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JEL Classification

G10, G12, G14

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"You're not more punk because you wear leather jackets."

Dean Mackin, Australian radio announcer

1. Introduction

Benchmark bonds are the most liquid of bonds. By virtue of their liquidity, they serve as the focus of price discovery. What they discover they convey through prices to the market at large, thus supplying an informational public good. Indeed, to Dunne, Moore and Portes (2002), price discovery provides the defining characteristic of a benchmark bond. Referring to benchmarks in over-the-counter markets, Duffie, Dworczak and Zhu (2017) argue that a "benchmark can raise social surplus by increasing the volume of beneficial trade, facilitating more efficient matching between dealers and customers, and reducing search costs."

In the world's largest government bond markets, benchmarks seem to arise without government intervention. In the US Treasury market, for example, market convention has long established the on-the-run issues as the benchmarks. One possible reason for such a convention is a revelation mechanism proposed by Duffie, Dworczak and Zhu. Under certain conditions, this mechanism would lead low-cost dealers to name a benchmark. Dunne, Moore and Portes (2007) explain that once benchmarks are established, network externalities would reinforce their status. Pasquariello and Vega (2009) show that the strength of this status also depends on the degree of information heterogeneity in the market.

To the extent that benchmarks form a yield curve, there are gains that accrue to the broader fixed-income market. Wooldridge (2001) points out that the presence of this yield curve makes

it easier to price corporate bonds as well as certain derivative contracts.[2] Benchmark bonds also seem to be a source of market resilience in times of stress. Furfine and Remolona (2002), for example, find that during the global flight to liquidity in 1998 in the wake of the Russian sovereign default and the near collapse of the hedge fund Long-Term Capital Management, trading activity shifted to benchmark bonds and away from less liquid bonds.

When a benchmark fails to arise in a bond market, however, would it make sense for the government to step in and try to produce one? Many of the relatively small bond markets of emerging market economies, for example, have not had the advantage of benchmark bonds. This may be due to a coordination failure among market makers in choosing the benchmark. If it is simply a matter of such coordination, then the government can presumably step in and choose the benchmark. Indeed, it turns out that in some of these economies, governments have taken it upon themselves to designate benchmark bonds and even to reinforce these choices by fostering these bonds' liquidity. This liquidity is fostered through re-openings of bond issuance and market-making obligations imposed on primary dealers.

The question we ask in this paper is how well such policy interventions work. In other words, to what extent do these *de jure* benchmarks become *de facto* benchmarks? To us, the de jure benchmarks are very much like "wannabe" benchmarks. The Australian radio announcer, Dean Mackin, has said, "You're not more punk because you wear leather jackets." We see the government authorities' designation of a benchmark as analogous to Mackin's leather jackets. The designation alone may not lead to a real benchmark. In the end, the rise of

[2] Hence, the IMF and World Bank (2001) have recommended creating benchmarks in a range of maturities.

real benchmarks will depend on the trading activity of market participants and market makers. We can then ask what factors tend to turn wannabe benchmarks into real benchmarks.[3]

We look at three government local currency bond markets in emerging Asia, namely those in Indonesia, Malaysia and Thailand. These are markets that McCauley and Remolona (2000) would deem too small to be deep and liquid. These are also markets for which the authorities have designated de jure benchmark bonds in various chosen maturities. Importantly, in each of these markets, we are able to identify exactly which bonds were designated as de jure benchmarks, a total of 78 bonds. In looking at these bonds, we uncover a phenomenon that we have not seen in the literature nor in the more developed markets: a bond that is chosen as the de jure benchmark in its maturity segment is later "recycled" as the de jure benchmark in a shorter maturity. In our data, de jure bonds are recycled almost half the time.

We collect from Bloomberg daily data on 422 government bonds that were traded in these markets, including the de jure benchmarks. These are all the fixed-coupon local currency issues that are available for these markets. The sample period is from March 1999 to April 2017, a period that would have seen significant variation in liquidity within each market. The data consist of quoted prices, yields and bid-ask spreads. With the available data for the three countries, we measure bond-specific relative liquidity by combining these three measures. We are then able to determine the extent to which the de jure benchmark bonds end up becoming real benchmarks in the sense of being the most liquid bonds in their maturity segments. We

[3] When referring to benchmark bonds, we use the terms "de jure" and "wannabe" interchangeably and the terms "de facto" and "real" interchangeably.

find that this occurs in close to 55% of months in our sample. In Malaysia, the success rate is 77%.

Estimates from a probit model help us identify the factors that make success more likely. This model takes account of the selection bias that arises from the fact that the choice of the de jure benchmark is endogenous. In making this choice, we find that authorities are often torn between choosing the on-the-run issue and choosing a seasoned bond that was already the most liquid one. Interestingly, choosing an on-the-run bond issue does not seem to work, which is a departure from the experience of deep and liquid markets. Instead, the subsequent actions of market participants point to the seasoned bond as the choice that is more likely to lead to success.

In what follows, we start by characterising the de jure bonds and the recycling phenomenon. In Section 3, we then describe our data and explain how we use them to measure liquidity and compare liquidity across bonds. In Section 4, we determine which bonds have the most liquidity and whether these are the de jure bonds chosen by the government. In Section 5, we first estimate a probit model to identify the considerations that go into the authorities' choices of de jure bonds. We then take account of those choices in a second probit model that describes how market participants decide which of the de jure bonds become de facto benchmarks. Finally, in Section 6 we offer policy implications.

2. The de jure benchmarks

The government bond markets that we look at are those in Indonesia, Malaysia and Thailand. These are markets in emerging Asia that would presumably be too small to be deep and liquid

and thus to produce benchmark bonds spontaneously. When McCauley and Remolona (2000) analysed the liquidity of a broad cross-section of government bond markets, they suggested that the minimum size for a deep and liquid market was about USD200 billion in terms of the amount outstanding. As shown in Table 1, none of the markets in our sample exceeded that threshold as of the end of 2017. The largest of the three markets was Malaysia, with USD167 billion, which amounted to 54% of the country's GDP. The smallest was Thailand, with USD136 billion, or 30% of GDP. While Indonesia's market was bigger than Thailand's in terms of absolute size, it was smaller in terms of the ratio to GDP. All three markets were dwarfed by the more developed markets of the United Kingdom (USD2,785 billion), Japan (USD9,471 billion) and the United States (USD17,584 billion).

It seems unlikely that the three emerging market economies in our sample would have developed benchmark bonds without government intervention. Indeed, such intervention did take place. The authorities in all three economies have designated specific bonds as benchmarks and have tried to foster their liquidity. The strategy of designating benchmark bonds is pursued in other emerging markets as well, including in Mexico and Chile.[4]

Various official sources serve to identify the designated benchmark bonds or what we call *de jure* bonds. In Indonesia, the de jure bonds are announced by the Ministry of Finance. For

[4] For example, at the Banco de Mexico, Álvarez-Toca and Santaella-Castell (2014) advocate the creation of benchmarks. They state, "In a yield curve there is a wide set of securities issued at different maturities. Among the measures adopted to foster the government securities market is selecting only certain issues that will serve as benchmarks. This is done by increasing the outstanding amount in circulation through a re-opening process for the purpose of building a critical outstanding amount." Meanwhile, authorities in Chile support benchmarks with maturities of five, 10, 20 and 30 years using re-openings and additional benchmark issuance in exchange for non-benchmark securities (https://www.hacienda.cl/english/press-room/news/archive/ministry-of-finance-announces-issuance.html).

