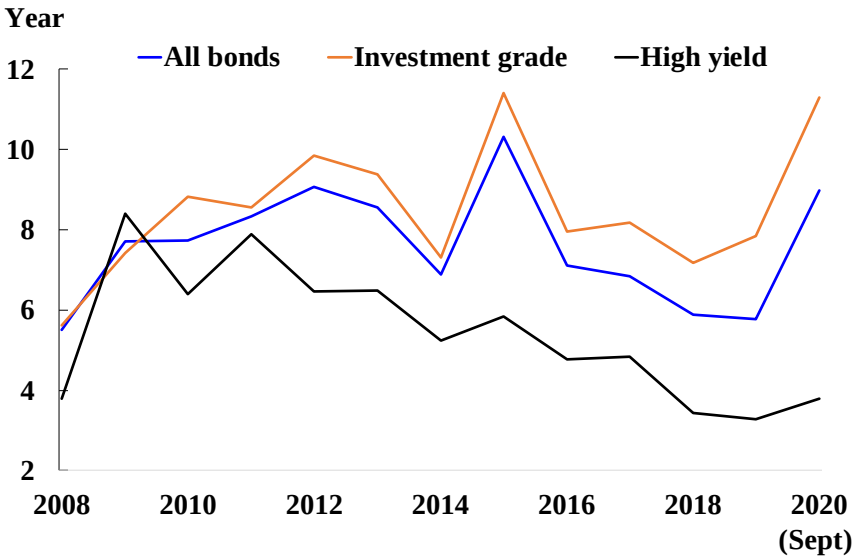


Sources: Dealogic and staff estimations.

c) Maturity:

EMEAP corporates with relatively weak financial strength have increasingly relied on short-term funding, as the average original maturity of the newly issued high-yield (HY) USD bonds has generally trended downwards since the GFC, dropping from 6.4 years in 2010 to 3.8 years in 2020. By contrast, for corporates financially strong enough to be able to issue investment grade (IG) bonds, the average original maturity of their bonds at issuance has not exhibited a clear downward trend, moving from around 7.2 years to 11.4 years over the period (Chart 4).[4] [5]

Chart 4: Average original maturity USD bonds by EMEAP corporates by year at issuance



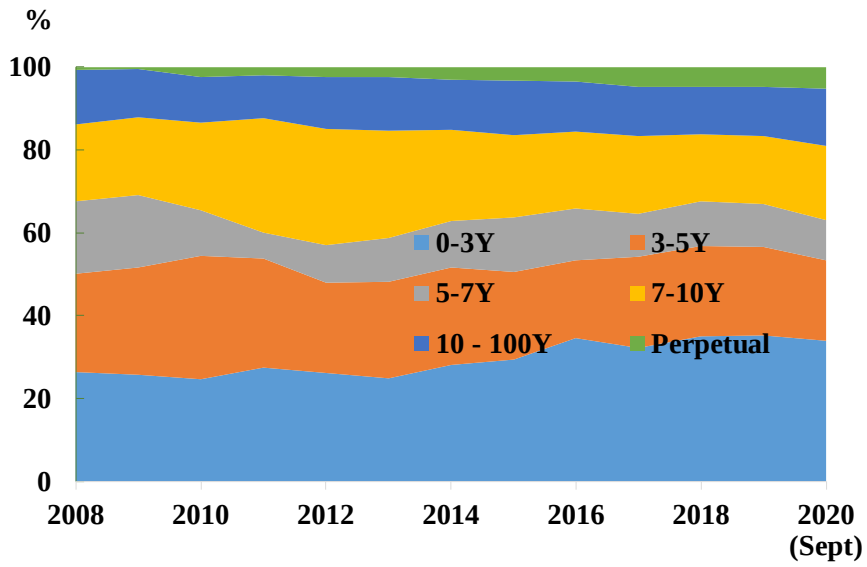
Sources: Dealogic and staff estimations.

Such development is also reflected in the average remaining maturity of outstanding USD corporate bonds in the region.[6] While the maturity profile for outstanding IG bonds has been relatively stable (Chart 5A), that of outstanding HY bonds has changed significantly, with the share of outstanding bonds maturing within 3 years increasing sharply and accounting for 61.9% of the total (Chart 5B).[7] Reflecting

[4] Perpetual bonds are excluded in this calculation as they don't have a finite maturity.
[5] It is suggested that the downward trend in the average maturity of high-yield USD bonds may be attributed to the shrinking credit spread over this period, which was observed in the US corporate bond market. While we acknowledge this possibility, the evidence in our data does not support such clear pattern for USD corporate bonds in Emerging market after 2009.
[6] The discussions here and in Section 3 are based on a smaller sample of 2,438 USD corporate bonds with rating information during the period.
[7] It is noted that the average original and remaining maturities of corporate bonds in China for both IG and HY were generally shorter than those of the rest of EMEAP economies.

this, the average remaining maturity of outstanding USD HY corporate bonds in the region dropped significantly from 5.9 years in 2010 to 2.4 years in 2020Q3.[8]

