

**Do foreign investors have a positive impact on the domestic government bonds market? A panel pooled mean group approach**

Author

Conterius, Simeon, Akimov, Alexandr, Su, Jen-Je, Roca, Eduardo

Published

2023

Journal Title

Economic Analysis and Policy

Version

Accepted Manuscript (AM)

DOI

[10.1016/j.eap.2022.12.031](https://doi.org/10.1016/j.eap.2022.12.031)

Rights statement

© 2023. This manuscript version is made available under the CC-BY-NC-ND 4.0 license <https://creativecommons.org/licenses/by-nc-nd/4.0/>

Downloaded from

<http://hdl.handle.net/10072/429483>

Griffith Research Online

<https://research-repository.griffith.edu.au>

# **DO FOREIGN INVESTORS HAVE A POSITIVE IMPACT ON THE DOMESTIC GOVERNMENT BONDS MARKET? A PANEL POOLED MEAN GROUP APPROACH**

## **Abstract**

This study examines foreign investors' impact on the domestic government bond market's yield and volatility by employing a pooled mean group (PMG) approach. The study uses the panel data of 38 countries from 2004 to 2018. The study finds that in the whole sample and the subset of developing countries, both in the long and short run, a large proportion of foreign investors is associated with a reduction in domestic government bond yields. However, an analysis of foreign investment's effect on the bond yield's volatility brought significant results only in the short run, while there is no substantial evidence of any long-run effects. The PMG methodology in this study allows differentiation between the long- and short-run relationships between foreign ownership and bond yield and yield volatility. Our sample allows the analysis and comparison of these relationships in developed and developing countries. We further apply nonlinear autoregressive distributed lag (ARDL) to test for potential asymmetry in the relationship, which has not been done in other studies.

Keywords - foreign holdings, bond market, bond yield, yield volatility, PMG

**JEL Classification:** C51; G11; G19; H63

## 1. Introduction

Debt securities (bonds) are an alternative funding source for governments in developing and developed countries and are the means of funding budget deficits. A domestic bond market is critical for the implementation of monetary policy and also aids in ensuring a country's overall financial market stability (World Bank and International Monetary Fund, 2001).

Bond markets have expanded rapidly over the past two decades, from around USD 66.2 trillion in 2007 before the global financial crisis, to approximately USD123.5 trillion in 2020 in terms of the value of outstanding securities; roughly, an 87% growth (Securities Industry and Financial Markets Association, 2021). One reason for this rapid growth is the globalization of the financial market, which has allowed cross-border investments in fixed-income securities. The rise in the local currency bond markets and their improved accessibility to foreign investors has encouraged the demand for domestic bonds in many countries (Sienaert, 2012).

Foreign investors have been significant contributors to the domestic bond market. Past studies show that foreign investors' presence has had several potential impacts on the domestic bond market. This impact is indicated by changes in bond yields and bond yield volatility. Peiris (2010), Beltran *et al.* (2013), and Ebeke and Lu (2014) found that foreign ownership of securities can lead to increased demand for bonds, which, in turn, increases the price of securities and lowers their yield. However, the foreign investors' trading activities might also increase yield volatility (Borio and McCauley, 1996; Andritzky, 2012, Ebeke and Kyobe, 2015). Further studies reveal mixed results on the effect of foreign investment on the bond yield (Broos and Haan, 2012; Wu, 2005) and bond yield volatility (Peiris, 2010; Ebeke and Lu, 2014). This equivocal evidence served as our motivation for comprehensively examining the foreign investment-bond yield/yield volatility links. Understanding foreign investors' impact on the domestic bond market yield and volatility is crucial because it will help the government and other related parties manage the market better and judge future market movements. As the issuer of government bonds, governments will also benefit from this study, given that there is little research on the bond market from the bond issuer's perspective (Zunino *et al.*, 2012).

This study focuses on the effects of foreign investment on the domestic government bond market. Government bond markets are the backbone of most fixed-income securities markets globally (World Bank and International Monetary Fund, 2001). They are a primary target for foreign investors, given their low-risk profile, and they serve as a benchmark for risk-free assets in their respective countries (Boy, 2015).

This paper makes the following contributions to the literature. It is designed to be the most comprehensive study of the foreign effect on the domestic government bond market to date and is the first to differentiate long-run and short-run relationships between the level of foreign ownership, and how it affects bond yield level and bond yield volatility. The ARDL-PMG methodology enables us to make such a distinction between long term and short term. Secondly, by dividing the sample into groups of developing and developed countries, the study aims to drill deeper into whether the impact of foreign investors is different for developed and developing countries. Finally, we employ a nonlinear panel ARDL approach to discover whether there is asymmetry in the nexus; that is, whether increasing and decreasing foreign ownership have a varying impact on bond yields/bond yield volatility.

The remainder of the paper is structured as follows: Section 2 discusses the theoretical framework and literature study; Section 3, the data and methodology; Section 4, the findings and discussions. Section 5 concludes the paper.

## **2. Overview of the Literature**

### ***2.1 Theoretical Framework***

Capital flows between countries, especially developing economies, have exploded since the early 1990s and comprise foreign direct investments (FDI), portfolio equity and debt flows, commercial lending, and official flows (official bilateral grants). Portfolio investments in equity and fixed-income securities have also multiplied (Chen and Khan, 1997). According to UNCTAD (1999), portfolio investments are those made by a resident entity of one country in the equity and debt securities of an enterprise resident in another country that primarily seeks capital gains and does not reflect significant and lasting interest from the investors.

