

Determining Factors for 10-year Local Currency Sovereign Bonds Yield: Indonesia Case

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1 Introduction

Indonesian government regularly issue Rupiah-denominated sovereign bonds (conventional and sharia bonds) in the primary market to finance the deficit of the national budget. In 2021, the issuance target for the sovereign bonds is around 80-85% of total deficit financing which amounts to IDR1,006 Trillion or equivalent to USD72 Billion.¹ As of 2 September 2021, the total outstanding of local currency sovereign bonds is IDR4,539 Trillion or equivalent to USD318 billion.²

The government sells the sovereign bonds through an auction which is conducted every Tuesday. The announcement will be released three days before the auction day (T-3). During a 2-hour auction, investors (both individuals and institutions) can put their bidding in multiple prices through primary dealers, and auction winners will pay their bonds based on their proposed volumes and yields. In addition to the multiple price (competitive) mechanism, the government also offers sovereign bonds to several non-competitive participants such as Indonesia Central Bank (Bank Indonesia) and Indonesia Deposit Insurance Corporation (Lembaga Penjamin Simpanan). This non-competitive buying may also be conducted by primary dealers to complement their competitive bidding purchase. Non-competitive buyers will pay their bonds based on weighted average yield (WAY) from the winning competitive bidding.

There are several benchmark series offered in the auction. These series represent various maturity times. For conventional bonds, tenors of benchmark series in 2021 are ranging from 5, 10, 15, and 20 years. Meanwhile, benchmark tenors of sharia bonds cover 2, 4, 13, and 25 years.

Since 2021, the yield of 10-year sovereign bonds has become one of the macroeconomic assumptions in the national budget, replacing treasury bills of tenor 3-month (Surat Perbendaharaan Negara). This replacement is because the yield of 10-year sovereign bonds is deemed as having a larger and more significant portion in the nation's cost of borrowing compared to the T-bills. Moreover, the 10-year yield is also reflecting long-term economic development and its movement is commonly used as a sign for predicting country's economic health.

During a period of 2014-2018, Indonesia is said to have a higher average of 10-year sovereign bonds yield compared to its ASEAN-5 peers (Thailand, Philippines, Malaysia, Vietnam) as well as several other emerging countries with similar credit ratings like Mexico, Columbia, and India (Muktiyanto and Aulia 2019). This condition makes Indonesia pays more expensive debt compared to these countries. As corporate and business use the yield for benchmarking when issuing local currency bonds as well as lending money, the impact of costly debt is also spilled over in the national economy.

Considering the important functions of the 10-year sovereign bonds yield in Indonesia's economy, this study will analyze several variables that determine the yield and quantify their impact using the Ordinary Least Squared (OLS) model. This paper will be delivered in several sections. First, we will explain our research's purpose in Section 2. Section 3 will provide background knowledge from prior studies related to the topic. Section 4 will briefly explain variables of interest as well as conducting exploratory data analysis (EDA) by visualizing data to check any interesting patterns or characteristics. Section 5 and section 6 will cover the research methodology and result of analysis consecutively. The appendix contains all detailed visualizations.

2 Motivation

This paper provides two new values to existing literature. First, it employs an exploratory data analysis (EDA) approach at the beginning of analysis to gain better intuition of each explanatory variable. This approach is quite important especially for capturing particular data characteristics, i.e. non-linearity before we can proceed to a confirmatory step. Disregarding the data characteristic will result in inappropriate data modeling. Second, this is the first work that empirically studies the impact of primary dealers' behavior on the 10-year local currency sovereign bonds yield in Indonesia.

The purpose of this work will be to provide insights and policy recommendations for the government in

¹Assumed exchange rate for conversion (IDR/USD) = 14,284.00

²ibid

reducing sovereign bonds yield, particularly by aiming at significant determinant factors, which in turn help to optimize the national's cost of borrowing.

3 Literature Review

Numerous researches have been conducted using various methodologies and scopes of study to find factors that affecting sovereign bonds yield. Dachroui et al (Dachraoui, Smida, and Sebri 2020) analyze role of capital flight as a driver of sovereign bond spreads in Latin American countries. They found that spreads are positively correlated with capital flight, inflation, government final consumption expenditure, unemployment rate, VIX and crisis, while economic growth, trade openness and governance index appear to have a negative effect (2020).

UST

CDS Kim et al. (2014) study role of default risk using credit default swaps as proxy in explaining spread of sovereign bonds yield. Their finding confirm that the variable contributes in determining the spread by 37%.

EXCHANGE RATE Gadanecz et al (Gadanecz, Miyajima, and Shu 2018) use exchange rate volatility and expected exchange rate as predictor variables of emerging market economies local currency sovereign bond yields. They conclude that the significant relationship between exchange rate and bonds yields. Permanasari et al. (2021) see negative significant relationship between exchange rate and government bond yield in Indonesia, while Saenong et al (Saenong et al. 2020) conclude that exchange rate has an effect on bond yields only in the short run.

FOREIGN (Gadanecz, Miyajima, and Shu 2018) Moreover, they also found that foreign ownership in local currency sovereign bonds market plays important role as stabilizing force of exchange rate volatility.

Other studies such as,,also confirm this.

VIX Izadi et al (Izadi and Hassan 2018) focus on local fundamental, global factors, volatility as determinant factors of yield spreads using empirical data of 24 developed countries in North America, Europe and Pacific Rim regions in period of January, 2010 until March, 2015. Their finding include significant and positively correlation between equity market volatility (VIX) and yield spreads in all observed regions. Their study also show strong relationship between fixed income and stock markets particularly in developed countries.

Other researches took different angle by looking at primary dealers system and its impact on bonds yield Tchuindjo et al.(2015), Endo (2020), Nyborg et al. (2004), Mercer et al. (2013), and Ferrari et al. (2018). Endo (2020) study role of primary dealers in low income economies, while Ferrari et al. (2018) focus on primary dealers' funding constraints on sovereign bonds yield. Nyborg et al. (2004), Mercer et al. (2013) and Tchuindjo (2015) concern on primary dealers trading behavior in US Treasury auction. The last name also provide several mathematical models to estimate the impact of primary dealers' strategic behavior in the auction (2015).

4 Explanation of Collected Data

Based on these existing literature, this paper will study relationship and impact of 10-year US Treasury (UST) yield, 5-year Credit Default Swap (CDS), foreign share in sovereign bonds ownership (%), central bank's policy rate, exchange rate, volatility index (VIX) as well as primary dealers' behavior on a response variable of the 10-year local currency sovereign bonds yield. All variables are collected as time-series data covering period of 2 January 2015 until 5 August 2021.

4.1 10-year Local Currency Sovereign Bonds Yield

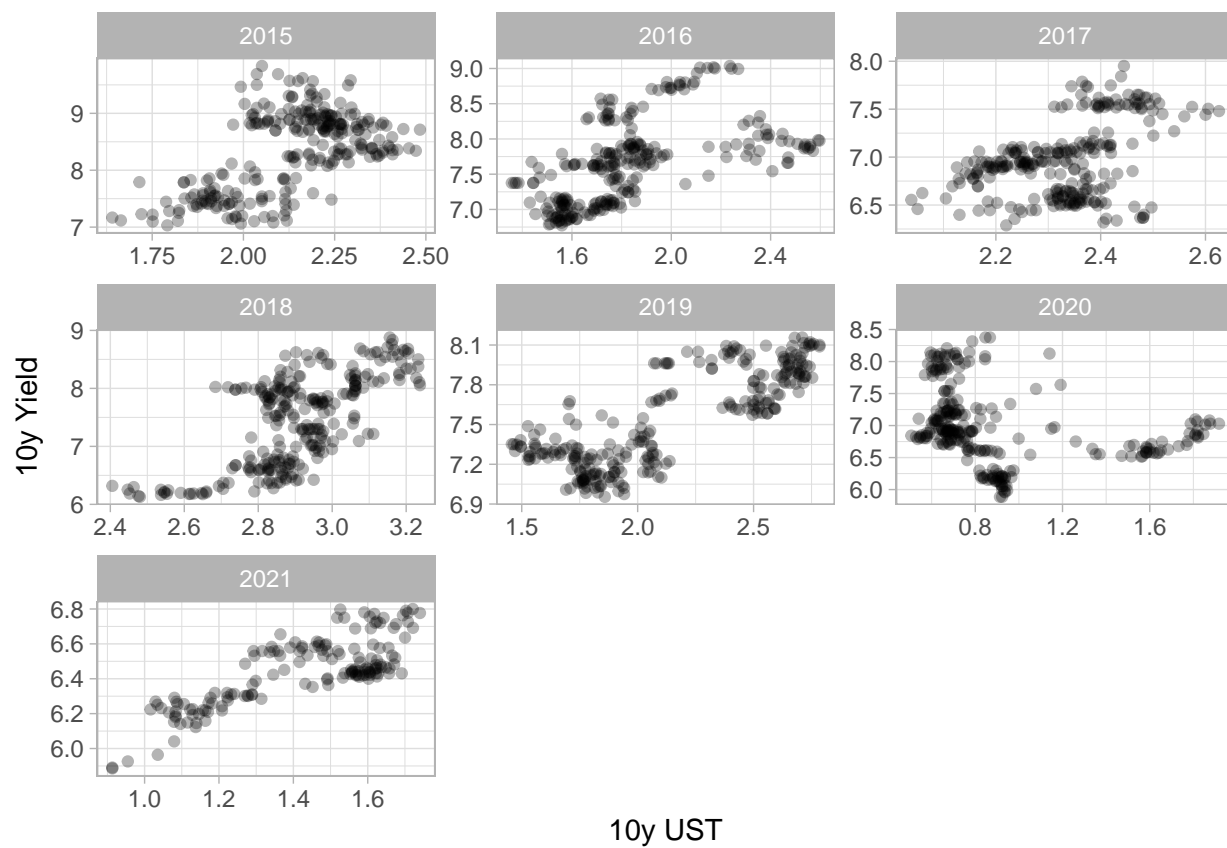
Yield can be described as expected return in exchange of risks taken by investors. The 10-year yield data used in this study is a generic yield retrieved from Bloomberg platform by using ticker "GRR" (Global summary