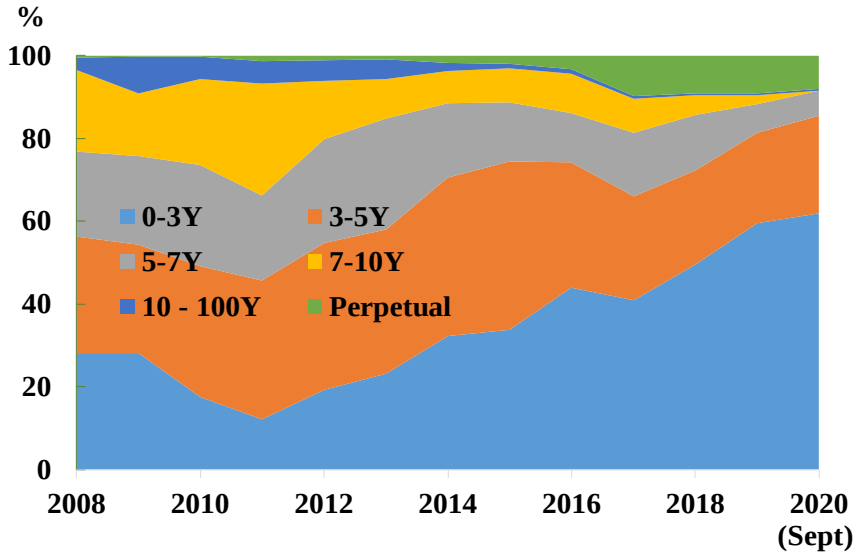
Chart 5A: Maturity profile of outstanding USD investment grade bonds by EMEAP corporates



Note: The figures are calculated based on remaining maturities of bonds.

Sources: Bloomberg, Dealogic and staff estimations.

Chart 5B: Maturity profile of outstanding USD high yield bonds by EMEAP corporates



Note: The figures are calculated based on remaining maturities of bonds.

Sources: Bloomberg, Dealogic and staff estimations.

[8] By contrast, the average remaining maturity for IG bonds increased slightly from 6.5 years to 7.5 years.

d) Unrated bonds:

There were altogether 919 unrated USD bonds issued by 543 firms between 2008 and 2020Q3. Along with the surge in new issuance, the amount of newly issued bonds without initial ratings increased by more than 10-fold from US$3.1 billion in 2008 to US$33.9 billion in 2019. In the first three quarters of 2020, the issuance of unrated bonds slightly declined, with the share of unrated bonds among total issuance moderating from 16.1% to 15.4% compared with the corresponding period of 2019, as the outbreak of COVID-19 made investors more cautious towards these bonds.

There are some reasons that contribute to the increasing issuance of unrated bonds in recent years. First, firms can avoid paying fees to rating agencies for rating their bonds if they issue unrated bonds.[9] In particular, the issuance of unrated bonds is more common as the rating fees might not be economically justified if the size of the bond issuance is too small, the issue is too complex and might incur expensive fees, or the absence of any need for visibility.[10] Second, some companies that had issued rated bonds previously might choose to issue unrated bonds to avoid rating fees as investors can make reference on the firms' previous rating or rated bonds issued by the same company in the past. Of all unrated bonds issued during the period, there are 347 bonds issued by 144 firms with a history of either firms' rating or rated bonds issued by the same company in the past that investors can make a reference.[11] In other words, there were 572 unrated bonds from 399 firms that did not have any benchmark for reference, with a total issuing amount of US$146.0 billion.

(3) Are there any risk concerns associated with these trends?

In this section, we focus on some major risks that might arise from the recent development in the market.[12]

a) Deterioration in average credit quality and the increase in unrated bonds

[9] For example, cost of obtaining S&P Global Ratings for corporate bonds is up to 7.2 basis points, with a minimum fee of US$ 110,000 for most transactions as of January 2021. The fees may differ due to various factors such as the type of credit rating being assigned and the principal amount of the debt issuance being rated.

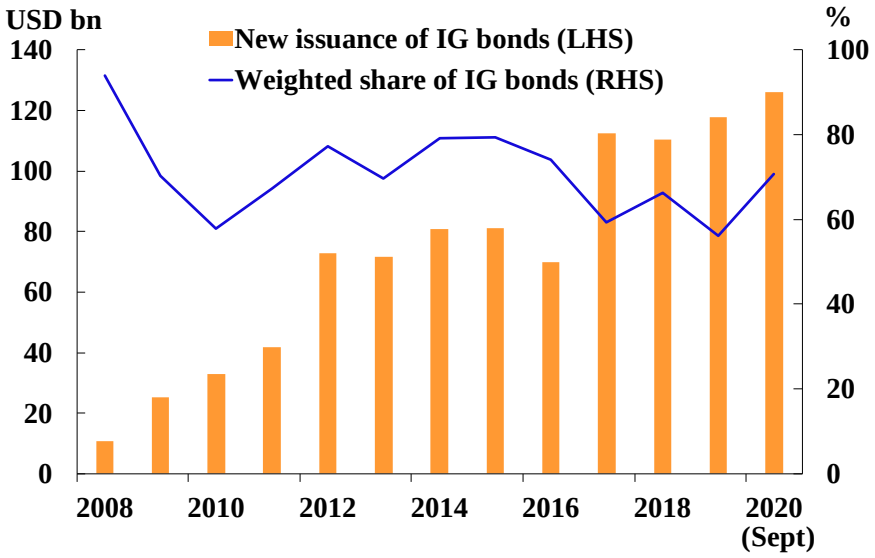
[10] In some cases, the unrated bonds are sold to an entity that is closely connected to the issuer, such as a sister company within the same holding company. As the buyer knows the issuer well, there is no need for the independent analysis of the bond by rating the firm.

[11] Among the 347 unrated bonds issued by 144 firms that investors can refer to the issuer's rating and/or rated bonds issued in the past, 174 were issued by the companies with their previous rating or their rated bonds classified as investment grade and 173 belonged to high yield category.

[12] A number of recent studies have theoretically argued and empirically tested that deteriorating credit quality is a worrying indicator of an overheated credit market which may lead to systemic risk. For example, Greenwood and Hanson (2013) showed that the credit quality of corporate debt issuers deteriorates during credit booms, and is a more reliable signal of credit market overheating than rapid aggregate credit growth. The deterioration also forecasts low excess returns to corporate bondholders.