Malaysia, the source is the central bank's website. In Thailand, the de jure benchmarks are announced by the Public Debt Management Office. Based on these sources, the authorities in Indonesia announced 27 specific de jure benchmarks between March 1999 and April 2017. In the same period, Malaysia announced 32 de jure benchmarks and Thailand announced 19. This gives us a total of 78 de jure bonds to analyse.

The choices of de jure benchmarks have always been associated with specific maturities. As shown in Table 2, Indonesia has tended to prefer four maturities for its de jure bonds, namely the 5-year, the 10-year, the 15-year and the 20-year maturities. Malaysia has also tended to choose four maturities for its de jure bonds, but at somewhat shorter maturities, namely the 3-year, the 5-year, the 7-year and the 10-year maturities. Thailand has tended to spread its de jure bonds across eight maturities, although there has been a slight preference for the 5-year, the 10-year and the 15-year maturities. What is common to the three jurisdictions are three maturities that tended to be chosen for de jure bonds, namely the 5-year, the 7-year and the 10-year maturities.[5]

In the three jurisdictions in our sample, the authorities have sometimes chosen de jure bonds in a surprising way. In particular, they would choose a de jure bond in a given maturity and later recycle the exact same bond as the de jure benchmark in a shorter maturity. As shown in Table 3, in Indonesia in 2011, bond FR0053 was the de jure government benchmark in the 10-year maturity. Five years later, the same bond became the de jure benchmark in the 5-year maturity. A similar recycling of roles happened to six other bonds in Indonesia. Table 3 also

[5] For a full list of the designated benchmarks, see Tables A1-A3 in the appendix.

illustrates the phenomenon in Malaysia, where a recycling of de jure bonds took place four times. Similarly, Table 3 also illustrates the phenomenon in Thailand, where such recycling took place seven times. Indeed, a Thai de jure bond, identified as LB21DA, was recycled twice. If all de jure bonds in our sample were recycled once, there would be 39 instances of recycled bonds. Instead we find 18 such instances, meaning that 46% of de jure bonds were recycled.

The recycling phenomenon is surprising because, at least in the more developed bond markets, the benchmarks tend to be newly issued bonds. As far as we know, benchmark bonds in well developed markets never repeat as benchmarks in shorter maturities. As mentioned above, in the US Treasury market, the benchmarks are always the "on-the-run" issues or the most recently issued bonds. In Japan, the benchmark is always a recently issued 10-year government bond, although not always the *most* recently issued one (Boudoukh and Whitelaw, 1991). One question we ask is whether a recycled de jure benchmark has a better chance of success than does a new de jure benchmark.

The life of the Thai de jure bond that was recycled twice illustrates the interaction between recycling and re-openings. As shown by red bars in Graph 1, the bond identified as LB21DA first received de jure benchmark status at the 10-year maturity as soon as it was issued in late 2010. It retained that status for two years even as its time to maturity shortened. In late 2012, it became the de jure benchmark for the 7-year maturity, a status it retained for about a year. It lost that de jure status when its time-to-maturity shortened to six years. However, it regained de jure benchmark status after a year, this time for the 5-year maturity, when its maturity had shortened to approximately five years.

The blue region in Graph 1 displays the cumulative issuance of bond LB21DA, and illustrates another important aspect by which authorities have sought to foster the liquidity of wannabe benchmarks that we see in our sample. Each blue step represents a re-opening of the bond. This occurs 21 times, all during periods when the bond was a de jure benchmark. We will examine the importance of issuance in supporting benchmark behaviour in de jure benchmark bonds.

Another way by which the authorities try to foster the liquidity of de jure benchmarks is by requiring primary dealers to make markets in these securities. Primary dealers are market participants that are eligible to trade with the central bank, and they often have market obligations as well as special privileges. In the case of the Indonesian bond market, primary dealers have the obligation "to provide continuous two-way price quotations (bid and offer prices) for benchmark series of government securities…"[6] In the case of the Malaysian market, Bank Negara Malaysia requires primary dealers "to provide two-way price quotations for benchmark securities under all market conditions to ensure liquidity in the secondary market."[7] In the case of the Thai market, primary dealers are obliged to "[q]uote two-way firm prices for all benchmark bonds under normal market conditions, particularly after the private repurchase market has been in place."[8]

6 See Asian Development Bank (2017, p. 82).

7 See: http://bondinfo.bnm.gov.my/portal/server.pt?open=514&objID=27247&parentname=CommunityPage&parentid=68&mode=2.

8 See Bank of Thailand (2002).

3. Measuring liquidity

We collect daily data on 422 government bonds from Bloomberg that were traded in these markets, including the de jure bonds, for a total of over 237,000 observations.[9] These are all the fixed-coupon local currency issues that are available for these markets. In a sample spanning the period from March 1999 to April 2017, the data consist of quoted prices, yields and bid-ask spreads. Unfortunately, there are a significant number of missing observations. We are also unable to obtain data on trading activity. Nonetheless, the available data allow us to measure bond-specific relative liquidity in various ways and thus to compare liquidity across bonds. Indeed we are able to use to our advantage the fact that there are missing observations.

To compare liquidity we limit ourselves to sample periods and maturity buckets in which de jure benchmarks exist and there are a sufficient number of other bonds for comparison. In general, we consider wider buckets for longer maturities. We construct the bucket widths as shown in Table 4.

The buckets are centred on the maturity of the de jure benchmark. Given that the remaining time to maturity for the de jure benchmark is not for a fixed maturity, but shortens over time, there are cases where the associated buckets overlap. In these cases, the demarcation between buckets is drawn at the midpoint of the remaining times to maturity of the two associated de jure benchmarks.

In limiting ourselves to sample periods and maturity buckets in which sufficient data are available, we are left with data that start after 2005 and with only five maturity buckets for

[9] Schestag, Schuster and Uhrig-Homburg (2016) find that proxies for bond market liquidity based on daily data, including bid-ask spreads, tend to measure transaction costs well.

Thailand (instead of eight) and four maturity buckets for Indonesia (instead of five).[10] We then have 252 bonds and 126,279 daily observations. With these data, we calculate bond-specific liquidity within each bucket at the monthly frequency, using the following three simple measures:

1) Average bid-ask spread, in which the bond with the narrower spread is considered more liquid;

2) Average yield to maturity, in which the bond with the lower average yield is considered more liquid, since greater liquidity would command a price premium that would be reflected in a lower yield; and

3) Number of days for which the above quotes are available, in which the bond with more days with quotes is considered more liquid.