The current stream in capital flows, specifically portfolio investments, has been brought about by push and pull factors. Push factors are related to the global economic environment, such as low-interest rates and declining asset investment returns in advanced economies. In contrast, pull factors are related to increased investment opportunities and post-crisis changes in emerging markets, such as relaxed regulatory restrictions on foreign portfolio investments through capital market liberalization (Montiel, 1998; Kim and Yang, 2008). Moreover, declining home-country interest rates and the search-for-yield also lead investors to shift their portfolios toward riskier bonds such as emerging market bonds (Ammer *et al.*, 2019).

The research into the effect of foreign holdings on the domestic bond yield is commonly based on several theories. One of these is the Loanable Funds Theory introduced by Wicksell,

Robertson, and Ohlin (Bertocco, 2007). This theory suggests that the market interest rate is determined by the factors that control loanable funds' supply and demand. The demand for loanable funds comes from households, businesses, governments (by issuing securities), and foreign governments/corporations (issuing securities to foreign governments/institutions). The supply sources are households, businesses, and governments (Madura, 2008). Based on this theory, the mechanism between demand and supply sources in the bond market will affect the yield level. Foreign governments and institutions are also sources of demand for government bonds issued by local businesses or governments. More demand from these foreign investors will increase a domestic government bond's price and reduce yield.

Regarding the effect of foreign investments on a country's asset prices, Kim and Yang (2008) argued that foreign investments in a country could affect asset prices in three ways: (i) by increasing the demand for assets, the price will increase; (ii) capital inflows may increase the money supply and liquidity, which also boosts asset prices; and (iii) capital investments may fuel strong economic growth and lead to an increase in asset prices. Arslanalp and Poghosyan (2016) also argued that foreign purchases of government debt could lead to a decline in bond yields for several reasons. First, the foreign investment of an asset is a capital inflow, and capital inflows, all else equal, can reduce the cost of funding for domestic borrowers to the extent that they expand the domestic savings pool available for domestic borrowers. Second, financial integration, motivated by a wish for portfolio diversification by global investors and an expanding pool of world savings, increases cross-border flows; thus, foreign inflows can lead to a convergence in real interest rates. Finally, foreign investors may have a higher demand for liquidity and safety than domestic investors, leading to market segmentation and deviations from the standard term structure of interest rates due to supply-demand imbalances.

However, the entry of foreign investors may also bring side effects. The increased trading activities may increase bond market volatility and encourage herding behavior in the bond market. Banerjee (1992) defined herd behavior as doing what everyone else does, even when their private information suggests doing something different. The presence of foreign investors can increase the extent of herding, which is not necessarily irrational, and play a key role in crisis contagion (Lee, 2000).

The impact of foreign investments on the domestic bond market could also differ in the short and long run. According to Kim and Yang (2008), the initial period of capital inflows is often characterized by exchange rate appreciation, domestic credit expansion, consumption and investment boom, and asset price bubbles. Over time, the process tends to reverse; real

exchange rate appreciation weakens the current account and reduces domestic assets' attractiveness to foreign investors. In this case, we can infer that the effect of foreign inflow on developing countries' bond markets is higher in the short run than in the long run. This might be because the 'euphoria' of foreign investment in the developing market is more significant in the initial period, then will reverse in the long run.

The effect of additional investment from foreign sources on the domestic bond market may differ between countries with different economic conditions. Ebeke and Lu (2014) argued that different fundamental macroeconomic conditions might cause mixed findings. When foreign investors move to a country with good fundamentals, a reduction in yield is possibly accompanied by some volatility. However, countries with poor fundamentals that receive massive investments in the domestic bond market may experience an increased risk of flow reversal or sudden stops, so yield volatility becomes obvious.

In contrast, the effect on countries with good macroeconomic conditions or developed countries could also be different than on developing countries. Arslanalp and Poghosyan (2016) explained the 'safe-haven' consideration that encourages investors to invest in developed countries. Hauner and Kumar (2006) also discussed the strong downward effect of interest rates on foreign investors' inflows to the G-7's financial market. If some problems, such as market turbulence or economic crisis arise, investors may see the developed countries' bond market as a 'safe haven,' at least, in the long run, forcing them to pull out of their investment in developing countries.

Apart from the expected positive effect of foreign inflows on the domestic bond yields, the impact of outflows should be examined. The impact of foreign inflows and outflows may be asymmetric, and the nature and the scale of their effect on the market may differ. A large influx of foreign investment can overheat the economy, increase exchange rate volatility, and create outflow because of changing expected returns on assets, herding, and contagion effects (Lopez-Mejia, 1999). Extreme swings in capital flows can pose significant macroeconomic and financial instability (Lopez and Stracca, 2021).

Market volatility transmission could also affect the asymmetry between bad and good news. Volatility related to negative information seems to be transmitted more quickly than the volatility linked to good news, and volatility transmission from one region to another on the same trading day is significant (Clements *et al.*, 2015). The market also responds more to negative news, which significantly positively affects the yield spread (Caporale *et al.*, 2018).

Nevertheless, volatility regarding news announcements also seems to be short-lived. Jones *et al.* (1998) found that announcement shocks usually have no subsequent impact on the next trading day, while Clements *et al.* (2015) argued that volatility transmission between regions is more significant on the same trading day. The Asian Development Bank (2013) found that enhanced market liquidity would reduce market fluctuations, where one of the main contributors to increased market liquidity is foreign investors (World Bank and International Monetary Fund (2001).