For the EMEAP region as a whole IG bonds have accounted for a decreasing share of total corporate bond issuance, declining from about 79% in 2014 to 56% in 2019, although in dollar terms, the issuance of IG bonds has continued to increase steadily since 2010 and held up in the years after 2016 (Chart 6). In the first three quarters of 2020, however, relatively more IG bonds have been issued in the region as the ratio rebounded to 71% amid the outbreak of COVID-19, reflecting that bonds issued by corporates with stronger financial strength and sound credit ratings were better received by investors in the bond market in the stress period. However, it may also indicate that weaker corporates in the region may find it difficult to source USD funding from the bond market when USD funding stress occurred.[13]

Chart 6: New issuance of investment-grade USD bonds by EMEAP corporates

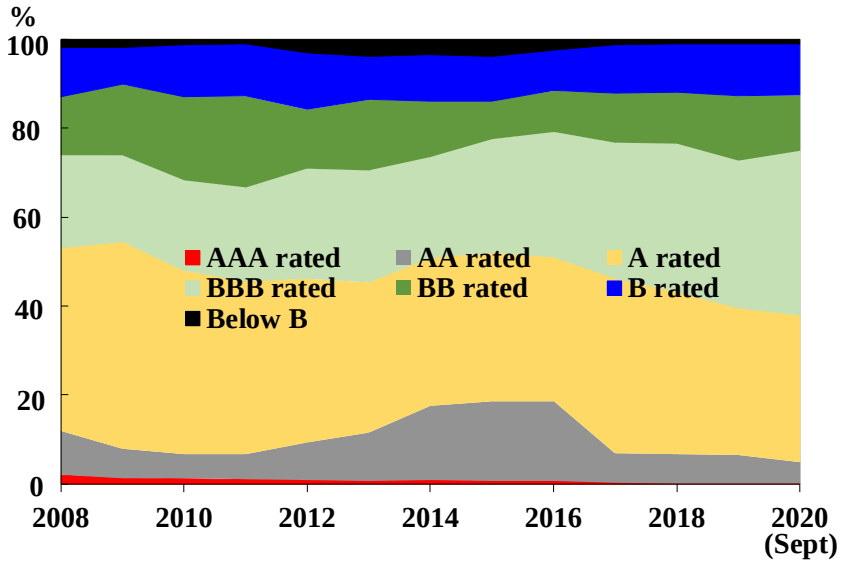


Sources: Dealogic and staff estimations.

The deterioration in credit quality can also be observed when looking at the credit rating composition of outstanding IG bonds. The share of IG bonds with A rating or better has decreased steadily since the GFC from around 53.1% in 2008 to 37.9% in 2020, while that of IG bonds with lower credit ratings (i.e. BBB+ to BBB-) increased significantly from 20.7% to 37.1% (Chart 7). This development shows that more USD IG bonds issued by corporates in the region were exposed to fallen angel risk, the risk that an IG bond is downgraded to a junk bond status (ratings below BBB-). Fallen angel events may trigger fire sales of such bonds, as many investors may be forced to sell them given that their investment mandates only allow them to hold IG bonds.

Chart 7: Ratings of outstanding USD bonds by EMEAP corporates

[13] Indeed, the absolute amount of HY bond issuance was US$ 52.5 billion in Q1-Q3 2020, down from US$ 74.9 billion in Q1-Q3 2019.



Sources: Bloomberg, Dealogic and staff estimations.

One implication of our study is that higher rollover risk should predict deterioration in firms' credit quality subsequently (as measured by credit rating downgrades), especially for corporate bonds issued by fundamentally weak firms. In our sample, the number of credit downgrades in bonds has surged from 27 in 2010 to 142 in the first three quarters of 2020. As a total, there were 967 credit rating downgrades in our study. We examine those bonds with credit events and monitor their rollover risk measures one/two year(s) ahead of its credit downgrade. It is observed that ahead of the credit event, the firm's rollover risk measure deteriorated continuously, on average increasing from 13.7% in 8 quarters ahead to 16.0% in 4 quarters ahead and reached around 17.7% during credit events. These firms were generally weaker fundamentally with issues such as decreasing profitability and increasing leverage ratio. Average profitability decreased sharply from 12.7% in 4 quarters ahead to -2.8% in the quarter with credit downgrade while average leverage ratio slightly increased from 37.7% in 4 quarters ahead to 38.2% in the quarter with credit downgrade. Overall, we find that higher rollover risk helps predict deterioration in firms' credit quality subsequently, especially for fundamentally weak firms.

While there were only 50 fallen angel cases for USD corporate bonds from 2010Q1 to 2020Q3, the risk may have increased significantly recently as the outbreak of COVID-19 may have hit hard the fundamentals of corporates in the region, which may subsequently result in massive credit rating downgrades for corporates if the pandemic is prolonged. Indeed, the number of credit downgrades in bonds has surged from 27 in 2010 to 142 in the first three quarters of 2020, while the number of bond defaults has increased notably to 27 or 1.4% of the outstanding bonds, a jump from an average number of 4.3 or 0.4% of outstanding bonds, in the decade before 2020.[14] This

[14] Data consisted of ratings from rating agencies such as S&P, Moody's and Fitch. We compare the ratings of the bond by the end of each year. If the bond was downgraded by more than one rating agency, it will be counted as one single downgrade event.