In using as one measure of liquidity the number of days for which quotes are available, we take advantage of the fact that there are missing observations for some bonds for a significant number of days, since this is itself a proxy for liquidity.

For each of the three measures above, we standardise their scores and take the average across the three standardized measures.[11] We identify the bond with the lowest average as the

[10] We limit our analysis to de jure benchmarks where associated maturity buckets include data for at least three bonds most months. Daily bond price data is scant for 30-year maturity bonds, and almost non-existent for 50-year bonds.

[11] We define each measure such that a small score indicates high liquidity (that is, we take the negative of measure 3).

most liquid bond in its maturity bucket and therefore as the de facto benchmark for that maturity.

With more complete data, it might be possible to identify the de facto benchmarks by examining their role in price discovery. Dunne, Moore and Portes (2002), for example, use Granger-causality and co-integration methods to identify benchmarks in the euro area government bond markets. One can also extract principal components from the price movements of bonds in a market, and identify as the benchmark the bond with the highest factor loading. These methods, however, do not work well with the data available to us. Hence, in this paper, we limit ourselves to measuring liquidity, which we recognise is a necessary but not sufficient condition for true benchmark status.

4. Does de jure become de facto?

The question we ask in this section is simple. In determining the de facto benchmark, to what extent do market participants act on the government's de jure choice? Our empirical version of this question is: does the de jure benchmark turn out to be the de facto benchmark in the sense of being the most liquid bond in its maturity bucket in a given month? It turns out that sometimes it does and sometimes it does not. The issue does not seem to be a simple matter of coordination in which the government chooses a benchmark for market participants to then coordinate on.

To summarise our results, we take the proportion of months in the year in which the de jure benchmark turns out to be also the de facto benchmark. We then graph that proportion for

each market and maturity bucket over the years in which we are able to carry out the liquidity analysis.

We find that the frequency with which a de jure benchmark becomes the de facto benchmark depends on the market and the maturity bucket. As shown in Graph 2, in Indonesia especially since 2010, the de jure benchmark for the 20-year maturity was more often than not also the de facto benchmark. This was not the case for the other maturities in Indonesia. In the case of Malaysia, the de jure benchmark was also the de facto benchmark most of the time. This was especially the case for the 5-year and 10-year maturities since 2006 and for the 7-year maturity since 2010. In the case of Thailand, the 5-year de jure benchmark was the most successful one across de jure maturities. It was the de facto benchmark for its maturity in the majority of months since 2009. The 20-year de jure bond also saw some success but only until 2015. When it comes to maturity, the 5-year de jure bond seems to be the most successful one overall.

When we combine maturities and markets, de jure benchmarks become de facto benchmarks 55% of the time. When we compare markets, Malaysia wins the race. In that market, de jure benchmarks make it as de facto benchmarks 77% of the time. As shown in Graph 3, since 2006, a Malaysian de jure benchmark more often than not has become the de facto benchmark. In the case of Indonesia and Thailand, their de jure benchmarks had good years and bad years. The good and bad years in Indonesia do not coincide with those in Thailand, suggesting that the lack of success of their de jure benchmarks was likely due to market-specific factors rather than global or regional factors.

Does a bond's de jure benchmark status enhance the bond's liquidity at all even if the bond does not become the de facto benchmark? To answer this question, we consider all our de jure benchmarks together and track their liquidity in terms of our calculations relative to the month before a bond becomes a de jure benchmark. We report our calculations month-by-month before and after the bonds receive their de jure designation. It turns out that indeed there is an improvement in relative liquidity, but that this improvement is somewhat gradual. As shown in Graph 4, the improvement starts as early as four months before the designation and continues for two months after the designation. The overall improvement is quite striking, with the confidence bands indicating that the change is highly statistically significant, comparing before and after designation periods. This suggests that de jure status does enhance a bond's liquidity somehow, whether or not the improvement in liquidity is sufficient to make the bond the de facto benchmark. To some degree, market participants seem to heed their governments' call by trading the designated benchmark somewhat more actively than otherwise. Moreover, it appears that these participants are able to anticipate which bond will receive de jure benchmark status, since this improvement begins before the designation.

What happens when a bond loses its benchmark status? As shown in Graph 5, there is a deterioration in the bond's liquidity in the final months of its tenure as a de jure benchmark. The deterioration seems to end by the time the status is lost. Again, market participants apparently have some idea of when a new de jure benchmark will be chosen, although the effect at this stage is not as large or statistically significant as the effect around the start of de jure status.

In the case of the US Treasury market, the issuance calendar makes the issuance of on-the-run securities perfectly predictable. In the case of our three emerging markets, if the choice was indeed predictable, then that choice would be endogenous to the process. This endogeneity should be taken into account when we try to determine what factors account for the success of a de jure bond.

5. When does de jure become de facto?

Why do some de jure benchmarks make it as de facto benchmarks, while others do not? We answer this question in two steps. First, we model the choices by the authorities in picking de jure benchmarks. Second, recognizing that these choices are endogenous to the process, we take them into account in a model of what determines the success of a chosen de jure benchmark. More specifically, we estimate a probit model of the choice of the de jure bond. We use the resulting estimates to construct the inverse Mills ratio, which we then include among the explanatory variables for a second probit model. This second model is about what factors actually lead to the success of the de jure choice as the de facto benchmark. Knowing how the authorities tend to choose the de jure benchmarks, the second model will then allow us to evaluate those choices.

5.1 How do the authorities choose the de jure bonds?

We start by addressing the question of how the authorities decide on which bonds to designate as de jure bonds. For this purpose, we estimate the probit model,

$$Pr(\text{de jure} = 1) = f(\boldsymbol{x\beta}) \qquad (1)$$

where the dependent variable is a dummy that takes on the value of one if the bond is a de jure benchmark in a given month, and zero otherwise. For the vector of dependent variables $\boldsymbol{x}$, we consider the following:

1) A dummy variable for whether the bond was the on-the-run issue in that maturity segment;
2) A dummy variable for whether the bond was issued (or reopened) during the month;[12]
3) Total accumulated issuance of the bond;
4) A dummy variable for whether the de jure bond was the de facto bond in the previous month;
5) A dummy variable for whether the bond had previously been a de jure benchmark at a longer maturity;
6) The number of bonds in the bucket; and
7) Fixed effects for each benchmark maturity in each country.

This empirical model nests various ways in which authorities could choose de jure benchmarks. To choose an on-the-run issue as the de jure benchmark is to emulate the large advanced bond markets, especially the U.S Treasury market, where the most recently issued bond automatically becomes the benchmark. To choose a bond that was the "de facto in the previous month" is to choose an issue that has already proven itself as one that is able to command superior liquidity. Similarly, to choose one that was "previously de jure" is to choose

[12] As a robustness check, we also consider total issuance in the second half of the previous month or first half of the current month, given that our assessment of liquidity is conducted at monthly frequency.

a bond that is already familiar to market participants. We can interpret the choice of authorities as an effort to anticipate what market participants will decide to trade most actively.