## ***2.2 Empirical evidence***

The effect of foreign investment on financial markets, especially bond markets, has attracted attention from academics, supranational agencies, and policymakers. The existing literature has identified the following effects of foreign participation on the local market: (i) increased development, innovation, and efficiency in domestic markets (World Bank and International Monetary Fund, 2001); (ii) increased domestic bond market liquidity and potentially, maturity extension of the bonds (World Bank and International Monetary Fund, 2001; Caruana, 2011; Asian Development Bank, 2013); (iii) foreign holdings in the domestic bond market, especially in emerging countries, help the government to evade the risk of original sin or the inability to borrow abroad in own currency (Patnaik *et al.*, 2013).

Besides the effects above, it is important to research the impact of foreign investment on the bond market yields as they represent the cost of borrowing for governments. Most of the literature has found that foreign investments lower local bond market yields, with some exceptions where no evidence for the relationships was found. In contrast, the research on a foreign investor – bond yield volatility nexus is mixed.

### *Effect on the domestic bond yield*

The European Central Bank (2006) used Generalized Least Square regressions and found that foreign central bank purchases of U.S. Treasury reduced the U.S. Treasury yields. Bandholz *et al.* (2007) employed Vector Error Correction Method (VECM) to find that foreign holdings reduce the U.S. Treasury yield. Warnock and Warnock (2009) used the Ordinary Least Square (OLS) method and found that in the absence of substantial foreign holdings of U.S. government bonds, the 10-year Treasury yield would have been higher.

Peiris (2010) used fixed-effect regression to estimate foreign participants' role in determining long-term local currency government bond yields and volatility in 10 emerging markets in their emerging market research. The study found that foreign participation is associated with lower

bond yields. Pradhan *et al.* (2011) used panel fixed effect regression on emerging countries' data and found that non-resident participation in the local bond market significantly impacted long-term yields. Goda *et al.* (2013) used an ARDL based model to determine what caused the bond yield 'conundrum' in the U.S. (when the federal funds rate rose from mid-2004 but the long-term rates continued to fall), and they found that official foreign investors' demand has a negative effect on yields. Ebeke and Lu (2014) used pooled OLS and found that foreign holdings reduce bond yields. Kurniasih and Restika (2015), in their research on the Indonesian domestic bond market, performed multiple linear regression on monthly data of Indonesian local government bond yields and percentage of foreign ownership. The research found that foreign ownership reduced government bond yields. Ebeke and Kyobe (2015) used OLS to study emerging market local currency bonds. They found that higher foreign participation provided additional financing, decreased the yield level, and increased yield volatility.

There is also some research that has been done into foreign investors' effect on the domestic bond market in developed countries. Andritzky (2012) used OLS in his study on G20, and other advanced Euro area countries tested the relationship between the yield of 10-year government bonds and the share of non-resident holdings. His research found that the share of securities held by non-residents negatively correlated with bond yields. A ten percentage points increase in foreign ownership share led to lower bond yields. Beltran *et al.* (2013) used the VAR method to uncover the relation between foreign purchases of U.S. Treasury securities and their yields. They found that a decrease in foreign holdings of U.S. Treasury notes increases bond yields. Arslanalp and Tsuda (2014a, 2014b) pointed out that rising foreign participation in government debt markets can lower borrowing costs and broadly spread risks among investors. Carvalho and Fidora (2015) researched the effect of foreign holdings on the Euro area bond market, using VAR regression between 10-year government benchmark bond yield and foreign holding. The research found that increasing foreign holdings lowered the long-term interest rate. Arslanalp and Poghosyan (2016) examined advanced economies' bond markets and whether foreign ownership affected bond yields, using panel regression. The research found that an increase in foreign ownership is associated with a statistically significant decline in long-term bond yields.

In contrast, Wu (2005) found opposing results that foreign purchases and bond yields do not always move in the opposite direction. There was insufficient evidence for them to show that foreign holdings cause lower interest rates in the United States' financial market. In the research on European countries, Broos and Haan (2012) regressed the annual yield-to-maturity spread of 10-year government bonds on government bonds' foreign ownership. The study concluded



that foreign ownership could negatively affect the yield, subject to the country's level of indebtedness. The effect is positive in countries with high debt, whereas the impact is negative in countries with low debt. Pham (2015) used the OLS method in the research about the effect of foreign participation on the Chinese bond market and found a significant but weak positive relationship between the Chinese sovereign 10-year bond yield and foreign participation.

*Effect on the domestic bond yield volatility*

Besides research on the bond market's yield level, several studies have examined the effect of foreign investment on the bond market's volatility. Borio and McCauley (1996) used AR(1) regression to research the Group of 7 European markets. They found that foreign investor activity was linked to increased market volatility. Furthermore, they argued that withdrawals of funds had a substantially higher effect on volatility than their deposit. Peiris (2010) used the GARCH framework to model the impact of foreign investors' participation on government bond yield volatility. They found that greater foreign participation did not increase the volatility of bond yields in emerging markets and could even dampen volatility. Andritzky (2012) tested the relationship between the quarter-end standard deviation of government bonds yield and the share of non-resident holdings and other control variables. He found that a higher percentage of non-resident holdings is associated with a small but significant increase in bond yield volatility. Ebeke and Lu (2014) found that the foreign holding and yield volatility relationship could be inverse in countries with sound economic fundamentals but direct in those with weak fundamentals. Balli, Basher, and Rana (2014) found that larger asset holdings in offshore financial centers held by non-bank financial institutions increased market volatility. Ebeke and Kyobe (2015) found that higher foreign participation provided additional financing, decreased yields, and increased volatility. Yuniarto (2019), in the research on the Indonesian market, found that foreign participation has a negative but insignificant impact on long-term yield volatility.