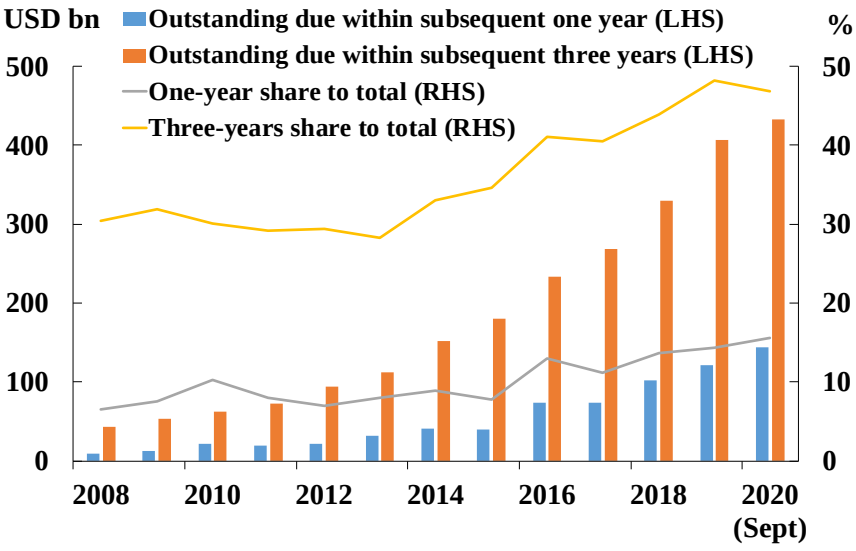
development may suggest that default risks for USD corporate bonds in the region should be closely monitored along with the increase in fallen angel risk.

For unrated bonds, there is a low degree of transparency in the firm's financial health, especially for unlisted companies, as it is impossible to keep track of any changes in their credit ratings. For independent investors with little association with the firms, it might be extremely difficult to assess the risk associated with any holdings in these unrated bonds due to asymmetric information, which might eventually require extra premium to lure these investors and thus increase the funding cost of these firms. With the increasing issuance of unrated bonds, the risk implications for the overall market cannot be ignored.

b) Rising rollover risk

Rollover risk refers to the risk that corporates fail to rollover their matured debts into new ones. The rollover risk of USD corporate bonds in the region increased over the period, partly due to the decline in the average maturity of USD HY corporate bonds. Chart 8 shows an upward trend in the amount and share of outstanding USD corporate bonds in the region that will mature within 1 year and 3 years, pointing to higher rollover risk since the GFC. By the end of 2020Q3, the amount of USD corporate bonds due within one year and three years were at US$144.3 billion and US$433.2 billion respectively, accounting for about 15.6% and 46.9% of the total outstanding in the region.[15] [16]

Chart 8: Redemption profile of USD bonds by EMEAP corporates



[15] Of the bonds due to mature in one year or three years after 2020Q3 in the region, China alone accounted for US$102.6 billion and US$301.6 billion, more than two-thirds of the total.

[16] The outstanding amount of perpetual bonds increased to around US$88.8 billion in 2020Q3. They are excluded from this sample as (i) they do not have rollover issue and (2) from an accounting perspective, perpetual bonds belong to the category of "Equity" instead of "Liability". In other words, issuing perpetual bonds will increase the firm's equity instead of its liability.

Sources: Dealogic and staff estimations.

(4) How rollover risk affects default risk of corporates in EMEAP

As detailed in the previous section, USD corporate bonds in the region were more exposed to rollover risks. A rise in rollover risks would increase the likelihood of bond default, particularly during periods of market stress. In order to quantify this impact, this section conducts an econometric analysis to study the response of bond spreads to rollover risks using a panel dataset of USD corporate bonds in the region.

a) Literature Review

While there is a rich body of works in the literature examining the relationship between rollover risk and corporate defaults (see for example, Leland and Toft (1996), He and Xiong (2012)), not many of them have empirically studied this issue. On the empirical front, based on a data set of international corporate bonds, Valenzuela (2016) showed that the effect of debt market illiquidity on credit spreads of corporate bonds is exacerbated by a higher proportion of short-term debt through the rollover risk channel. Wang et al. (2017) examined the effect of rollover risk on default risk by using dataset of US industrial firms, and they found that rollover risk's impact on default risk was stronger during periods when credit market conditions were tighter.

Following broadly the empirical models in these two papers, we aim to assess the impact of various risk factors, including (i) the rollover risk, and (ii) financial characteristics of issuers on credit spread of USD non-financial corporate bonds in EMEAP economies.

b) Data description and methodology

Our dataset covers the USD bonds issued by EMEAP corporates during the period of January 2008 to September 2020. The dataset is constructed by incorporating bond-specific, firm-specific and macroeconomic data extracted from Dealogic and Bloomberg. Altogether our empirical analysis includes 1,225 bonds from 427 firms, a total of 33,568 quarterly observations.

Similar to Valenzuela (2016), we use option-adjusted spread (OAS), a measure of bond yield spread in excess of US Treasuries after accounting for the option premium, as a proxy of bonds' default risk. In this study, a panel fixed effect regression model is applied to estimate how the default risk, measured by the OAS, is affected by rollover risk, after controlling for individual firm characteristics. Our baseline regression model is as follows:

$$OAS_{i,c,n,t} = \beta_0 + \beta_1 Rollover\ risk_{i,c,n,t} + \beta_2 Remaining\ maturity_{i,c,n,t} + \beta_3 \log(Firm\ Size)_{c,n,t} + \beta_4 Profitability_{c,n,t} + \beta_5 Leverage_{c,n,t} + \beta_6 Sovereign\ CDS\ Spread_{n,t} + \alpha_i + \varepsilon_t \quad \text{Equation 1}$$

where subscript i, c, n, and t denote bond, issuer, country, and time respectively; α_i are the bond fixed effects, and ε_t is the error term.