We first estimate the probit model for all three countries together. Then, to allow for the possibility that the factors that determine de jure choices need not be the same across countries, we estimate the model separately for each country. It turns out that the choices of de jure bonds are fairly predictable. As reported in Table 5, the pseudo R-squared for the probit model for all the countries together is 0.49. The choices are more predictable for Malaysia than for the others, with a pseudo R-squared of 0.59 for the Malaysian probit estimates.

The estimates suggest that the authorities tend to make very similar choices of de jure bonds. Whether we estimate the model for all three counties together or estimate it for each country separately makes little qualitative difference. The estimates suggest that the authorities in all three countries are often torn between choosing the on-the-run bonds and choosing bonds that have recently traded with superior liquidity. The coefficients for the on-the-run dummy variable are consistently positive and statistically significant. And yet the coefficients on whether the bond was the de facto benchmark in the previous month are also all positive and statistically significant.

The authorities also like bonds that were issued or reopened during the month. Surprisingly, however, in spite of the number of recycled de jure benchmarks, this recycling was a much less likely choice once we control for other factors, as indicated by the negative coefficient on the corresponding variable.

Does a larger outstanding stock increase the likelihood that the bond will be chosen as a de jure benchmark? Surprisingly, the answer is not always. Our estimates suggest a larger stock

of the issue outstanding increases the likelihood of the bond being chosen as a de jure benchmark for Indonesia and Thailand, but not for Malaysia.

How well do these choices work? It is to that question that we now turn.

5.2 What factors lead to a de jure bond's success?

To identify the factors that lead to success for a de jure bond, we specify a second probit model. Estimates of this model will reflect the choices of de jure bonds made by the authorities. To correct for selection bias, we include the inverse Mills ratio as an additional explanatory variable.[13] We calculate the inverse Mills ratio from our estimates of the previous probit model. The ratio is calculated as the ratio of the probability density function to the cumulative distribution function.

Our probit model now takes the form

$$Pr(\text{de jure} = \text{de facto}) = f(\boldsymbol{x\beta}), \qquad (2)$$

where the dependent variable in a given month takes on the value of one if the de jure bond succeeds as a de facto benchmark and otherwise takes on the value of zero. For the vector of independent variables $\boldsymbol{x}$, we consider the following:

[13] The inverse Mills ratio is usually applied to take account of selection bias in the presence of a censored variable. A dependent variable that cannot take on negative values, for example, would lead to a concentration of observations just above zero. To correct for the bias, Heckman (1979) proposed a two-stage estimation procedure using the inverse Mills ratio. In the first stage, as discussed in the previous section, a probit model is estimated and the estimated parameters are used to calculate the inverse Mills ratio. In the second stage, this ratio is included as an additional explanatory variable.

1) The inverse Mills ratio based on the estimates of the probit model for the choice of the de jure bonds;
2) A dummy variable for whether the chosen de jure bond was the on-the-run issue;
3) A dummy variable for whether the chosen bond was the de facto benchmark in the previous month;
4) A dummy variable for whether the chosen bond was a recycled de jure benchmark;
5) A dummy variable for whether the chosen bond was issued or reopened during the month;
6) Total accumulated issuance of the chosen bond;
7) The number of months the chosen bond had already served as a de jure benchmark;
8) The number of de jure benchmark maturities;[14]
9) How many bonds are in the maturity bin; and
10) Fixed effects for each benchmark maturity in each country.

This time, the important explanatory variables represent the decisions made by market participants. Some of these variables are the same variables we used to explain the choices by the authorities. This will allow us to see whether market participants confirm the authorities' choices. Again, we estimate the model for two sets of specifications, in parallel with our first probit model as reported in Table 5 above. One set includes all three countries together, while the other set considers each country individually. For the former, we use the inverse Mills ratio

[14] The number of bonds is as shown in Tables A1-A3.

derived from the estimates reported in the column "All" in Table 5, while for the individual country estimation we use the country-specific estimates of the inverse Mills ratio.

Our estimates indicate an important role for the inverse Mills ratio. As shown in the top row of Table 6, the estimated coefficient for the inverse Mills ratio is negative and statistically significant at the 1% level when the three countries are considered together and statistically significant at the 5% level when Malaysia is considered by itself. The negative sign means the other coefficients would have been biased downward if not for the inclusion of the inverse Mills ratio. Our estimates of the coefficients on the other variables now allow us to properly evaluate the effectiveness of the choices made by the authorities.

Our most striking result points to the importance of proven superior liquidity for a de jure bond if it is to succeed as a de facto benchmark. As reported in Table 6, the estimated coefficients on "de facto benchmark in previous month" are consistently positive and highly statistically significant. While we do find in the previous section that indeed authorities tend to favour bonds with such proven liquidity, they nonetheless would do even better by favouring such bonds even more. Interestingly, the strategy of recycling a bond that had previously been chosen as a de jure bond at a longer maturity is a strategy that seems to help, although the estimated coefficient is statistically significant only when the three countries are considered together.

The above results stand in contrast to our estimates for the on-the-run variable. Here the estimated coefficients are negative and statistically significant, specifically when the three countries are considered together and when Malaysia is considered by itself. This means that

when it is a choice between an on-the-run issue and an older issue with demonstrated liquidity, the authorities would do well by going for the latter.

There are other interesting results that are specific to Indonesia or Thailand. In the case of Indonesia, the estimated coefficient on "number of benchmark maturities" is negative and highly statistically significant. This means that the periods in which the country had more maturities in which they chose de jure benchmarks were also periods in which the chosen bonds tended not to succeed as de facto benchmarks. Too many de jure benchmarks may have spread market-making capacity too thinly. In the case of Thailand, the authorities tend to favour as de jure bonds those issues with the larger stocks outstanding. The negative and statistically coefficient on that variable suggests that the Thai authorities have been placing a higher weight on size when selecting de jure benchmark bonds than they should have.

The results are largely robust to how we locate issuance within the month. When we move the issuance date by 15 days (so that issuance is counted as being in a month if it is between the 15th of the previous month and the 15th of the current month instead of within the calendar month, to allow for the possibility of issuance affecting liquidity with a short lag), the results are similar. The first stage results (reported in Table A4) are almost identical. In the second stage (Table A5), the only notable changes are that the inverse Mills ratio and the on-the-run variable become less statistically significant, while other variables are little changed.

All these results suggest that the problem of creating a real benchmark bond is not as simple as resolving a coordination failure by designating the benchmark. The choice of the de jure bond itself seems to matter a great deal. In the small markets of emerging economies, a good choice seems to be a bond with proven liquidity, perhaps because this would be a bond for

which information asymmetry is less pronounced than for other bonds.[15] Emulating the large markets of advanced economies by always choosing the on-the-run issue is not the best strategy.