of government bill, note, and benchmark bond rates for individual countries).

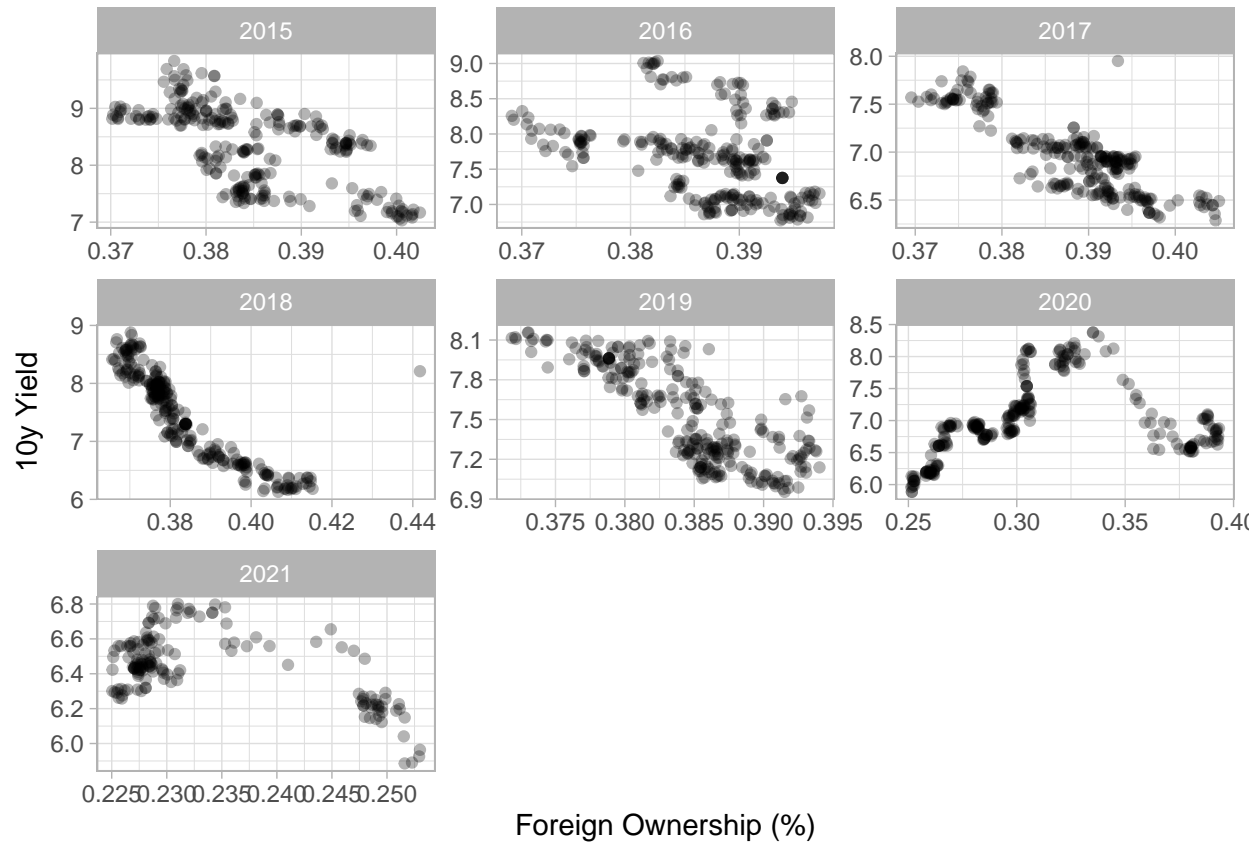
Furthermore, as yield's definition is associated with risks, we can group the explanatory variables based on their related risk categories as follow:

4.2 External Risk

4.2.1 10-year US Treasury

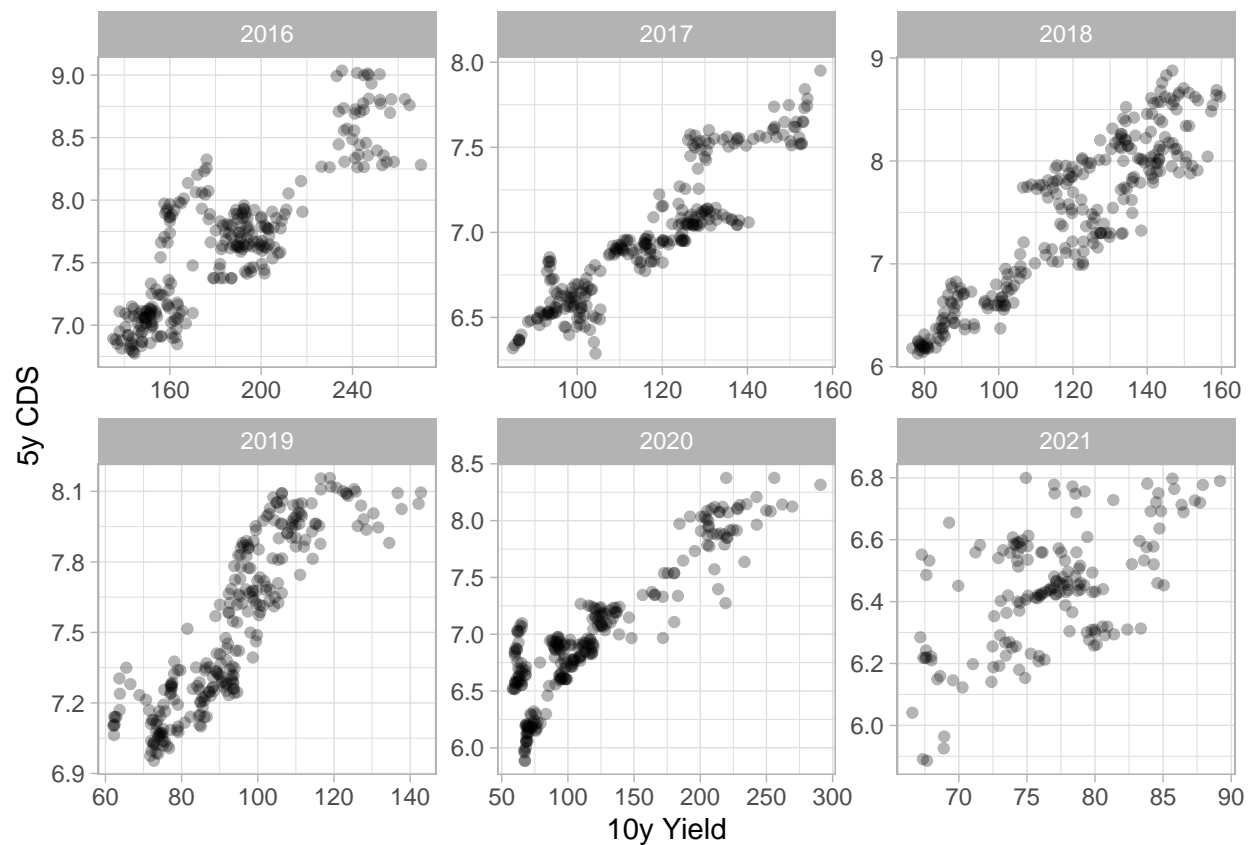


4.2.2 Foreign Ownership



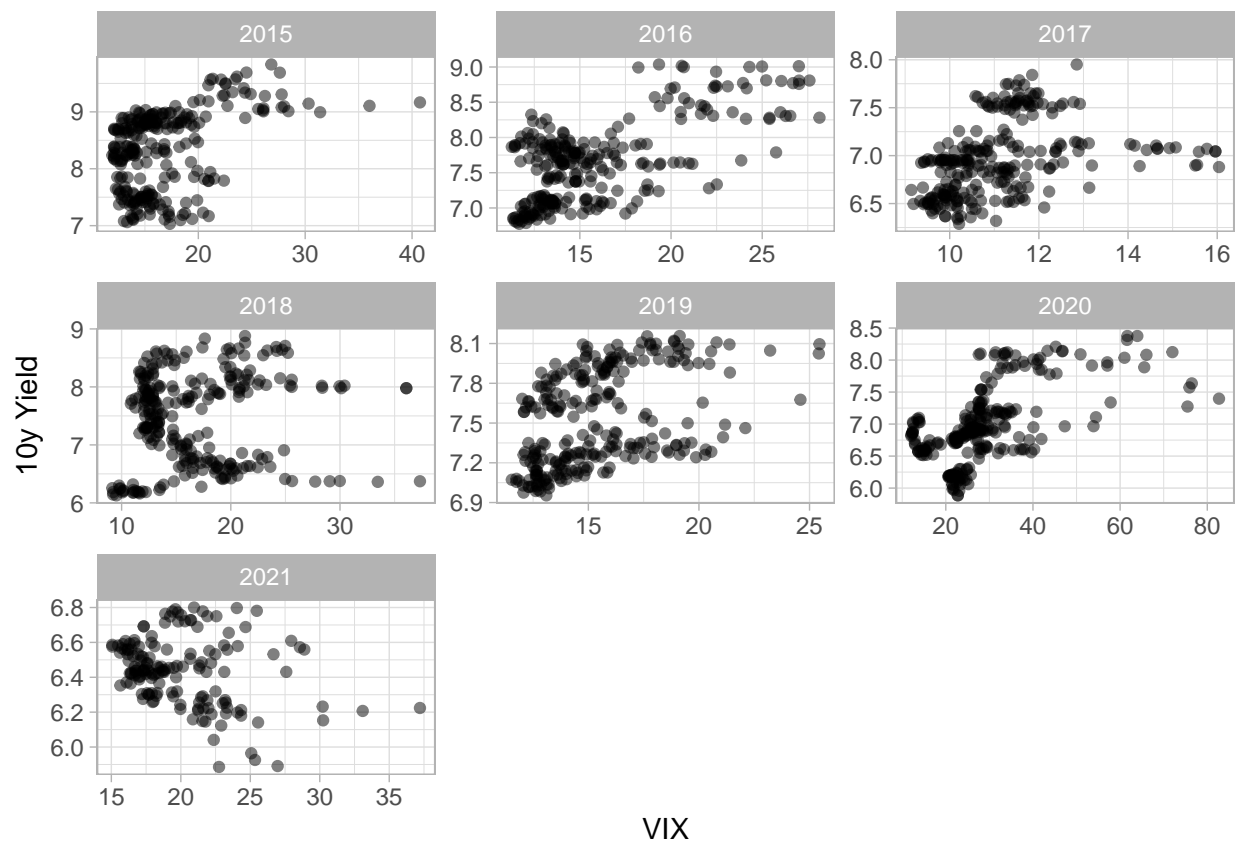
4.3 Default Risk (5-year Credit Default Swap)

A credit default swap (CDS) is a derivative contract that allows the investor to hedge against the default of a borrower. This provides a market-based measure of the credit-risk premium. CDS spreads indicate that the credit risk that investors perceive is significant. (codogno?)

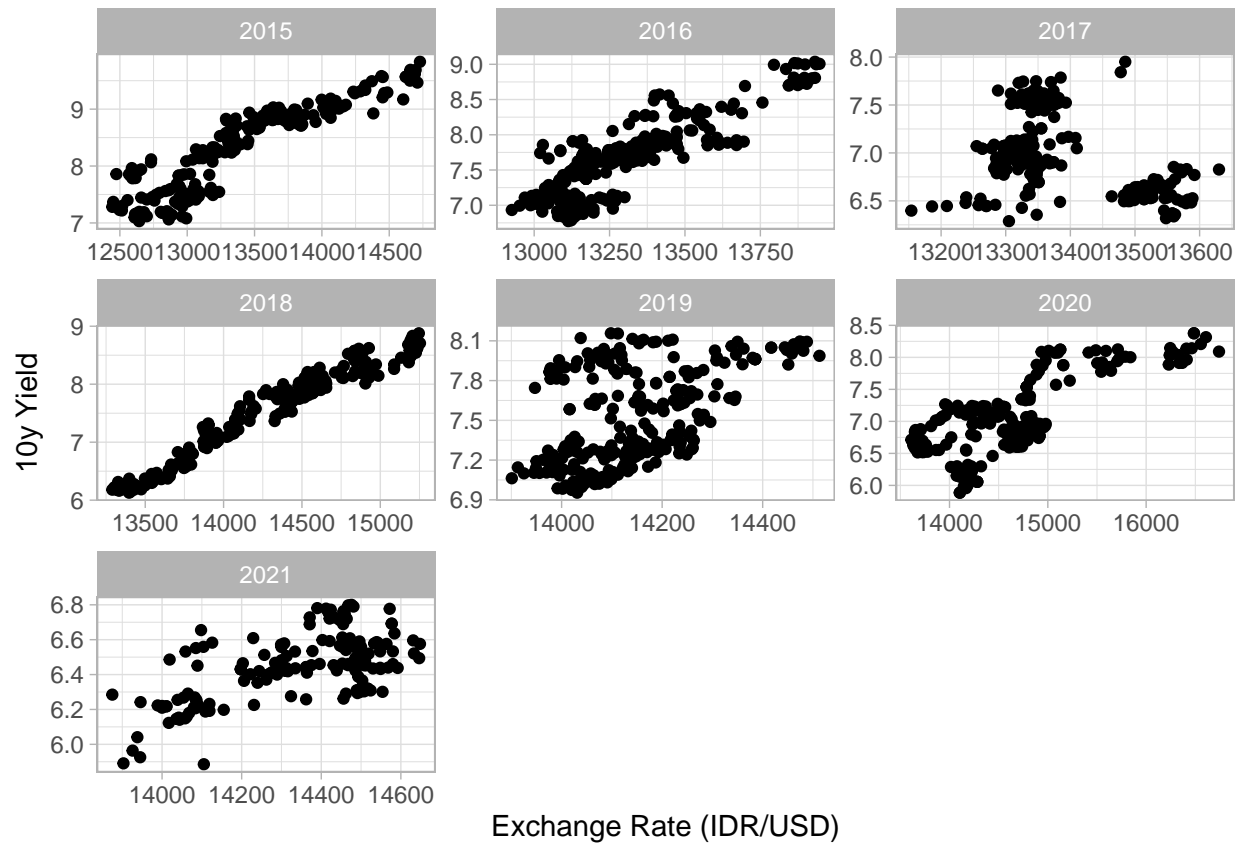


4.4 Financial Market Risk (Volatility Index)

Warning: Removed 3 rows containing missing values (geom_point).



4.5 Macroeconomic Risk (Exchange Rate USD/IDR)



4.6 System Risk (Primary Dealers Behavior)

Primary dealers system in Indonesia has been established since 2007. The system is expected to run several functions as shown in more developed economies. Arnone and Arden (2003) describe role of primary dealers as intermediary between debt managers and investors in primary market, bookmakers and bonds distributors, liquidity provider between primary and secondary market, promoter of continuous market and efficient price discovery, and adviser to government.