Regarding the explanatory variables, we include $Rollover\ risk$, which is defined as the ratio of the current portion of long-term debt (CPLTD) to the sum of CPLTD and total long term debt outstanding.[17] This variable measures the need of a company to refinance its maturing long-term debts. We have included other factors that may affect a firm's bond spread, including: (1) remaining maturity of the bond; (2) firm size measured by the logarithm of the firm's total asset; (3) profitability measured by the ratio of operating income to sales; (4) leverage defined as the ratio of total debt to total asset. Besides, the sovereign CDS spread is also added to control for differences in country risk among the bonds. These variables are commonly adopted in the literature. Detailed definition, interpretation and expected sign of coefficient estimates for these explanatory variables, as well as the summary statistics, are listed in Table 1 and Table 2 of Appendix 2 respectively.

As rollover risk may have a stronger impact on default risk during stress periods, we modify the baseline regression equation to quantify the impact. Specifically, we first construct a dummy variable (VIX90) that is defined as one when the level of the stock volatility index (VIX) stays at or above its 90th percentile threshold during the study period and zero otherwise. By definition, VIX90 captures the stress periods as revealed from the VIX. We then modify our baseline model by adding VIX90 and an interaction term between VIX90 and $Rollover\ risk$ as below:

$$OAS_{i,c,n,t} = \beta_0 + \gamma_0 VIX90 + \beta_1 Rollover\ risk_{i,c,n,t} + \gamma_1 Rollover\ risk_{i,c,n,t} \times VIX90 + \beta_2 Remaining\ maturity_{i,c,n,t} + \beta_3 \log(Firm\ Size)_{c,n,t} + \beta_4 Profitability_{c,n,t} + \beta_5 Leverage_{c,n,t} + \beta_6 Sovereign\ CDS\ Spread_{n,t} + \alpha_i + \varepsilon_t \quad \text{Equation 2}$$

c) Empirical results

Table 3 presents the estimation results. For the Model 1, the response of OAS to rollover risk is estimated to be positive and statistically significant at 11.9, suggesting that a one percentage point increase in the current portion of the long-term debt would

[17] The current portion of long-term debt (CPLTD) is the portion of a long-term liability that is coming due within the next twelve months. In the balance sheet, it is categorised as current liability because it has to be paid within one year.

lead to 11.9 basis points rise in OAS, other things being equal.[18] The result is broadly consistent with findings of the empirical literature (e.g., Gopalan et al. (2014), Valenzuela (2016)), suggesting a significant impact of rollover risk on default risk.

Model (2) extends the baseline model to capture the impact of rollover risk on OAS during financial distress periods. It reveals that one percentage point increase in the current portion of the long-term debt is associated with a 10.0 basis points rise in OAS. The interaction term between rollover risk and the VIX90 shows that during financial distress period, the OAS rises further by 6.2 basis points when the portion of maturing long-term debt increases by one percentage point.

It is also interesting to see whether the rollover risk plays a different role in driving up bonds' default risk between advanced economies (AEs) and emerging markets (EMs) in the region.[19] To capture this, we further extend the model by incorporating a) an interactive term between EM and $Rollover\ risk$ and b) an interactive term among EM, VIX90 and $Rollover\ risk$ into Model 2 (Model 3). We find that response of OAS to the rollover risk becomes statistically insignificant both in normal and stress periods for the overall samples. However, a significant positive response is found for USD corporate bonds issued in EMs of the region. Specifically, during normal periods, a one percentage point increase in rollover risk measure for those bonds that were issued in EMs of the region would lead to 14.2 basis points rise in OAS, other things being equal. For stress period, the response of credit spread to rollover risk is found to surge further by 6.5 basis points. Taken together, the empirical findings suggest that investors may concern more about the rollover risk of USD corporate bonds issued by EMs in the region, but less so for those issued by their AE counterparts in the region.

As discussed in the previous section, the credit ratings of many corporate issuers in the region have recently been cut as the business of these companies are suffering from massive scale economic contraction in the near term as the coronavirus pandemic evolves. In some cases, such downgrade leads the bond to change from an investment grade to speculative grade, as the bond becomes fallen angel. To examine the risk of fallen angel subgroup and its performance during stress period, we focus on the sub-sample of investment grade bonds.[20] We use two dummy variables to proxy for the fallen angel risks.[21] One focuses on bonds with rating of BBB- (FA dummy), and the other handles bonds with all BBB rating.

[18] The average portion of maturing long-term debt jumped from 0.165 in 2019Q3 to 0.203 in 2020Q3. If the trend continues, investors will demand an additional 44.5 basis points in OAS on average in a year, which is economically significant.

[19] Advanced economies (AEs) include Australia, Hong Kong, Japan, New Zealand, Singapore and South Korea while emerging markets (EMs) include China, Indonesia, Malaysia, Thailand and the Philippines.

[20] Non-investment grade bonds do not have fallen angel risk by definition.

[21] The fallen angel risk in the FA group is more imminent as the rating is just borderline above speculative grades. However, owing to a small number of observations of the FA group we supplement the analysis by considering a broader group with BBB dummy (for all BBB grades) as an alternative to deal with the small sample problem in the FA group. There are 998 and 4,139 observations with BBB- and all BBB ratings (which include BBB+, BBB and BBB-), which account for 3% and 12% of total observations, respectively.