A summary of the effects of foreign investment on the domestic bond market from an issuer perspective is presented in Table I.

-----

Insert Table I here

-----

### 3. Data and Methodology

This paper uses quarterly data from 2004 to 2018 from 19 advanced economies and 19 developing countries<sup>1</sup>. We use quarterly 10-year government bond yield as the dependent variable in Equation 1, and government bond yield volatility as the dependent variable in Equation 2. The primary causal variable that is the focus of this research is foreign ownership in each country's domestic bond market. The data regarding foreign investor ownership in domestic government securities has been sourced from the IMF database. The data set provides good coverage of the period pre-and post-the Global Financial Crisis and reflects contemporary developments in the bond markets.

The yield variable is represented by quarter-end yields of each country's 10-year government bonds and is sourced from the Bloomberg database. The yield volatility data is calculated from the quarterly standard deviation of the Bloomberg database's daily ten-year government bond yield. Control variables are sourced from Bloomberg, OECD, and IMF databases as listed in Table II.

-----

Insert Table II here

-----

We control the effect of five variables in the literature for their impact on bond yield and yield volatility (Andritzky, 2012; Ebeke and Lu, 2014; Ebeke and Kyobe, 2015). The first is the inflation rate (*CPI*) used to control for the country's economic condition and as an indicator that could affect bond investor demand and trading activity. We expect a positive sign for both tests. The second control variable is the central bank policy rate (*ctbrate*), controlling for monetary policy's impact on bond yield structure and trading (expected positive sign for both tests). The third control variable is the budget balance (*budget*) to control for a country's fiscal condition (expected sign negative for test on yield, and positive for test on volatility). The fourth variable is real GDP growth (*growth*), to account for the impact of a country's macroeconomic condition on the bond market (expected signs negative and positive). The final

---

<sup>1</sup> **19 developed:** Australia, Austria, Belgium, Canada, Czech Republic, Finland, France, Germany, Ireland, Italy, Korea, Netherlands, New Zealand, Portugal, Slovenia, Spain, Sweden, United Kingdom, United States, and **19 developing** countries: Brazil, Bulgaria, Chile, China, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, Ukraine

variable is the current account balance (*currentA*), to control for currency risk (expected sign negative and positive).

The analysis is undertaken in three steps: first, we test the effect of foreign ownership on bond yield and yield volatility for the whole sample. The analytical tools allow us to differentiate between short and long-run effects. Some robustness tests follow the analysis. In the second step, we split the sample into developed and developing countries in an attempt to identify whether there are any differences in the relationships between those two subgroups. Finally, we test for any potential asymmetry in the relationship between foreign investors and bond yield/bond yield volatility.

In the first and second stages of the analysis, the paper applies autoregressive distributed lag (ARDL) pooled mean group (PMG) panel analysis (Pesaran and Shin, 1998; Pesaran *et al.*, 1999). This method is appropriate when the variables exhibit a mixture of first-order and zero-order stationarity differencing (i.e.  $I(1)$  and  $I(0)$ , respectively) (Shrestha and Bhatta, 2018), which is the case in this study. This method enables the researcher to test the impact of variables on both the short term and the long term. According to Blackburne and Frank (2007) and Shrestha and Bhatta (2018), an ARDL model is applicable for both non-stationary series and series with mixed order of integration. This model uses sufficient lags to capture the data generating process in a general-to-specific modeling framework. A dynamic error correction model (ECM) can be derived from ARDL through a simple linear transformation. Likewise, the ECM integrates the short-run dynamics with the long-run equilibrium without losing long-run information and avoids problems such as spurious relationships resulting from non-stationary data. If the variables are, for example,  $I(1)$  and cointegrated, then the error term is an  $I(0)$  for all  $i$ . A principal feature of cointegrated variables is their responsiveness to any deviation from long-run equilibrium. This feature implies an error correction model in which deviations from equilibrium influence the system's short-run dynamics. Thus, it is common to re-parameterize the ARDL model in the error correction model.

Panel ARDL has several estimators, Mean Group (MG), Pooled Mean Group (PMG), and Dynamic Fixed Effect (DFE) estimators. To analyze dynamic panel data, at one extreme, mean group estimators (MG) can be used with separate equations for each group and the distribution of the estimated coefficients across groups. MG estimator is said to produce consistent estimates of the average of the parameters. However, this estimator does not consider that certain parameters may be the same across groups. At the other extreme, there are the traditional pooled estimators, such as the fixed and random effect estimators, where the

intercepts are allowed to differ across groups, while all other coefficients and error variances are the same. An intermediate estimator is also called pooled mean Group (PMG), which involves pooling and averaging. This estimator permits the intercepts, short-run coefficients, and error variances to differ across groups but constrains the long-run coefficients to be the same (Pesaran and Smith 1995; Pesaran *et al.* 1999). Bildirici (2014) recommends PMG as a good alternative compared to other panel estimators such as Dynamic OLS and Fully-Modified OLS because PMG presents evaluations of the long-run homogeneity relationships implemented. This study will compare the results between these three estimators in the Robustness test. The Hausman test is used to determine the most efficient among them.