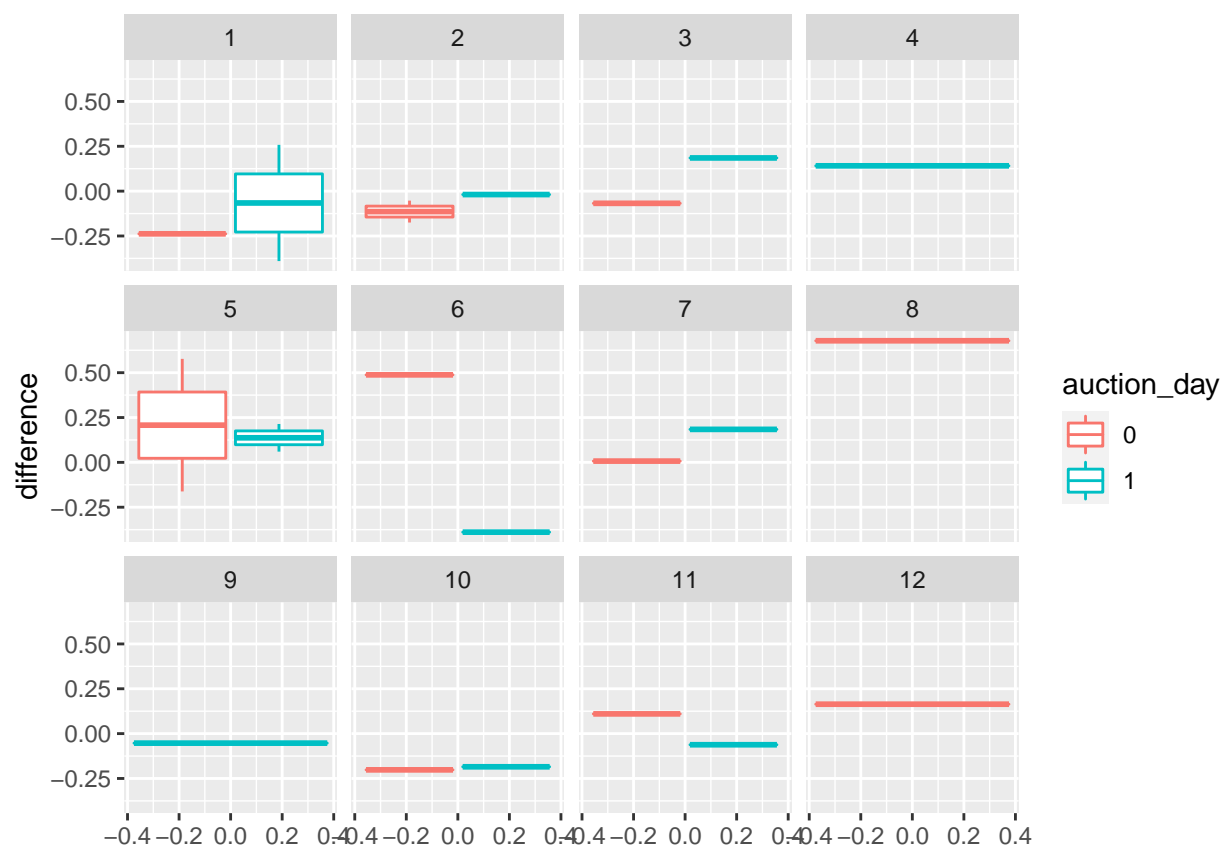
In 2021, there are 20 primary dealers of conventional bonds comprise of 16 conventional banks and 4 securities companies. For sharia bonds, there are also 20 primary dealers consist of 13 conventional banks, 3 Islamic banks and 4 securities companies. Primary dealers are required to participate in every auction and to bid for a minimum quantity of the total offering amount. They can bid both on behalf of their customers and for their own accounts. As primary dealers can participate in competitive bidding in primary market as well as buy and sell in secondary market, they have direct contribution on forming yield of sovereign bonds.

Tchuindjo (2015) writes that primary dealers will make bilateral contracts for the offered securities as soon as auction announced, known as pre-sale or when-issued market. Mercer et al. (2013) argue that they will be able to “discover” the ultimate auction price since in pre-sale period. Many primary dealers are also believed to often short in the when-issued market (Nyborg and Strebulaev 2004), which encourages them to bid aggressively and assign lower prices to the auctioned securities (Tchuindjo 2015), meaning higher demanded yields.

Thus, our analysis will be based on an assumption that primary dealers’ strategic behavior in the auctions can affect sovereign bonds yield. To check this assumption, we use dummy variables of “auction days” that

representing the pre-sale/when-issued period and “non-auction days” that representing regular workdays. Referring to Nyborg et al. (2004) pre-sale period is described as days started from the day of auction announcement (T-3) until a moment before bonds is distributed on the day of settlement (T+2). For simplicity, we define auction days as days started from T-3 until T+1. Here, we exclude the day of settlement (T+2) since bonds is usually distributed by the Central Bank in the morning of the settlement day. In addition, we only include auction days that offer benchmark series of the 10-year sovereign bonds in the auction day (T). Before 2019, the 10-year series is not regularly offered in the auction.

In the graph below, we will observe the pattern of 10-year yield movement and the dummy categories.



From figure 1, volatility in non auction days (post auction) is also tend to be higher than volatility in auction days.

³Full period of observation can be seen in the Appendix

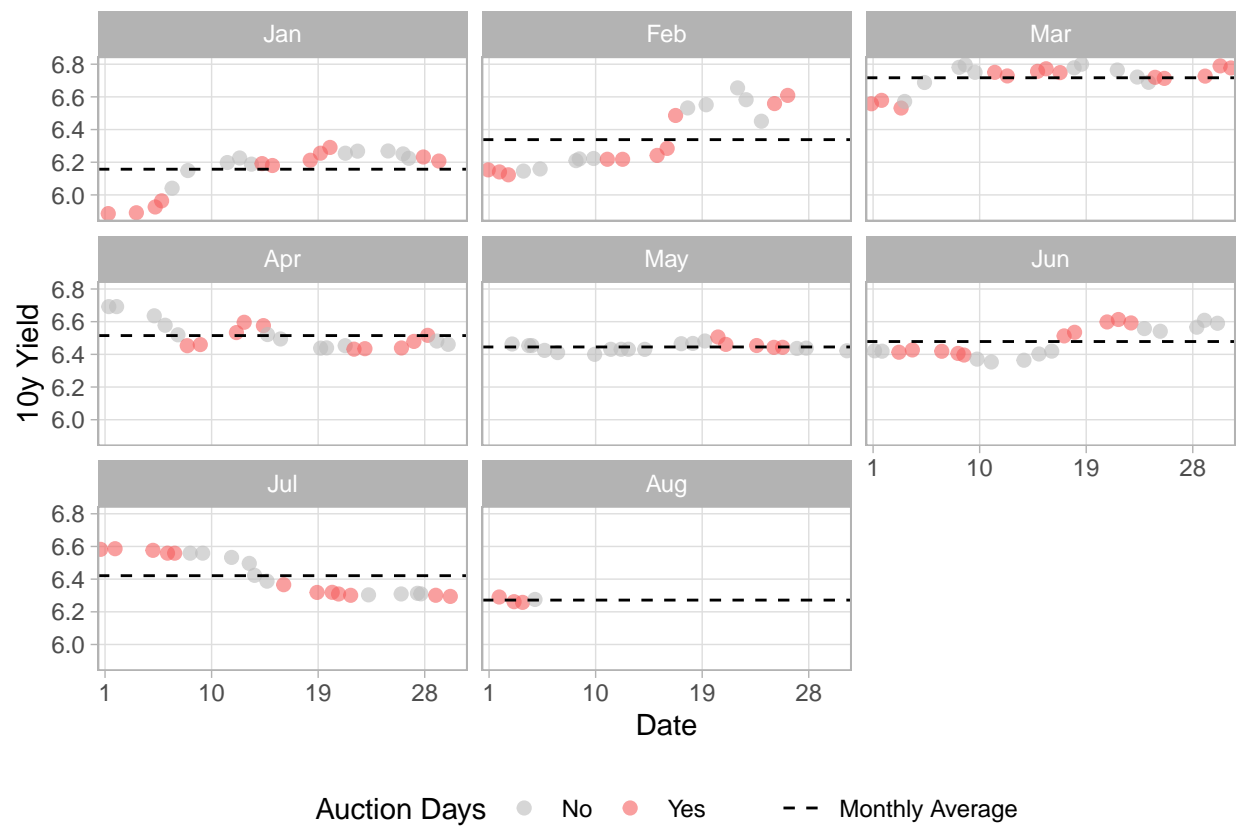
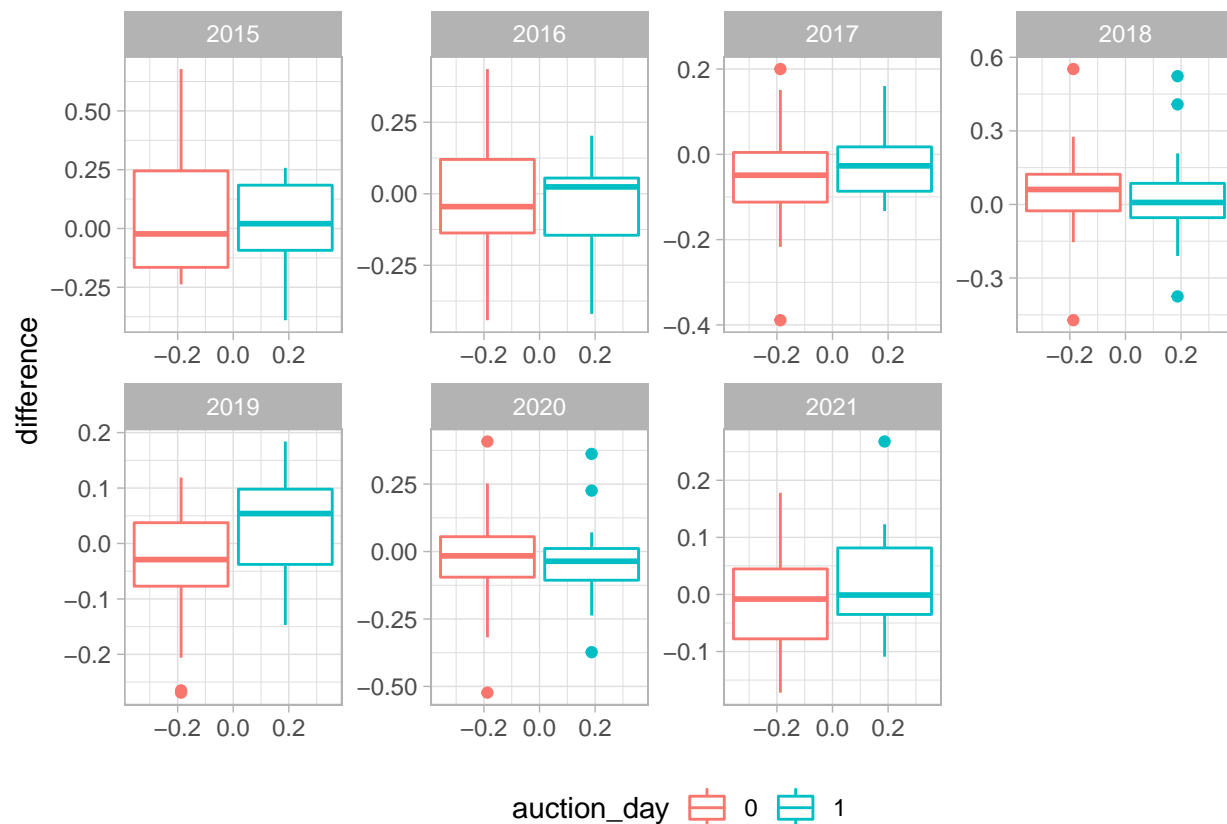