With the dummy FA, we modify Model 2 by incorporating a) a FA dummy, b) an interactive term between FA and *Rollover risk* and c) an interactive term among FA, VIX90 and *Rollover risk* into it (Model 4). As shown in the column of Table 3, the response of OAS to rollover risk, whether during normal or not, from non-FA bonds is insignificant, indicating that the rollover risk of investment grade bonds might mainly come from bonds with fallen angel risk during financial distress periods. Similar results are also observed by using the BBB dummy (Model 5). Taken together, fallen angel risk would be one additional factor that should be considered in accessing the response of bond spreads to rollover risk for investment grade universe. [22] [23]

(5) Conclusion

The build-up in dollar borrowing by non-financial corporations in EMEAP economies after the GFC and their increasing reliance on short-term funds have exposed the firms to higher rollover risks, as repayment obligation surges and the maturity of their outstanding debt shortens. The high rollover risk could be a potential trigger for a sharp rise in corporate default risk, especially during financial crises, as USD market liquidity evaporates and credit supply is scant when financial markets are under stress and economies are subject to capital outflows and depreciating domestic currency pressure.

Meanwhile, the gradually declining bond quality in EMEAP economies is also a concern. In particular, IG bonds accounted for a decreasing share of total corporate USD bond issuance after the GFC, while within IG bonds, those with lower credit ratings (i.e. BBB+ to BBB-) also increased significantly, indicating a high fallen angel risk. In addition, the non-negligible share of unrated corporate bonds may also pose challenges in monitoring the credit quality of the USD corporate bonds in the region.

Our empirical analysis confirms the importance of rollover risk in driving up the default risk of non-financial corporates after controlling financial characteristics of individual firms and country risk factor, which is consistent with the findings of recent empirical studies focusing on other markets. The empirical results also show that the risks of EMEAP non-financial corporates during financial distress periods are mainly found in EMs. In addition, fallen angel risks may amplify the response of default risk to the rollover risks.

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[22] For robustness check, we have re-estimated the model using the ratio of the bid-ask spread of 10-year US Treasury yield to the mid yield of Treasury as an alternative proxy for liquidity premium to capture the overall bond market liquidity. The results remain largely similar and details of the results are shown in Table 4 of Appendix 2.

[23] It is noted that stock return volatility, besides credit ratings, is another important determinant of bond yield spread (Campbell and Taksler (2003)). Our empirical model here does not include this as the sample used in our estimation consists of a substantial proportion of unlisted firms, which do not have stock return volatility per se. As a robust check for our results, we re-estimate the relationship by including the stock return volatility as a control variable for the listed firms only and find that the inclusion of the new variable has not changed our major findings in our original results, in particular the impact of rollover risk to the firms' default risks. Details of the regression results with stock return volatility for listed firms are shown in Table 5 of Appendix 2.

Our empirical findings have three implications for financial stability. First, while the low interest rate environment may provide breathing space for corporates in the short term, should this bond issuance pattern continue, the accumulation of debts, especially by those fundamentally weaker corporates, may actually worsen their debt repayment problem as the debt will reach an unsustainable level.

Second, the increasing reliance of shorter maturity bonds by firms, partly due to an expectation of a prolonged USD low interest rate environment, might expose them to the risk from a change in US monetary policy. Should the interest rate rise, these firms might face much higher refinancing costs. As a result, the firms, especially those corporates from EMs and the fallen angel group, are likely opening themselves to higher rollover risks and even default risks.

Third, despite the fact that the USD corporate bonds play a relatively minor role in the overall bond market in the EMEAP region, accounting for about 15-20% of total bond outstanding in the last decade, the increasing exposure to USD bonds by corporates might be a potential problem for those EMs with weaker economic fundamentals. Firms with significant currency mismatches as a result of rising exposure to USD bonds would be particularly vulnerable if their economies are subject to economic downturn, capital outflow and depreciating exchange rate pressure. As seen in many crises in history, the currency mismatch problem faced by corporates in emerging markets can turn into a country's balance of payment crisis as USD shortage usually emerges when financial markets in emerging economies are under stress.[24] In order to further explore the currency mismatch problem faced by corporates and their aggregate impacts to the country level, more micro analysis, such as studying individual firms' balance sheet data, may help.

[24] Recent lessons in the EMEAP region can be traced back to Thailand and Indonesia in the Asian Financial Crisis in 1990s.

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Appendix 1: Major findings of the 2020 OECD report on "Corporate Bond Market Trends, Emerging Risks and Monetary Policy"

- Using data of 92,069 non-financial corporate bonds issued from 114 countries between January 2000 and December 2019, the report found that along with the unprecedented growth in the global bond market, the quality and dynamics of the outstanding stock of corporate bonds have changed.

- **Extended growth in corporate bond borrowing.** Since 2008, the annual global issuance of corporate bonds has averaged US$1.8 trillion, double the annual average between 2000 and 2007. The outstanding stock of non-financial corporate bonds also reached the all-time high of US$13.5 trillion in 2019.

- **Long-lasting decline in overall bond quality.** In every year since 2010, around 20% of the total amount of all bond issues has been non-investment grade and the portion reached 25% in 2019. There have been pockets of risks of fallen angels as the portion of BBB rated bonds status edged higher to 51% of all investment grade issuance in 2019. Only 30% of the global outstanding stock of non-financial corporate bonds were rated A or above and issued by companies from advanced economies as of December 2019. The total payback or refinancing requirements within 2020 to 2022 for emerging market issuers and non-investment grade and unrated bonds issued by companies from advanced markets is US$2.5 trillion (41% of their total outstanding amount).

- **Longer maturities.** The average length of maturity for investment grade bonds at the date of issue has been 12.4 years in 2015-2019, compared to 9.4 years in the early 2000s. The combination of longer maturities and declining credit quality has made bond markets more sensitive to change in monetary policy.

- **Issuer quality and rating stability.** The median firm in each investment grade rating has higher leverage ratios compared to a decade ago. The one-year 1-notch downgrade probability is lowest for bonds rated BBB-. It may reflect that companies with BBB status pay extra close attention to their rating metrics in order to maintain their rating status and borrowing costs.