Assume the following simple model to illustrate the ARDL modeling approach:

$$Y_t = \alpha_i + \beta_1 X_t + \beta_2 Z_t + e_t \quad (1)$$

The error-correction version of the ARDL will be as follows:

$$\Delta Y_t = \theta_i [Y_{i,t-1} - \theta_1 X_{i,t-1} - \theta_2 Z_{i,t-1}] + \sum_{l=1}^p \beta_0 \Delta Y_{t-l} + \sum_{l=1}^{q^1} \beta_1 \Delta X_{t-l} + \sum_{l=0}^{q^2} \beta_2 \Delta Z_{t-l} + \mu_i + e_t \quad (2)$$

The parameter  $\theta_i$  is the error-correcting speed of adjustment term. If  $\theta_i = 0$ , then there is no evidence of a long-run relationship (expected that  $\theta_i < 0$ );  $[Y_{i,t-1} - \theta_1 X_{i,t-1} - \theta_2 Z_{i,t-1}]$  is the error correction term, and  $\theta_1$  and  $\theta_2$  are the long-run coefficients for foreign holding and other control variables. The first part of the equation contains  $\beta_0$ ,  $\beta_1$ , and  $\beta_2$ , which represent the short-run dynamics of the model, and  $p$ ,  $q^1$ ,  $q^2$ , ...,  $q^k$  represent the optimal lags.  $\mu_i$  is group-specific effects;  $e_t$  is the error term.

Within the context of the ARDL model of Pesaran and Shin (1998) and Pesaran *et al.* (1999), equation (2) can be used in this research to examine the impact of foreign holdings on the domestic bond market's yield and volatility: where  $y_{i,t}$  is the domestic quarterly bond yield (10-year bond yield is used) for Equation 1 (to test for the effect of foreign holding on the yield volatility); or the quarterly standard deviation of daily domestic bond yield for Equation 2 (to test for the effect of foreign holding on the yield volatility).  $Y_{i,t-l}$  is the lagged dependent variable (in ARDL-PMG, the lagged dependent variable is also used in the equation),  $X_{i,t}$  represents the quarterly foreign ownerships, and  $Z_{i,t}$  represents the control variables.

In the third stage of the analysis, we expand the ARDL method to nonlinear ARDL. In the nonlinear ARDL, movements of foreign ownerships have been decomposed into their negative

and positive partial sums. Nonlinear ARDL allows testing whether foreign ownerships have symmetric or asymmetric effects on yield and yield volatility in the short and long run.

In the process of formulating nonlinear ARDL by considering the previous ARDL Eq. (1), we decomposed the main independent variable into two additional sets of series based on positive and negative changes, following Bahmani-Oskooee and Mohammadian (2016) and Bahmani-Oskooee and Saha (2017). We decomposed positive and negative changes for foreign ownerships (denoted  $\mathcal{X}$ ) by  $\mathcal{X}^+$  and  $\mathcal{X}^-$  as follows:

$$\text{Pos}(\mathcal{X})_t = \sum_{l=1}^q \mathcal{X}_t^+ = \sum_{l=1}^q \text{MAX}(\Delta \mathcal{X}_t, 0)$$

$$\text{Neg}(\mathcal{X})_t = \sum_{l=1}^q \mathcal{X}_t^- = \sum_{l=1}^q \text{MIN}(\Delta \mathcal{X}_t, 0)$$

We can rewrite Eq. (3) in nonlinear form by incorporating a new series of positive and negative changes in foreign ownership as follows:

$$Y_{i,t} = \theta_i [Y_{i,t-1} - \theta_1 x^+_{i,t-1} - \theta_2 x^-_{i,t-1} - \theta_3 z_{i,t-1}] + \sum_{l=1}^p \beta_0 Y_{i,t-l} + \sum_{l=0}^{q_1} \beta_1 \text{PosX}_{i,t-l} + \sum_{l=0}^{q_2} \beta_1 \text{NegX}_{i,t-l} + \sum_{l=0}^{q_3} \beta_2 Z_{i,t-l} + \mu_i \quad (3)$$

Shin *et al.* (2014) have enriched the previous linear ARDL and labeled a nonlinear ARDL model due to generating PosX and NegX variables. Unlike the linear panel ARDL, the nonlinear panel ARDL or asymmetric panel ARDL, allows for an asymmetric response of foreign ownerships to the independent variable used in this research. The coefficient estimates attached to PosX and NegX variables are used to test whether the two new variables have the same effects (symmetric) or different effects (asymmetric).

#### 4. Findings and Discussion

Before conducting the panel ARDL, several diagnostic tests should be executed, such as correlation analysis, unit-root test,<sup>2</sup> lag selection,<sup>3</sup> cointegration tests,<sup>4</sup> and the Hausman test.<sup>5</sup> We also run a VIF test to detect multicollinearity. Having performed these tests, the model satisfied the criteria for further analysis with ARDL-PMG.

---

<sup>2</sup> Im–Pesaran–Shin unit-root test

<sup>3</sup> The panel ARDL model selection uses Stata’s default Bayesian information criterion (BIC); we use maximum lags of 2; the result is lag 1 0 0 0.