6. Conclusions

Because of their special role in price discovery, benchmark bonds supply an important informational public good to the bond market at large. Hence, if such bonds did not exist, it would make economic sense for the government to help create them. As it turns out, the governments of Indonesia, Malaysia and Thailand have been making this effort. These governments have designated de jure benchmark bonds in various maturities in their bond markets. They have then tried to foster the liquidity of these wannabe bonds by reopening issuance and by requiring primary dealers to make markets in them. This paper is about the extent to which such efforts have succeeded and what might make these efforts even more effective. In the end, it is market participants who will determine whether a bond will actually perform the role of a benchmark.

We started by identifying exactly which bonds have been designated by the governments as de jure benchmarks. With daily data on 422 bonds, including the de jure benchmarks, we measured bond-specific liquidity to ask whether the de jure benchmarks do end up possessing the superior liquidity that true benchmark bonds would have. Since the markets that are the focus of our study are still in the process of development, the available data are somewhat

[15] When faced with information asymmetry, market makers may be less able to provide liquidity. See the intuitive discussion by Bagehot (1971) or the more rigorous one by Kyle (1985).

sparse. We proposed tools that can be used to assess benchmark status in spite of this. To assess liquidity, we combined standardised measures based on average yields, bid-ask spreads and the number of days for which quotes are available.

We found that the governments' efforts have met with mixed success. For the three markets together, the de jure benchmark ends up being the de facto benchmark about 55% of the time. In the case of Malaysia, the government's efforts have succeeded 77% of the time. With respect to maturity, the successful benchmarks tended to be in the five-year maturity bucket. We also found that the choices of de jure bonds tend to be anticipated and, once anticipated, the chosen bonds tend to gain liquidity. The loss of de jure status also tends to be anticipated, and there is some deterioration in the liquidity of the bonds that are about to lose their de jure status.

What accounts for the success of some de jure bonds and the failure of others? To find out, we first estimated a probit model about how the authorities decide on their de jure benchmarks. We found that the authorities in the three different countries tend to make very similar choices. They are often torn between choosing on-the-run issues and choosing seasoned bonds that had performed as de facto benchmarks in the previous month. At times, the authorities would also choose bonds that were issued or reopened during the month.

To tell which choices by the authorities worked best, we then estimated a second probit model that accounted for the associated selection bias. We were surprised to find that imitating the on-the-run convention of large advanced markets is not the best strategy. The chosen on-the-run issues often fail to become successful benchmarks. Instead, the best strategy for choosing the de jure bond is to choose the bond had recently demonstrated superior liquidity.

Failing that, the next best strategy seems to be to recycle a bond that had already been the de jure benchmark in the past at a longer maturity.

In light of the experience of large, advanced bond markets, the obvious choice for the de jure benchmark would seem to be the on-the-run issue. Matters are evidently not so simple, however. In the relatively small bond markets of emerging economies, where market making capacity may be limited, familiarity seems to breed liquidity. Designating a de jure benchmark seems to work better when the chosen bond has already been trading in the market and has shown itself to be favoured by market participants as a de facto benchmark.

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Size of government bond markets **Table 1**

Nominal amount outstanding of government bonds in selected countries as of end-2017

	Amount outstanding in USD billions	Ratio to GDP
Thailand	136	0.30
Indonesia	156	0.15
Malaysia	167	0.54
United Kingdom	2,785	1.06
Japan	9,471	1.94
United States	17,584	0.90

Sources: Salomon Smith Barney; national data.

Number of de jure bonds by maturity **Table 2**

De jure benchmark bonds as designated by national authorities: selected sample periods in selected markets

	Maturities in years							
Countries	3	5	7	10	15	20	30	50
Indonesia 2009-2018		9	1	9	9	8	1	
Malaysia 2006-2018	14	14	9	13				
Thailand 2010-2017	3	7	4	5	5	4	4	2

Sources of data: For Indonesia, Ministry of Finance; for Malaysia, Bank Negara Malaysia; and for Thailand, Public Debt Management Office.

The recycling of de jure benchmark bonds **Table 3**

Bond ID	Initial year	Initial maturity	Recycled year	Recycled maturity
Indonesia				
FR0053	2011	10 years	2016	5 years
FR0056	2011	15 years	2016	10 years
FR0061	2012	10 years	2017	5 years
FR0059	2012	15 years	2017	10 years
FR0063	2013	10 years	2018	5 years
FR0064	2013	15 years	2018	10 years
FR0065	2013	20 years	2019	15 years
Malaysia				
MJ050004	2006	5 years	2007	3 years
MO060001	2006	10 years	2011	5 years
MJ0120005	2012	5 years	2015	3 years
MJ160004	2016	5 years	2018	3 years
Thailand				
LB196A	2010	10 years	2013	5 years
LB296A	2010	20 years	2014	15 years
LB21DA	2011	10 years	2013	7 years
"	"	"	2015	5 years
LB25DA	2011	15 years	2015	10 years
LB316A	2011	20 years	2017	15 years
LB176A	2012	5 years	2013	3 years

Definitions of maturity buckets, in years **Table 4**

Selected countries, buckets are centred on time to maturity of de jure benchmark bond

	Maturities in years					
Countries	3	5	7	10	15	20
Indonesia		+/- 1		+/- 2	+/- 2.5	+/- 2.5
Malaysia	+/- 1	+/- 1	+/- 1	+/- 2		
Thailand		+/- 1	+/- 1	+/- 2	+/- 2.5	+/- 2.5

Sources of data on maturity of de jure benchmark bonds: For Indonesia, Ministry of Finance; for Malaysia, Bank Negara Malaysia; and for Thailand, Public Debt Management Office.

The probability that a bond will be chosen as the de jure benchmark **Table 5**

Variable	All	ID	MY	TH
On the run	1.50 *14.19* ***	0.49 *2.29* **	1.81 *11.70* ***	2.08 *9.29* ***
De facto benchmark in previous month	0.87 *12.71* ***	0.69 *6.11* ***	1.20 *9.21* ***	0.91 *6.77* ***
Previously de jure in a longer maturity	-0.53 *-7.17* ***	-1.36 *-8.21* ***	-0.63 *-3.81* ***	0.23 *1.71* *
Issued or reopened during month	1.59 *19.10* ***	1.64 *17.23* ***	1.01 *3.65* ***	2.15 *10.32* ***
Stock x ID	2.7E-14 *12.64* ***	2.9E-14 *12.62* ***		
Stock x MY	-1.1E-05 *-0.86*		-1.6E-05 *-1.03*	
Stock x TH	5.8E-06 *5.59* ***			4.4E-06 *3.73* ***
Number of bonds in bin	-0.12 *-7.71* ***	-0.089 *-5.07* ***	-0.18 *-5.84* ***	-0.18 *-3.41* ***
Pseudo R^2	0.49	0.43	0.59	0.47
Number of observations	3494	1798	905	791

Notes: t-statistics are in italics. *, **, *** indicate significance at the 10%, 5% and 1% level, respectively.