- **Sell-offs and financial stability concerns.** Corporate bond holdings by exchange traded funds (ETFs) who typically use passive rating-based strategies increased 13-fold from US$32 billion in 2008 to US$420 billion in 2018. Due to the use of rating-based investments and passive management, extensive downgrades of BBB rated bonds to non-investment grade status may lead to substantial sell-offs that put corporate bond markets in general under stress, giving rise to financial stability concerns.

Appendix 2: Explanatory variables used in the estimation and summary statistics

Table 1: Explanatory variables used in the estimation

Variables	Interpretations	Expected sign
Rollover risk The amount of CPLTD), divided by the sum of CPLTD and total long term debt outstanding	A higher value indicates that the portion of maturing long term debt (to be due within one year) is higher, i.e. a higher rollover risk.	Positive
Remaining maturity The number of years that the bond is expected to mature	A lower value indicates that the bond is closer to its maturity date. Long term bonds have a higher liquidity discount than short-term bonds. On the other hand, the rollover need of existing short-term bonds increases the cost of financial distress of the firm.	Indeterminate
Firm size $\log(Total\ asset)$	A higher value implies that the firm has a larger total asset, thus more resilient during market illiquidity.	Negative
Profitability Operating income divided by sales revenue	A higher value indicates that the firm has a higher profitability, thus having a larger buffer during economic downturn.	Negative
Leverage Total debt divided by total asset	A higher value suggests that the firm relies more on debt-financing.	Positive
Stock return volatility Annualized standard relative price change for the 30 most recent trading days closing price	A higher value suggests there is a higher volatility in stock returns. Investors require higher bond yields to compensate the increase in idiosyncratic equity volatility.	Positive
Sovereign CDS spread	A higher value implies that there is a higher default risk in the overall market.	Positive
Dummy for EM	A significantly-positive value indicates the average OAS in emerging markets is higher than that of advanced economies.	Positive
Dummy for fallen angel bonds	A significantly-positive value indicates the average OAS among fallen angel bonds is higher than that of investment-grade bond.	Positive

Dummy for stress periods The 90th percentile (or above) of the VIX Index over the sample period	A significantly-positive value indicates the average OAS is higher during financial distress periods.	Positive
Dummy for stress periods The 90th percentile (or above) of the liquidity premium over the sample period	The liquidity premium is defined as the ratio of the bid-ask spread of 10-year US Treasury yield to the mid yield. A significantly-positive value indicates the average OAS is higher during financial distress periods.	Positive

Table 2: Descriptive statistics of OAS and other variables

Variables	Unit	Min	Median	Mean	Max	SD	N
OAS	b.p.	-2,194	211	388	40,164	727	33,568
Remaining maturity	Year	0.0	3.6	5.4	87.4	6.3	33,568
Rollover risk	%	0	13.0	16.1	99.9	12.4	6,480
Short-term debt to asset	Ratio	0	0.082	0.137	8.423	0.434	14,660
Cash	$US mn	-2,359	1,719	5,300	63,077	8,659	14,880
Firm size	$US mn	45	27,213	68,691	624,890	110,304	14,888
Profitability	%	-5157.0	9.0	11.2	1730.1	65.2	9,682
Leverage	%	2.6	35.2	36.7	86.0	14.3	9,263
Stock return volatility	%	0.0	28.7	33.1	572.3	19.4	22,809
Sovereign CDS spread	b.p.	7.1	55.2	67.1	741.7	40.1	33,543
VIX Index	Index	10.3	16.0	18.3	58.6	7.1	33,568
Liquidity premium	Ratio	0.0004	0.0008	0.0012	0.0030	0.0008	33,568

Note: The statistics are based on panel data (quarterly average) between January 2008 and September 2020.

Table 3: Estimation results of the impact of rollover risks on option-implied spreads for USD corporate bonds in EMEAP

Dependent variable: OAS	Baseline model (1)	Stress dummy (2)	EM dummy (3)	FA dummy (4)#	BBB dummy (5)#
VIX90		-21.9	-4.5	42.5***	42.1***
		(46.0)	(44.7)	(5.6)	(6.3)
FA dummy				95.9	
				(70.7)	
BBB dummy					-0.8
					(9.2)
Rollover risk	11.9***	10.0**	-0.8	-0.1	-0.1
	(4.2)	(4.4)	(0.9)	(0.1)	(0.1)
Rollover risk * VIX90		6.2**	0.2	-0.0	-0.2
		(3.0)	(1.9)	(0.4)	(0.6)
Rollover risk * EM dummy			14.2**		
			(5.5)		
Rollover risk * EM * VIX90			6.5***		
			(1.9)		
Rollover risk * FA dummy				-0.7	
				(0.8)	
Rollover risk * FA * VIX90				1.6**	
				(0.7)	
Rollover risk * BBB dummy					-0.4
					(0.3)
Rollover risk * BBB * VIX90					1.2**
					(0.5)
Remaining maturity	-40.9***	-32.8***	-32.9***	6.4***	6.5***
	(9.8)	(12.1)	(12.0)	(1.3)	(1.3)
Firm size	-135.1*	-111.6	-134.3	-11.3	-9.2
	(73.0)	(76.5)	(82.4)	(8.6)	(8.8)
Profitability	-0.1	-0.1	-0.1	-0.3***	-0.3***
	(0.2)	(0.2)	(0.2)	(0.1)	(0.1)
Leverage	8.46**	6.9	6.0	0.6	0.4
	(3.9)	(4.3)	(3.9)	(0.4)	(0.4)
Sovereign CDS spread	4.1***	3.7***	3.8***	0.8***	0.8***
	(0.6)	(0.6)	(0.6)	(0.1)	(0.1)
Observations	4034	4034	4034	1821	1821
R^2	0.095	0.111	0.126	0.442	0.429
Adjusted R^2	-0.206	-0.187	-0.166	0.286	0.269
F Statistic	53.1***	47.0***	43.7***	102.4***	97.2***