<sup>4</sup> Pedroni cointegration test

<sup>5</sup> To select between mean group (MG), pooled mean group (PMG), and Dynamic Fixed Effect (DFE) estimators.

#### ***4.1. Descriptive Statistics***

Table III reports descriptive statistics for the whole sample. All variables, excluding the budget deficit and current account to GDP ratio, have a positive mean from 2004 to 2018. The generic 10-year government bond yield was on average 4.7% per year. The yield volatility, measured as the standard deviation of daily 10-year government bond yields, was around 0.18% during the same period. On average, the foreign investor holdings in the domestic bond market were 33.2%. CPI, central bank rate, and real GDP growth were 3.4%, 3.7%, and 0.97% per year. In contrast, on average, budget and current account balances registered deficits of 2.187% and 0.682%, respectively.

-----

Insert Table III here

-----

#### ***4.2. Foreign investments and bond yield/bond yield volatility***

In the first stage of the analysis, we examine the relationships between foreign investors on one hand and bond yield and bond yield volatility on the other hand in the full sample. Table IV reports the findings of PMG estimations.

-----

Insert Table IV here

-----

Estimations of the effect of foreign holdings on the domestic government bond market yield reveal statistically significant results both in the long run (at 99% level of significance) and the short run (at 90% level of significance). These indicators have negative coefficients, meaning that foreign investment in a domestic government bond market inversely impacts the bond yields; that is greater investor participation is associated with lower bond yields, and vice versa.

The test for the effect of foreign ownership on yield volatility shows the mixed results (direct and inverse) of foreign holdings on domestic bond yield volatility in the long and short run. We expected a direct relationship between foreign holding and bond yield volatility. Although the coefficient sign for long-run estimation is positive, it is insignificant at conventional levels. The result is only significant (at 95%) in the short run, showing that increased foreign presence reduces bond yield volatility.

The effect of foreign investment on reducing bond market volatility might be attributed to the increased liquidity in the domestic bond market. This relationship is described by World Bank and International Monetary Fund (2001) as foreign investors' contribution to the liquidity of government securities. Enhanced market liquidity would reduce fluctuations (Asian Development Bank, 2013). In the long run, though, this effect appears to wear off with no significant impact from foreign investors on the volatility.

These mixed results of the effect of foreign holdings on bond yield volatility are similar to those of Peiris (2010) and Ebeke and Lu (2014), which also found mixed results. Andritzky (2012) found positive but insignificant relationships, similar to what we have discovered in the long run.

Statistical results for most of the control variables are in line with the expectation. The inflation and central bank rate are positive and statistically significant in the long run, whereas there are some mixed results in terms of coefficients and significance in the short run. The budget balance to GDP coefficient is negative and significant in the long run but insignificant in the short run. The GDP growth ratio is statistically insignificant in most estimations, with only one small negative and significant coefficient in the short-run regression for bond volatility. The last control variable is the current account balance to GDP ratio, which resulted in insignificant bond yield volatility estimations. In the bond yield levels estimations, the results are negative and significant in the long run, meaning that an increased current account balance may also increase liquidity and help comfort the market. A small negative coefficient partially offsets it in the short run.

#### **4.3. Robustness Tests**

To test for the robustness of the results, we ran additional Mean Group (MG) and Dynamic Fixed Effect (DFE) tests which are also estimators in the panel ARDL (Pesaran *et al.*, 1999). We present the PMG result from Table IV and compare it with the MG and DFE results in Table V, as follows.

-----

Insert Table V here

-----

The estimation output for the test on yield for the Mean Group and Dynamic Fixed Effect estimators showed similar signs (inverse) to those of the PMG test, albeit with differences in the coefficient magnitude. Both the MG and DFE tests resulted in significance in the long run only, unlike the PMG test, where we found an inverse and significant statistically in both the long and short run.

The test on volatility using the MG test yielded practically identical results to those for our base PMG methods in terms of coefficient values and significance. The result of the DFE estimator was somewhat different in the long run. Unlike PMG and MG estimations, where foreign ownership does not seem to be linked with the bond yield volatility in the long run (insignificant at conventional levels), in DFE, we found negative and significant coefficients in both the long and short run. Overall, the MG and DFE estimations support the findings made in our main estimation and confirm the robustness of the results.

#### ***4.4. Developed vs. Developing countries***

In stage two of our analysis, we split the sample into the sub-samples of 'developed' and 'developing' to examine whether there are any differences in the foreign investment – bond yield/yield volatility nexus in these two subgroups. Table VI reports the findings of the estimations.

-----

Insert Table VI here

-----

The foreign investment- yield nexus estimations show similar results in developed and developing countries both for the main explanatory variables and for the controls. There is a significant (at 99%) inverse relationship between foreign investment and bond yield, with slightly higher coefficients in developed countries in the long run. This is complemented with a significant inverse relationship (at 95%) in developing countries in the short run, whereas the foreign investment variable in developed countries is insignificant in the short run.

In contrast, the foreign investment–bond yield volatility nexus estimations yielded mostly insignificant results for both explanatory and control variables. The only significant coefficient for foreign investment is in the short term and for developed countries. That is, increased inflow of foreign investors creates additional liquidity and does not cause excessive trading activity that would lead to yield volatility.