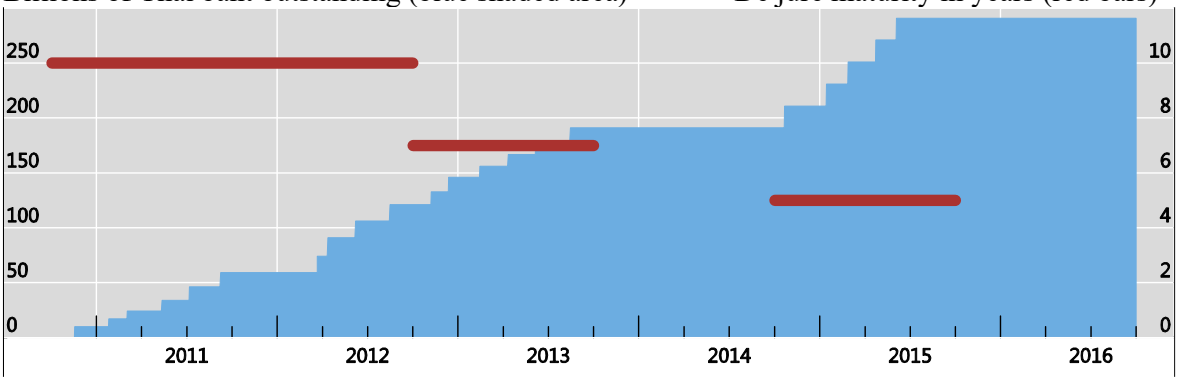
The probability that a bond will be chosen as a de jure benchmark **Table 6**

Variable	All	ID	MY	TH
Inverse Mills ratio	-0.71 *-3.21* ***	5.8E-03 *0.01*	-1.12 *-2.17* **	-0.15 *-0.45*
On the run	-0.37 *-2.05* **	0.29 *0.97*	-1.37 *-2.81* ***	-0.55 *-1.63*
De facto benchmark in previous month	0.78 *6.58* ***	0.86 *4.04* ***	0.54 *2.11* **	0.83 *4.44* ***
Recycled de jure in another maturity	0.55 *2.57* **	0.49 *0.91*	0.56 *0.95*	-0.054 *-0.19*
Issued or reopened during month	-0.27 *-1.65* *	0.44 *0.98*	-0.31 *1.50*	-0.31 *-1.08*
Months since becoming de jure	0.014 *1.09*	-0.032 *-1.11*	0.050 *1.80* *	0.035 *1.88* *
Stock x ID	-4.2E-15 *-0.95*	7.1E-15 *0.84*		
Stock x MY	1.3E-06 *0.51*		-1.8E-05 *-0.50*	
Stock x TH	-7.8E-06 *-3.35* ***			-5.8E-06 *-2.02* **
Number of benchmark maturities	5.8E-03 *0.10*	-0.46 *-3.00* ***	0.35 *1.60*	0.14 *1.80* *
Number of bonds in bin	-0.075 *-2.81* ***	-0.13 *-2.59* ***	-0.036 *-0.64*	-0.20 *-2.88* ***
Pseudo R^2	0.28	0.25	0.27	0.23
Number of observations	1222	400	457	365

Notes: t-statistics are in italics. *, **, *** indicate significance at the 10%, 5% and 1% level respectively. Includes fixed effects for each country/bin.

The life of a Thai de jure benchmark: LB21DA **Graph 1**

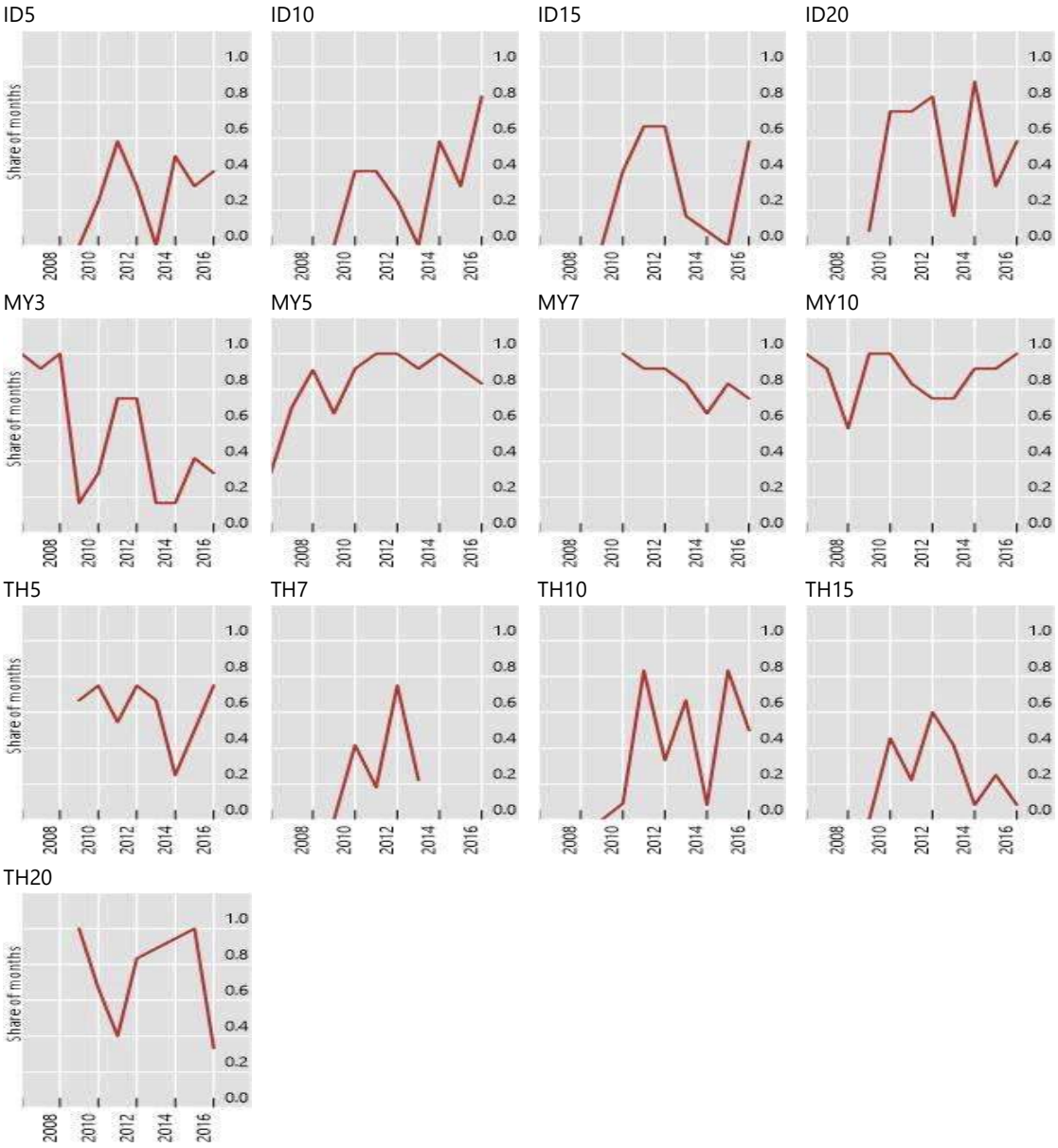
Billions of Thai baht outstanding (blue shaded area) De jure maturity in years (red bars)



Notes: The blue shaded area indicates the cumulative issuance of bond LB21DA (lhs). Red lines indicate the period when LB21DA was designated a de jure benchmark bond and at what maturity (rhs).