Figure 1: 10-year Yield's Movement during Auction Days during January-August 2021³



We tried to look further the difference of yield's movement between auction days and non auction days. The difference is calculated by subtracting yield of the last and first days in each period. The summary table of the yield difference (showing first 10 rows) can be seen in table ??.

```
##
## Attaching package: 'kableExtra'

## The following object is masked from 'package:dplyr':
##
##   group_rows
```

auction_day	date_from	date_to	domestic_10y_from	domestic_10y_to	difference
1	2015-01-02	2015-01-07	7.859	8.117	0.258
0	2015-01-08	2015-01-14	8.066	7.828	-0.238
1	2015-01-15	2015-01-21	7.791	7.401	-0.390
0	2015-01-22	2015-02-10	7.370	7.195	-0.175
1	2015-02-11	2015-02-17	7.412	7.393	-0.019
0	2015-02-18	2015-02-25	7.195	7.142	-0.053
1	2015-02-26	2015-03-04	7.104	7.289	0.185
0	2015-03-05	2015-03-25	7.404	7.336	-0.068
1	2015-03-26	2015-04-01	7.378	7.519	0.141
0	2015-04-02	2015-05-05	7.507	8.084	0.577

⁴ibid



Figure 2: Boxplot of 10-year Yield's Movement during Auction Days during January-August 2021⁴



Figure 3: 10-year Yield's Movement during Auction Days from 2016-2021

5 Research Methodology

In selecting determining factors for the 10-year sovereign bonds, we are mainly influenced by prior studies conducted by Gadanecz (2018), Tchuindjo (2015),

5.1 Stationary Test

To ensure that our model is not biased, we will conduct stationery test on the variables using Augmented Dicky Fuller (ADF) and KPSS.

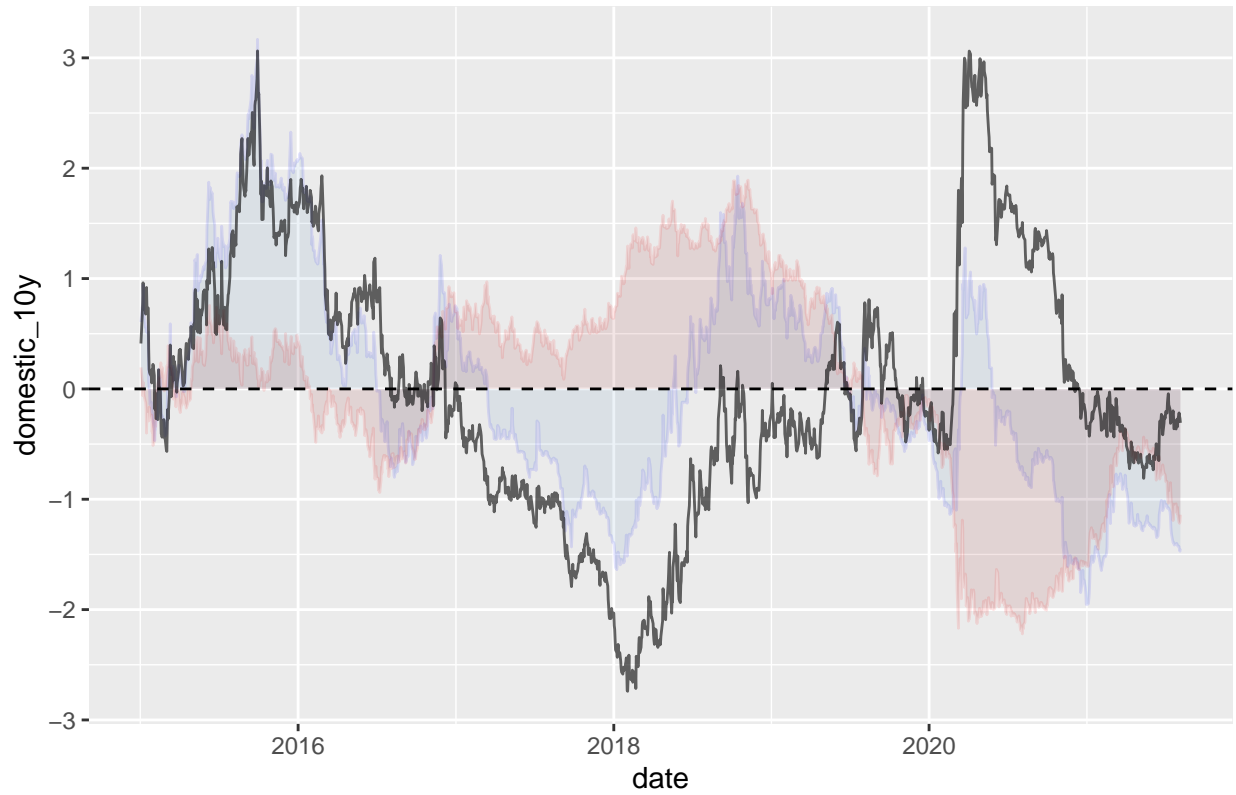
```
## Warning: package 'forecast' was built under R version 4.0.5
```

```
## Registered S3 method overwritten by 'quantmod':  
##   method      from  
##   as.zoo.data.frame zoo
```