Note: ***, **, and * denote statistical significances of 1%, 5%, and 10% respectively given that the standard errors are single-clustered at the cross-section dimension.
#: Based on the sub-sample of investment grade bonds.
Source: HKMA staff estimate

Table 4: Estimation results (replace the VIX Index by the liquidity premium)

Dependent variable: OAS	Baseline model (1)	Stress dummy (2)	EM dummy (3)	FA dummy (4)#	BBB dummy (5)#
Liquidity90		-0.1	55.0	55.4***	55.5***
		(79.5)	(80.3)	(8.2)	(8.2)
FA dummy				49.6	
				(64.5)	
BBB dummy					-2.8
					(10.2)
Rollover risk	11.9***	10.0*	0.0	-0.1	-0.1
	(4.2)	(5.6)	(1.2)	(0.2)	(0.1)
Rollover risk * Liquidity90		5.4	-3.2	-0.2	-0.1
		(6.3)	(4.3)	(0.3)	(0.3)
Rollover risk * EM dummy			13.7**		
			(6.8)		
Rollover risk * EM * Liquidity90			8.0*		
			(4.6)		
Rollover risk * FA dummy				-0.9*	
				(0.5)	
Rollover risk * FA * Liquidity90				6.5**	
				(2.9)	
Rollover risk * BBB dummy					-0.4
					(0.3)
Rollover risk * BBB * Liquidity90					0.8
					(0.5)
Remaining maturity	-40.9***	-31.5**	-31.1**	7.7***	7.9***
	(9.8)	(13.1)	(12.7)	(1.8)	(1.7)
Firm size	-135.1*	-123.6	-146.3*	-17.0*	-15.5
	(73.0)	(77.3)	(83.9)	(10.0)	(10.1)
Profitability	-0.1	-0.1	-0.1	-0.2**	-0.3***
	(0.2)	(0.2)	(0.2)	(0.1)	(0.1)
Leverage	8.5**	9.1**	8.1**	2.2***	2.4***
	(3.9)	(3.6)	(3.2)	(0.5)	(0.5)
Sovereign CDS spread	4.1***	4.2***	4.4***	1.2***	1.2***
	(0.6)	(0.6)	(0.6)	(0.1)	(0.1)
Observations	4,034	4,034	4,034	1,821	1,821
R^2	0.095	0.099	0.113	0.388	0.360
Adjusted R^2	-0.206	-0.202	-0.184	0.216	0.181
F Statistic	53.1***	41.6***	38.5***	81.8***	72.7***

Note: ***, **, and * denote statistical significances of 1%, 5%, and 10% respectively given that the standard errors are single-clustered at the cross-section dimension.
#: Based on the sub-sample of investment grade bonds.
Source: HKMA staff estimate

Table 5: Estimation results (with variable stock return volatility)

Dependent variable: OAS	Baseline model (1)	Stress dummy (2)	EM dummy (3)	FA dummy (4)#	BBB dummy (5)#
VIX90		-26.4	-3.2	52.4***	51.2***
		(63.6)	(60.6)	(7.8)	(8.5)
FA dummy				30.0**	
				(13.2)	
BBB dummy					1.7
					(11.6)
Rollover risk	10.8***	9.4**	-0.3	0.2	0.1
	(4.2)	(4.2)	(0.9)	(0.1)	(0.1)
Rollover risk * VIX90		5.9	-0.5	-0.06	-0.3
		(3.7)	(2.2)	(0.6)	(0.8)
Rollover risk * EM dummy			12.9**		
			(5.5)		
Rollover risk * EM * VIX90			7.4***		
			(2.7)		
Rollover risk * FA dummy				-1.8***	
				(0.7)	
Rollover risk * FA * VIX90				1.2	
				(0.8)	
Rollover risk * BBB dummy					-0.4
					(0.4)
Rollover risk * BBB * VIX90					1.1*
					(0.6)
Stock return volatility	0.7**	0.2	0.4	-0.4***	-0.4***
	(0.4)	(0.5)	(0.5)	(0.1)	(0.1)
Remaining maturity	-36.5***	-33.0***	-32.6***	7.7***	7.6***
	(9.9)	(11.8)	(11.8)	(1.4)	(1.4)
Firm size	-128.3*	-107.1	-133.4	-24.8***	-23.3***
	(70.9)	(75.1)	(83.5)	(7.7)	(8.4)
Profitability	-0.9	-1.0	-1.0	-0.1**	-0.2***
	(1.2)	(1.2)	(1.1)	(0.1)	(0.1)
Leverage	8.9**	9.0**	8.0**	1.8***	1.7***
	(4.0)	(4.0)	(3.7)	(0.5)	(0.5)
Sovereign CDS spread	3.9***	3.8***	3.8***	0.6***	0.6***
	(0.6)	(0.7)	(0.7)	(0.1)	(0.1)
Observations	2,844	2,844	2,844	1,394	1,394
R^2	0.128	0.140	0.160	0.471	0.468
Adjusted R^2	-0.070	-0.055	-0.032	0.366	0.362
F Statistic	48.4***	42.0***	40.1***	86.2***	85.2***

Note: ***, **, and * denote statistical significances of 1%, 5%, and 10% respectively given that the standard errors are single-clustered at the cross-section dimension.
[#]: Based on the sub-sample of investment grade bonds.
Source: HKMA staff estimate