#### 4.5. Tests of asymmetry

In the third stage of the analysis, we extend our research by looking for asymmetric shocks. The impact of foreign ownership could be different when the foreign ownership is on the rise or decreases. In ascertaining whether or not this is so, we use the nonlinear empirical framework of the panel ARDL. We follow the nonlinear ARDL approach by Shin *et al.* (2014) to capture the asymmetry effect of foreign ownership on the yield and yield volatility. We also compare the result of the pooled mean group (PMG), mean group (MG), and dynamic fixed effects (DFE) and use the Hausman test to choose the most consistent and efficient estimator for this test. All the results from the three estimators are presented for comparison. Table VII reports the estimation results for the asymmetry in the foreign investment–yield nexus, whereas Table VIII reports the results of the foreign investment–bond yield volatility link.

-----

Insert Table VII here

-----

As shown in Table VII above, the Hausman test chooses the DFE estimator as the most efficient. The DFE result shows that only an increase in foreign ownership significantly reduces the yield of the domestic bond market in the long run. The decrease in foreign ownership did not have any significant effect either in the short or long run.

All the test results on the PMG method gave an inverse result, although only significant in the long run. Both increase and decrease in foreign ownership reduce long-run yield. However, the magnitude is higher for the increase of foreign ownership. While test with the MG method also gave all inverse signs, but only significant in the long run.

-----

Insert Table VIII here

-----

As evident in Table VIII, the Hausman test chooses the PMG method as the most efficient for the bond yield volatility estimations. Test results on the PMG method showed a significant and inverse result for the increase and decrease of foreign ownership, but the significances are only found in the short run, where decreasing foreign ownership has a stronger impact on volatility

than increasing foreign ownership. That is when foreign investors pull out from the market, volatility rises by the larger magnitude than the magnitude of reduction of volatility when foreign investors share rises. The DFE result reveals that both an increase and decrease in foreign ownership significantly reduce short- and long-term volatility. The short-run effect between increase and decrease in foreign ownership is almost the same, albeit slightly higher in the former-signaling effect of increased liquidity. In the long run, the effect of a decrease in foreign ownership is also slightly higher in calming the market than the increase in foreign ownership, signaling decreased trading activity. In contrast, all tests show an inverse relationship with no statistical significance in the MG method.

Overall, these tests also show that changes in foreign ownership had almost the same impact on the market volatility in both directions. The effect of calming the market is marginally higher in the short run, possibly due to the additional liquidity, while in the long run, the effect of decreasing foreign ownership is also higher to show the possible effect of reduced trading activity.

## **5. Conclusion**

The paper has yielded several significant findings. Firstly, the study has confirmed that foreign ownership in the domestic bond market significantly reduces domestic government bond yield in the short and long terms. The reduced effect is consistent in all tests, including in subsamples of developing and developed countries. Moreover, increasing foreign ownership also gives a more substantial inverse effect on yield, at least in the long run.

This research found some evidence that foreign investment has the potential to reduce the bond market's volatility in the short run. The decomposition into developed and developing subsets revealed a significant and negative relationship only in developed countries. This might be due to the additional liquidity associated with the increased foreign investment, which creates additional depth to keep the yields stable.

The comparison between developed and developing countries revealed rather similar results, except in the study of the effect of foreign ownership on bond yield volatility, where estimations for the developing economies have not revealed any significant results for our explanatory variables.

We also found an asymmetric effect between increase and decrease in foreign ownership on the domestic bond market yield, where additional foreign ownership had a significant short-run effect in reducing overall yield compared to the decrease of foreign investments. On the

other hand, changes in foreign ownership gave almost the same magnitude of decreasing and increasing market volatility, albeit the effect was higher in the short run.

A better understanding of the effect of foreign investments on the domestic bond market's yield and volatility will help issuers, investors, policymakers and analysts to better forecast market movements.

From a policymaker's point of view, the findings of this study confirm that encouraging the participation of foreign investors in the domestic bond market is desirable. Foreign investors have the capacity to drive up the demand for local bonds and drive down the cost of borrowing. Access to cheaper funding is, in turn, beneficial to domestic borrowers whether these are private borrowers or the government. Cheaper funding makes more projects viable and thus has the capacity to spur economic activity regardless of whether it is a developed or a developing country. The presence of foreign investors may bring additional benefits to developing economies, because it may assist in efforts to modernise financial services, extending external scrutiny of the market and helping in developmental initiatives.

The findings in relation to the impact of foreign investors on bond market volatility, although less definitive, still suggest some positive outcomes from higher overseas participation. On the flip side, policymakers should be wary of creating the conditions that would lead to the flight of foreign investors from a country, as witnessed in many Asian economies at the end of the 20<sup>th</sup> century.

## References

- Ammer, J., Claessens, S., Tabova, A., & Wroblewski, C. 2019. "Home country interest rates and international investment in U.S. bonds.", *Journal of International Money and Finance* 95: 212-227. doi:<https://doi.org/10.1016/j.jimonfin.2018.06.010>.
- Andritzky, J. R. 2012. "Government Bonds and Their Investors: What Are the Facts and Do They Matter?." *IMF Working Paper* 12 (158): 1-29.
- Arslanalp, S., & Poghosyan, T. 2016. "Foreign Investor Flows and Sovereign Bond Yields in Advanced Economies." *Journal of Banking and Financial Economics* 2 (6): 45-67. doi:10.7172/2353-6845.jbfe.2016.2.3.
- Arslanalp, S., & Tsuda, T. 2014a. "Tracking Global Demand for Advanced Economy." *IMF Economic Review* 62: 430-464. doi:10.1057/imfer.2014.20.
- Arslanalp, S., & Tsuda, T. 2014b. "Tracking Global Demand for Emerging Market Sovereign Debt." *IMF Working Paper* 14 (39): 1-49.
- Asian Development Bank. 2013. *Broadening the Investor Base for Local Currency Bonds in ASEAN+2 Countries*, Asian Development Bank, Manila, Phillipines.