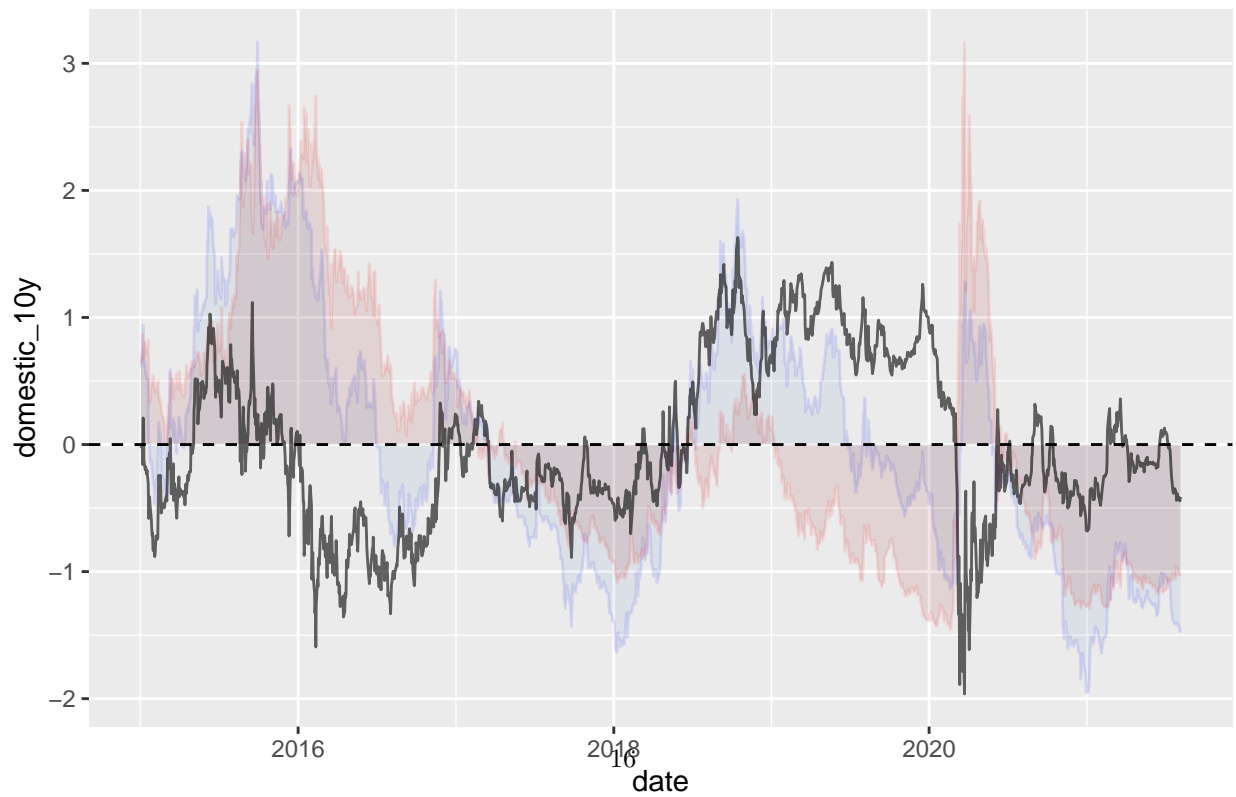

5.2 Cointegration test

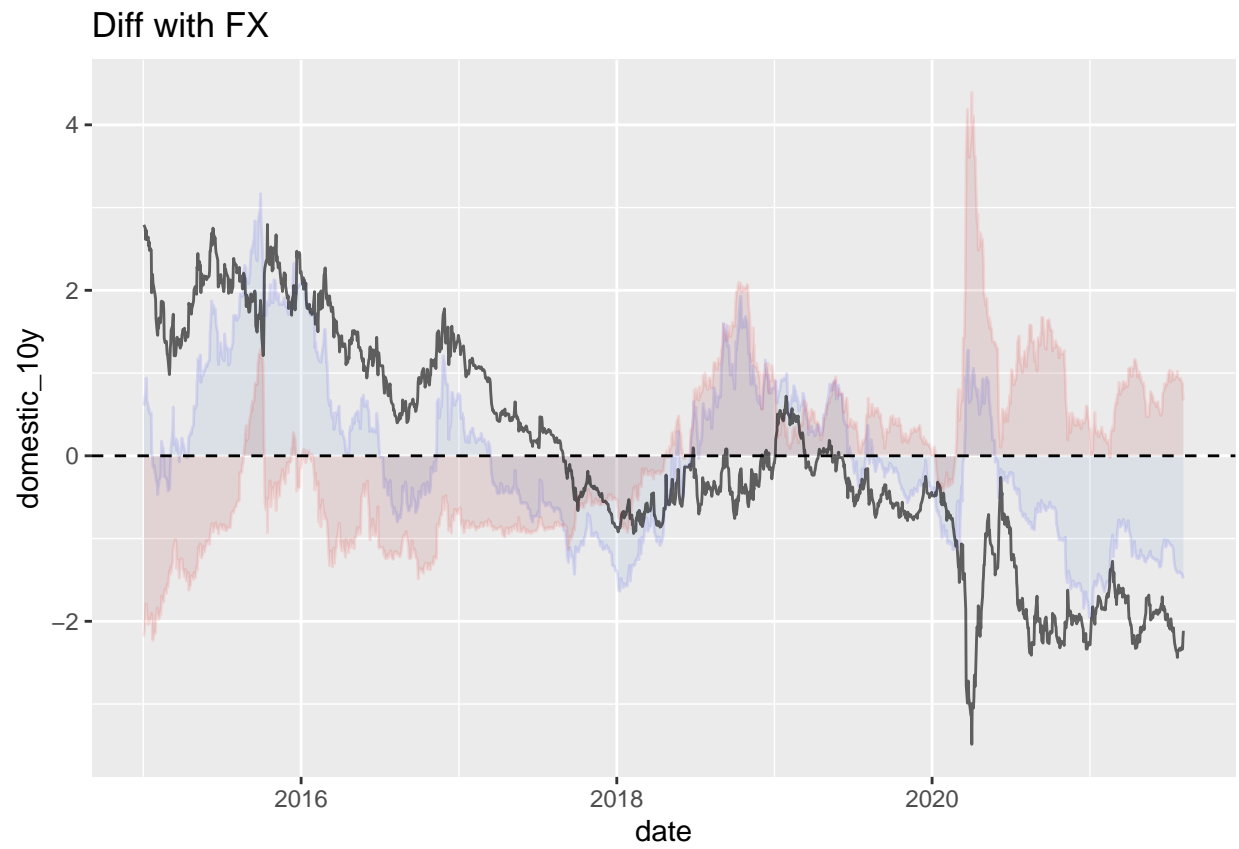
5.2.1 Visual Test

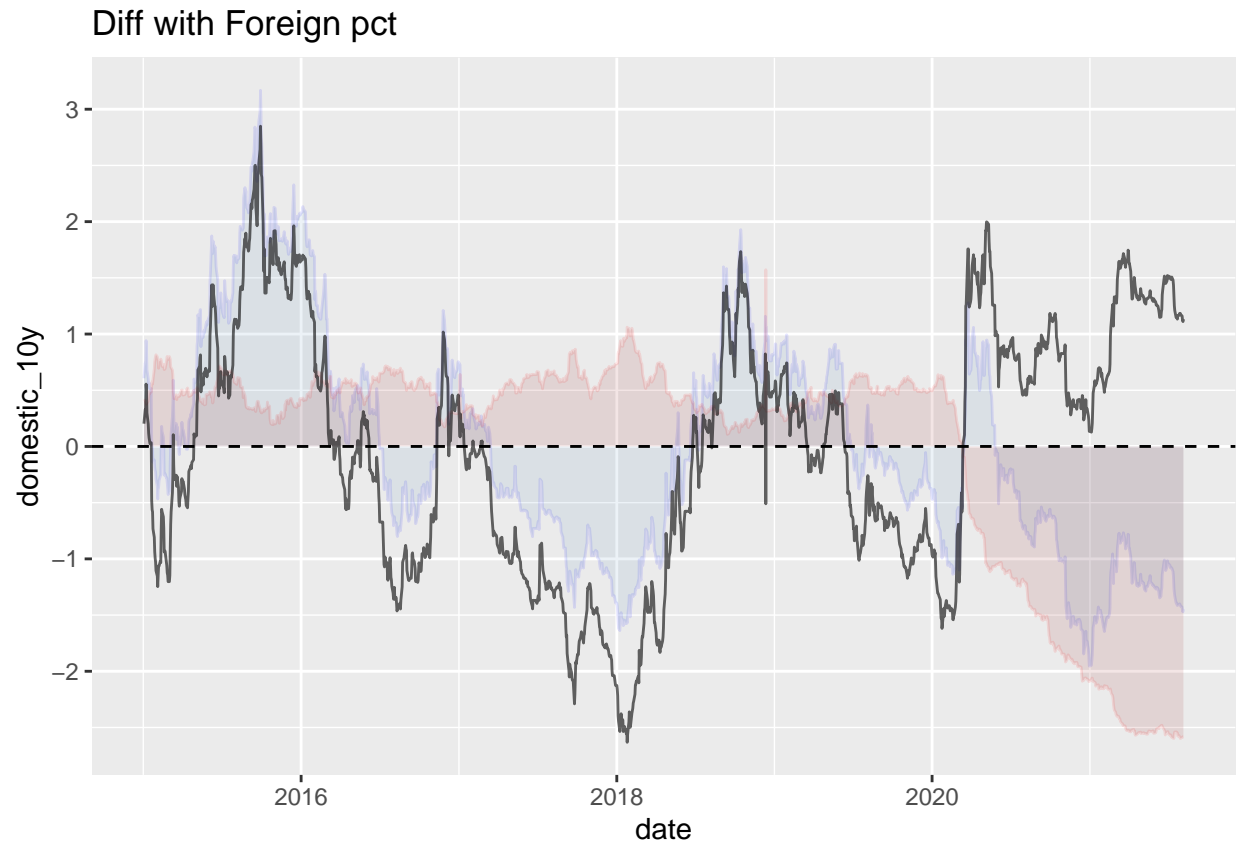
Diff with UST



Diff with CDS





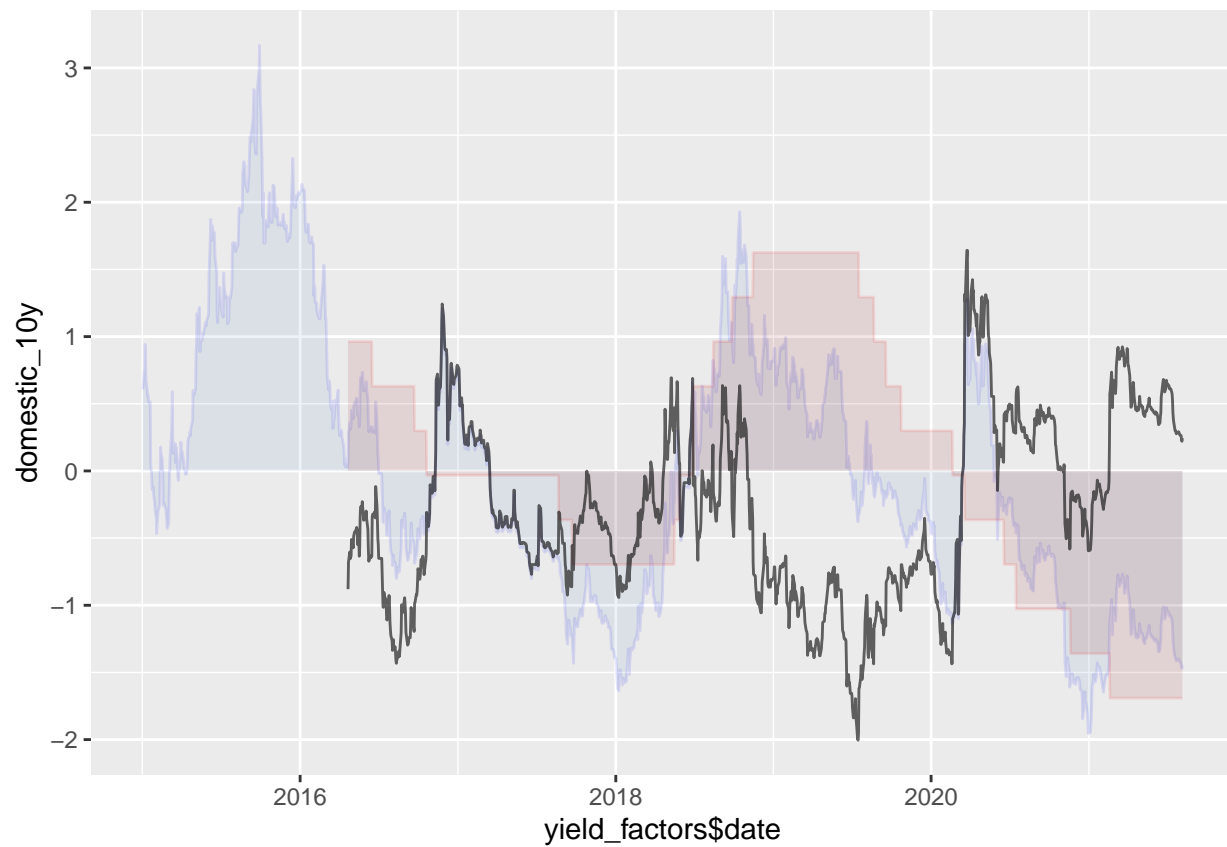


```
## Warning: Removed 338 rows containing missing values (position_stack).
```

```
## Warning: Removed 338 row(s) containing missing values (geom_path).
```

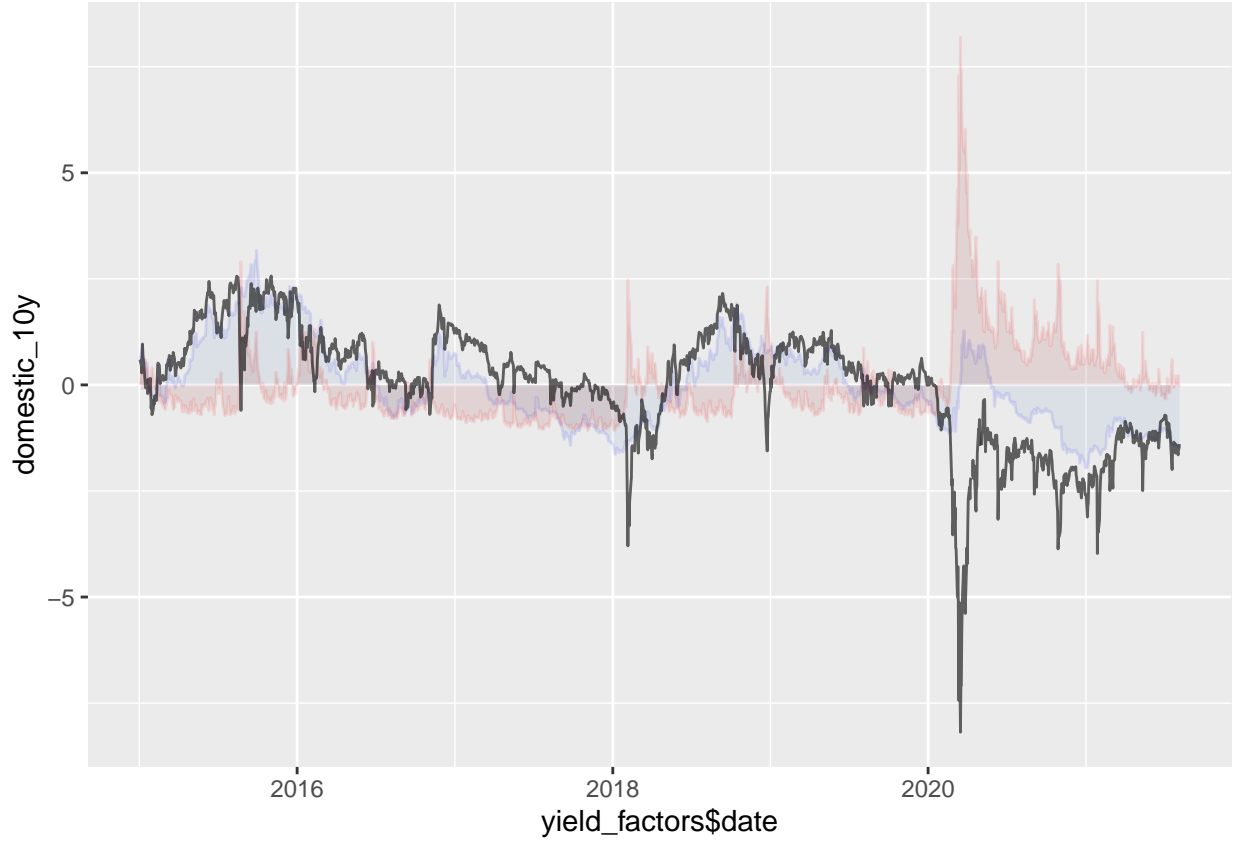
```
## Warning: Removed 338 row(s) containing missing values (geom_path).
```

```
## Warning: Removed 1 rows containing missing values (geom_hline).
```



```
## Warning: Removed 3 rows containing missing values (position_stack).
```

```
## Warning: Removed 1 rows containing missing values (geom_hline).
```



5.2.2 Formal Test

Regarding the result from the exploratory data analysis conducted in previous section as well as the cointegration test, we can write down relationship between variables in OLS model as follow:

$$yield_10y = \alpha + \beta_1 ust_10y + \beta_2 cds_5y + \beta_3 foreign_pct + \beta_4 policy_rate + \beta_5 exchange_rate + \beta_6 vix^2 + \beta_7 auction_days + \epsilon$$

Summary statistic of the data is shown in table 1:

Table 1:

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
10y Yield	1,371	7.165	0.612	5.886	6.673	7.650	8.878
5y CDS	1,371	115.163	38.156	58	85.3	137.6	291
10y UST	1,371	1.961	0.731	0.507	1.534	2.518	3.237
Policy Rate	1,371	4.776	0.754	3.500	4.250	5.250	6.000
Foreign Pct	1,371	0.354	0.056	0.225	0.324	0.389	0.442
VIX	1,371	17.796	8.562	9.140	12.420	20.740	82.690
Exchange Rate	1,371	14,006.420	625.921	12,926	13,400	14,417.5	16,741

6 Analysis

In particular, the results suggest that improved macroeconomic fundamentals, such as higher net foreign assets (in terms of GDP or imports), lower fiscal deficits, and lower ratios of debt service to exports and debt to GDP, help to lower sovereign spreads (**arora?**)