Sources: Bank of Thailand; Thai Bond Management Association.

How often does de jure become de facto? **Graph 2**

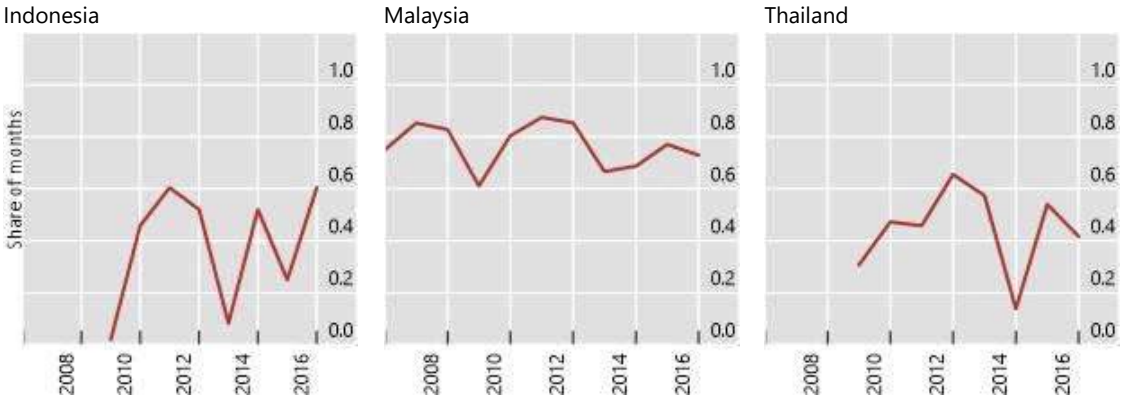


Note: Graphs display the share of months for which de jure = de facto by year, maturity and market.

Source: Authors' calculations.

Does de jure become de facto?

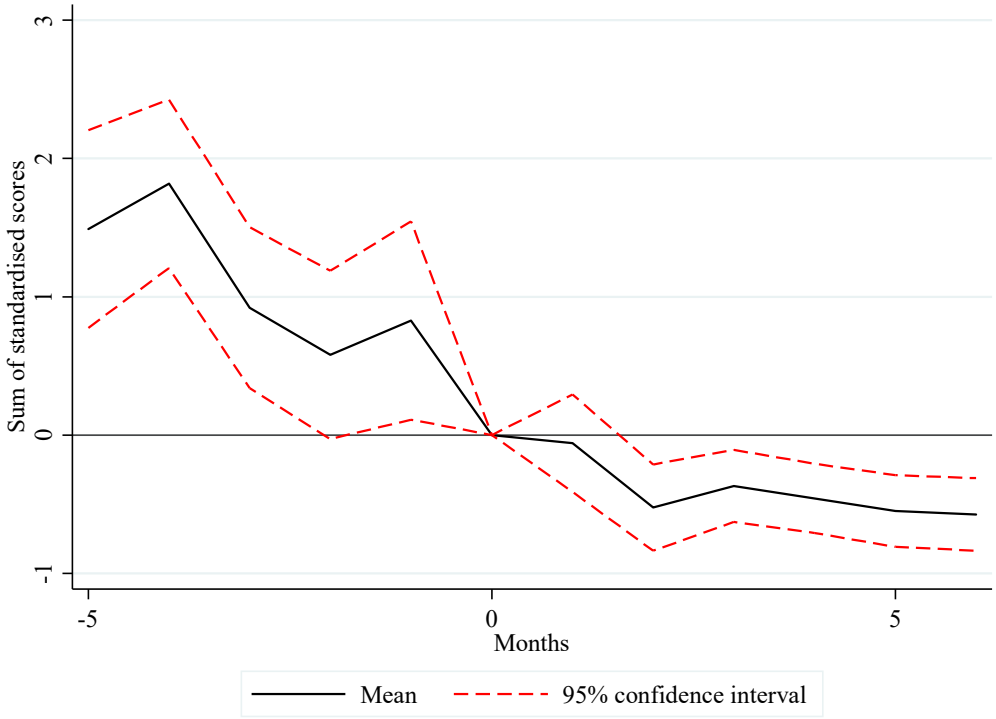
Summarising across maturities **Graph 3**



Note: Graphs display the share of months for which de jure = de facto by year, combining maturities by market.

Source: Authors' calculations.

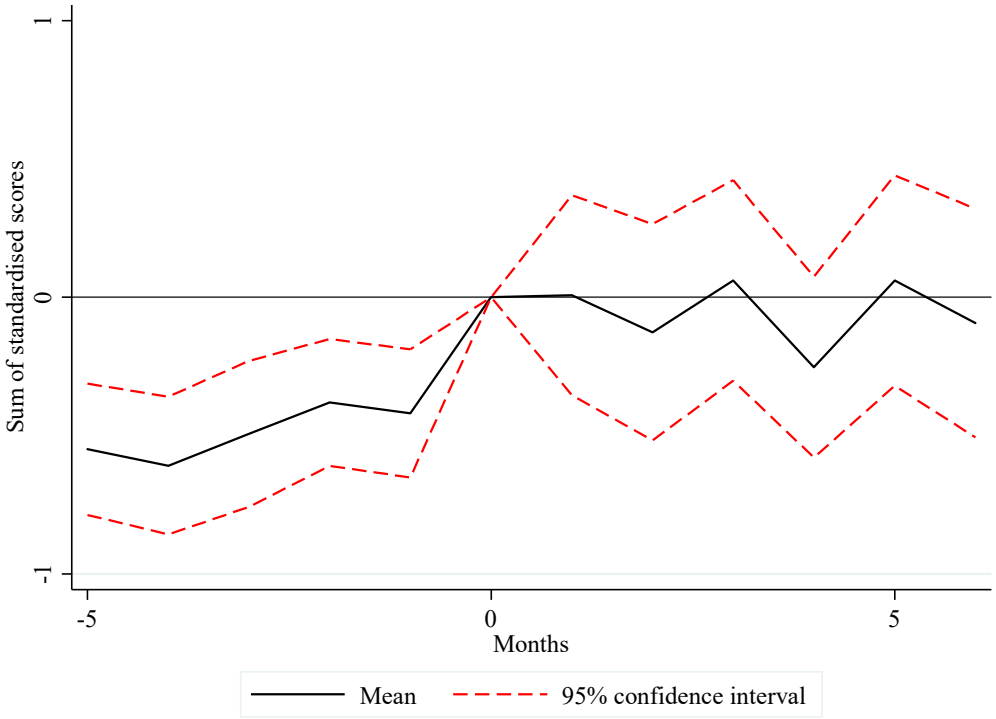
Do bonds become more liquid after they become de jure benchmarks? **Graph 4**



Note: Liquidity measured relative to month 0, defined as the final month before a bond becomes a de jure benchmark.

Source: Authors' calculations.

Do bonds become less liquid after they lose their de jure status? **Graph 5**



Note: Liquidity measured relative to month 0, defined as the final month for which a bond was a de jure benchmark.

Source: Authors' calculations.

Appendix

Specific de jure benchmark bonds for Indonesia **Table A1**

Calendar year	Maturity in years					
	5	7	10	15	20	30
2009	FR0051	FR0030	FR0036	FR0044	FR0047	FR0050
2010	FR0027		FR0031	FR0040	FR0052	FR0050
2011	FR0055		FR0053	FR0056	FR0054	
2012	FR0060		FR0061	FR0059	FR0058	
2013	FR0066		FR0063	FR0064	FR0065	
2014	FR0069		FR0070	FR0071	FR0068	
2015	FR0069		FR0070	FR0071	FR0068	
2016	FR0053		FR0056	FR0073	FR0072	
2017	FR0061		FR0059	FR0074	FR0072	
2018	FR0063		FR0064	FR0065	FR0075	

Specific de jure benchmark bonds for Malaysia **Table A2**

Calendar Year	Maturity in years			
	3	5	7	10
2006	MH060003	MJ050004		MO060001
2007	MJ050004	MJ070005		MN070002
2008	MN01001V	MJ080001		MS03002H
2009	MH090001	MN04002W		MS04003H
2010	MH090005	MJ090004		MO090002
2011	MH110002	MJ100001	ML100002	MO110001
2012	MH120003	MO060001	MK110005	MO120001
2013	MH130001	MJ120005	ML120006	MN130003
2014	MG140002	MI130002	MK130006	MO140001
2015	MJ120005	MJ140004	ML140003	MO150001
2016	MH150005	MJ150003	ML150002	MO160003
2017	MH170005	MJ160004	ML160001	MO170004
2018	MJ160004	MI170001	ML170002	MS130005
		MI180002	MK180001	

NB: The 3-year benchmark at the beginning of the sample is MV89001H.

Specific de jure benchmark bonds for Thailand **Table A3**

Fiscal year	Maturity in years							
	3	5	7	10	15	20	30	50
2010		LB155A	LB16NA	LB196A	LB24DA	LB296A	LB406A	
2011	LB14NA	LB15DA	LB17OA	LB21DA	LB25DA	LB316A	LB416A	LB616A
2012	LB165A	LB176A	LB193A	LB21DA	LB27DA	LB326A	LB416A	LB616A
2013	LB176A	LB196A	LB21DA	LB236A	LB27DA	LB326A	LB416A	LB616A
2014		LB196A		LB236A	LB296A		LB446A	LB616A
2015		LB21DA		LB25DA	LB296A		LB446A	LB616A
2016		LB206A		LB25DA	LB296A	LB366A	LB446A	LB666A
2017		LB226A		LB26DA	LB316A	LB366A	LB466A	LB666A

The probability that a bond will be chosen as a de jure benchmark **Table A4**

Robustness check: moving issuance by 15 days (so issuance is counted as being in a month if it is between the 15th of the previous month and the 15th of the current month)

Variable	All	ID	MY	TH
On the run	1.49 *13.74* ***	0.47 *2.15* **	1.82 *11.25* ***	2.05 *9.38* ***
De facto benchmark in previous month	0.88 *12.62* ***	0.68 *6.12* ***	1.26 *9.38* ***	0.93 *6.85* ***
Previously de jure in a longer maturity	-0.53 *-7.18* ***	-1.26 *-8.67* ***	-0.63 *-3.60* ***	0.20 *1.49*
Issued or reopened during month	1.65 *20.21* ***	1.59 *16.69* ***	2.22 *5.10* ***	2.07 *9.79* ***
Stock x ID	2.6E-14 *11.90* ***	2.6E-14 *12.12* ***		
Stock x MY	-1.5E-05 *-1.13*		-1.4E-05 *-0.85*	
Stock x TH	5.2E-06 *5.00* ***			3.9E-06 *3.30* ***
Number of bonds in bin	-0.11 *-7.43* ***	-0.085 *-4.90* ***	-0.17 *-5.46* ***	-0.18 *-3.50* ***
Pseudo R^2	0.49	0.41	0.63	0.46
Number of observations	3494	1798	905	791

Notes: t-statistics are in italics. *, **, *** indicate significance at the 10%, 5% and 1% level, respectively. Includes fixed effects for each country/bin. Issuance dates adjusted by -15 days.

The probability that a bond will be chosen as a de jure benchmark **Table A5**

Robustness check: moving issuance by 15 days (so issuance is counted as being in a month if it is between the 15th of the previous month and the 15th of the current month)

Variable	All	ID	MY	TH
Inverse Mills ratio	-0.39 *-1.80* *	-0.19 *-0.36*	-0.34 *-0.90*	0.12 *0.36*
On the run	-0.18 *-1.05*	0.20 *0.67*	-0.74 *-1.87* *	-0.35 *-1.12*
De facto benchmark in previous month	0.91 *7.71* ***	0.79 *3.41* ***	0.88 *4.06* ***	0.91 *4.99* ***
Recycled de jure in another maturity	0.47 *2.18* **	0.48 *0.89*	0.20 *0.41*	-1.1E-03 *-0.00*
Issued or reopened during month	-4.9E-03 *-0.03*	0.14 *0.28*	0.024 *0.11*	0.11 *0.39*
Months since becoming de jure	0.014 *1.14*	-0.048 *-1.80* *	0.058 *2.06* **	0.036 *2.01* **
Stock x ID	-1.4E-15 *-0.31*	6.4E-15 *0.76*		
Stock x MY	8.2E-06 *0.34*		-2.8E-05 *-0.79*	
Stock x TH	-6.8E-06 *-2.99* ***			-5.6E-06 *-2.04* **
Number of benchmark maturities	-2.6E-4 *-0.00*	-0.49 *-3.23* ***	0.32 *1.49*	0.14 *1.85* *
Number of bonds in bin	-0.085 *-3.24* ***	-0.12 *-2.49* **	-0.081 *-1.59*	-0.21 *-3.11* ***
Pseudo R^2	0.28	0.25	0.26	0.23
Number of observations	1222	400	457	365

Notes: t-statistics are in italics. *, **, *** indicate significance at the 10%, 5% and 1% level respectively. Includes fixed effects for each country/bin. Issuance dates adjusted by -15 days.