- a. UST vs Yield While the dramatic rise in capital flows to emerging markets has been induced primarily by the implementation of sound macroeconomic policies and wide structural reforms in these countries, it has also been driven by changing conditions in industrial countries that have encouraged investors to diversify their portfolios into developing country assets. Interest rate spreads (the differences between yields on sovereign bonds of developing countries and U.S. treasury securities of comparable maturities), which are a proxy for country risk, have tended to move in the same direction as the changes in U.S. interest rates (**arora?**)
- b. CDS vs Yield

Sovereign CDS spreads are used as an indicator of foreign currency sovereign creditworthiness. Lower sovereign CDS spreads are expected to lower local currency sovereign bond yields (**gadanecz?**)

- c. Foreign Ownership vs Yield
- d. Bank Indo Rate vs Yield
- e. Exchange rate (JISDOR) vs Yield Investors are exposed to gains and losses from exchange rate movements on their holdings of local currency sovereign bond. exchange rate risk can represent an important channel of transmission of market sentiment, uncertainty and default risk to local currency bond yield Exchange rate risk tends to affect liquidity conditions in both foreign exchange and domestic bond markets, which tend to be relatively low in many EMEs even in tranquil times. The direction of the causality runs from exchange rate volatility to local currency sovereign bond yields. This is especially the case in Asia and eastern Europe. In these two regions, local currency sovereign bond markets are relatively liquid and foreign participation relatively large.

The sensitivity of EME local currency sovereign bond yields to exchange rate volatility increases after the global financial crisis, and further after the taper tantrum in mid-2013 (**gadanecz?**)

- f. Volatility index (VIX) vs Yield It is a measure of market expectations of near-term volatility conveyed by S&P500 stock index option prices and considered as a forward-looking measure of investor risk. Hartelius et al. (2008) highlights the strong dependence of emerging market returns to the VIX, which should be positively related to changes in emerging market spreads since more risk aversion increases spreads. An attractive feature of this index is that it can be considered as exogenous for emerging economies (Siklos, 2011). (**hajer?**)

This result could be explained by the fact that as investors become more risk-averse and seek safer assets, the expected growth in volatility encourages them to liquidate their positions in risky assets in favor of safer ones, thus increasing sovereign spreads. (**hajer?**)

Intended to capture changes in investor sentiment which may be related to expected changes in U.S. monetary policy. It may also pick up the effects of other market-related events, such as the flight to quality effects during the Asian crisis. (**arora?**)

As historical data demonstrates a strong negative correlation of volatility to the stock market returns – that is, when stock returns go down, volatility rises and vice versa.(investopedia)

7 Conclusion

factors that steadily affect the yield? (foreign and insurance/pension fund are steadily associated with yield movement. Foreign has strongly negative correlation until 2019, while insurance/pension has strongly positive correlation)

pandemic effect? i.e. holding spending for investing in safe instrument? (need to check ownership of domestic banks, mutual funds, insurance, individual investors)

shifting power (bonds ownership) foreign to domestic participant (Do central bank/domestic banks become more dominant)? (Quantitative easing of Bank Indonesia and mandatory purchase of domestic banks can push down the yield)

As we can see from the plot, in 2015 and 2016 foreign ownership seems to have no strong relationship with the yield. Different situation happened in 2017-2019 where the changes in foreign ownership seems to strong-negatively affect the bonds yield movement.

To mention, 2017 is the year when Indonesia got investment grade rating from S&P, following FITCH and Moody's in previous years. It means that broader category of foreign investment entities (i.e. pension funds and insurance) can enter the country's market since Indonesia's rating has fulfilled their criteria of investment (yunianto, 2018).

Particularly In 2020, the pattern is quite anomaly in which increase from 0.25-0.33% in foreign ownership seems to raise the yield from 6 up to 8.5%. The yield stumbles afterwards with the increase of foreign ownership up to 40%.

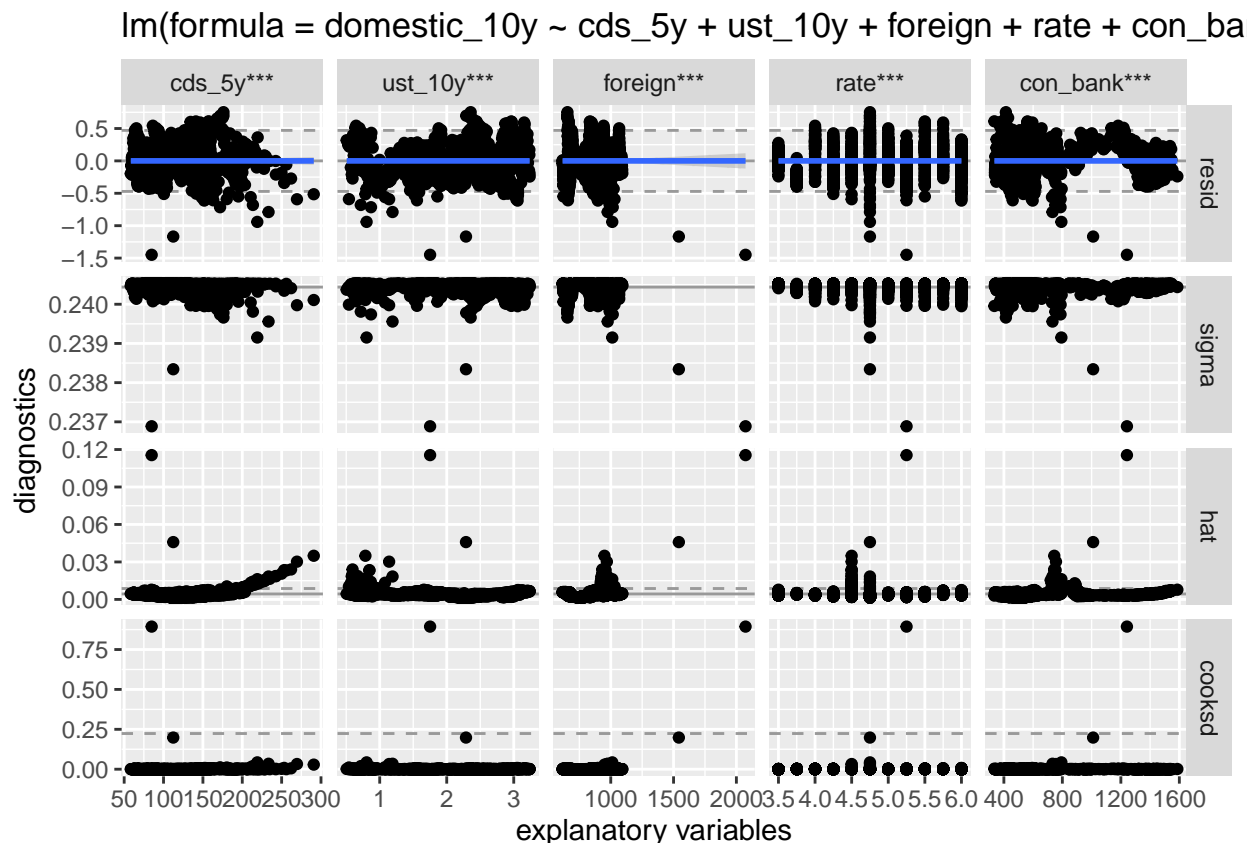
In January-August 2021, the relationship looks non-linear with no obvious pattern. The ownership drops below 25% but interestingly yield decreases further (6-7%).

We may assume that the anomaly in 2020 and 2021 are due to Covid19 pandemic that occurred since early 2020. The government is increasing its funding to sustain the economy. The decrease in foreign portion could be because foreigners sell their bonds more than their buying (net sell), or another reason is because their portion is deluged by domestic participants (i.e. central bank), thus we will track the pattern of domestic ownership in these years to check our assumption.

```
##
## Call:
## lm(formula = domestic_10y ~ cds_5y + ust_10y + foreign + rate +
##     con_bank, data = yield_factors)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.44899 -0.15056 -0.03247  0.17758  0.75192
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.477e+00  9.800e-02  15.07  <2e-16 ***
## cds_5y       1.171e-02  2.492e-04  47.01  <2e-16 ***
## ust_10y      3.056e-01  1.252e-02  24.40  <2e-16 ***
## foreign      1.082e-03  7.989e-05  13.55  <2e-16 ***
## rate         4.955e-01  1.382e-02  35.85  <2e-16 ***
## con_bank     6.016e-04  3.615e-05  16.64  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2404 on 1368 degrees of freedom
## (338 observations deleted due to missingness)
```

```
## Multiple R-squared:  0.8461, Adjusted R-squared:  0.8456
## F-statistic: 1504 on 5 and 1368 DF,  p-value: < 2.2e-16
```

```
## 'geom_smooth()' using method = 'gam'
## 'geom_smooth()' using method = 'gam'
## 'geom_smooth()' using method = 'gam'
## 'geom_smooth()' using method = 'gam'
## 'geom_smooth()' using method = 'gam'
```



As shown in the plot, proportion of Bank Indonesia and Conventional Bank are getting bigger in 2020-2021, while proportion of foreign holders is diluted. This can be seen as a result of implementation of new regulation on 1 May 2020 that mandate banks to reserve government bonds. This regulation has an impact on reducing bonds yield further in these two consecutive years.

Another noticeable change is proportion of individual in the bonds ownership that is growing started from mid of 2020 up to 2021. We may argue that people who prefer to hold their spending is channelling their excess money to investment, especially in a safe instrument like government bonds.

7.1 Policy Rate

From plot above, the movement of domestic 10y yield is parallel with movement of policy rate. The median spread in 2016 until 2018 is quite the same (around 2.5) while median spread of 2019 is the lowest. In 2020 and 2021, the differences between 10y yield and policy rate are increase with median spread is about 3. The range of spread in 2020 is also the widest compared to other observed years.

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