- Bahmani-Oskoe, M., Mohammadian, A. 2016. "Asymmetry effects of exchange rate changes on domestic production: evidence from nonlinear ARDL approach." *Australian Economic Papers* 55 (3): 181-191.
- Bahmani-Oskoe, M., Saha, S. 2017. "On the relation between exchange rates and stock prices: a nonlinear ARDL approach and asymmetry analysis." *Journal of Economics and Finance* 42 (1): 112-137.
- Balli, F., Basher, S. A., & Rana, F. 2014. "The determinants of the volatility of returns on cross-border asset holdings." *Journal of International Money and Finance* 44: 1-23. doi:<http://dx.doi.org/10.1016/j.jimonfin.2014.01.004>.
- Bandholz, H., Clostermann, J., & Seitz, F. 2007. "Explaining the US Bond Yield Conundrum." *MPRA Paper* 2386: 1-21. doi:10.1080/09603100801964370.
- Banerjee, A. 1992. "A Simple Model of Herd Behavior." *The Quarterly Journal of Economics* 107 (3): 797-817.
- Beltran, D. O., Kretchmer, M., Marquez, J., & Thomas, C. P. 2013. "Foreign Holdings of U.S. Treasuries and U.S. Treasury Yields." *Journal of International Money and Finance* 32: 1120-1143. doi:10.1016/j.jimonfin.2012.09.005.
- Bertocco, G. 2007. "Some Observations about the Loanable Funds Theory." *Department of Economics, University of Insubria in its series Economics and Quantitative Methods* 5: 1-28.
- Bildirici, M. E. 2014. "Relationship between biomass energy and economic growth in transition countries: panel ARDL approach." *GCB Bioenergy* 6: 717–726. doi:10.1111/gcbb.12092.
- Blackburne, E. F., & Frank, M. W. 2007. "Estimation of non-stationary heterogeneous panels." *The STATA Journal* 7 (2): 197-208.
- Borio, C. E., & McCauley, R. N. 1996. "The Economic of Recent Bond Yield Volatility." *BIS Economic Papers* 45: 1-136.
- Boy, N. 2015. "Sovereign Safety." *Security Dialogue* 46 (6): 530-547.
- Broos, M., & Haan, J. D. 2012. "Government bond yields and Foreign Ownership of Debt." *Applied Economics Letters* 19 (5): 435–438. doi:10.1080/13504851.2011.581206.
- Caporale, G. M., Spagnolo, F., Spagnolo, N. 2018. "Macro news and bond yield spreads in the euro area." *The European Journal of Finance* 24 (2): 114-134. doi:10.1080/1351847X.2017.1285797.
- Caruana, J. 2011. "Foreign participation and bond market development in Asia and the Pacific." Closing remarks at the *Bank of Japan–BIS high-level seminar on the development of regional capital markets*. "Yokohama, Japan. 20-22 November.
- Carvalho, D., & Fidora, M. 2015. "Capital inflows and euro area long-term interest rates." *Journal of International Money and Finance* 54: 186-204. doi:<http://dx.doi.org/10.1016/j.jimonfin.2015.02.021>.
- Chen, Z., & Khan, M. S. 1997. "Patterns of Capital Flows to Emerging Markets: A Theoretical Perspective." *IMF Working Paper* 13: 1-32.
- Clements, A. E., Hurn, A. S., Volkov, V. V. 2015. "Volatility transmission in global financial markets." *Journal of Empirical Finance* 32: 3-18. <http://dx.doi.org/10.1016/j.jempfin.2014.12.002>.
- Ebeke, C., & Kyobe, A. 2015. "Global Financial Spillovers to Emerging Market Sovereign Bond Markets." *IMF Working Paper* 15 (141): 1-21.

- Ebeke, C., & Lu, Y. 2014. "Emerging Market Local Currency Bond Yields and Foreign Holdings in the Post-Lehman Period-a Fortune or Misfortune?" *IMF Working Paper* 14 (29): 1-36.
- European Central Bank. 2006. "The Accumulation of Foreign Reserves." *Occasional Paper Series* 43: 1-75.
- Gujarati, D. 2003. *Basic Econometrics fourth edition*, McGraw-Hill, New York, USA.
- Goda, T., Lysandrou, P., Steward, C. 2013. "The contribution of U.S. bond demand to the U.S. bond yield conundrum of 2004–2007: An empirical investigation." *Journal of International Financial Markets, Institutions & Money* 27: 113-136. <http://dx.doi.org/10.1016/j.intfin.2013.07.012>.
- Hair, J., Black, W., Babin, B., & Anderson, R. 2014. *Multivariate Data Analysis vol. VII*, Pearson Education, Essex, UK.
- Hauner, D., & Kumar, M. 2006. "Fiscal Policy and Interest Rates-How Sustainable Is the New Economy." *IMF Working Paper* 6 (112): 405-444.
- Im, K. S., Pesaran, M. H., & Shin, Y. 2003. "Testing for unit roots in heterogeneous panels." *Journal of Econometrics* 115 (1): 53-74. doi:10.1016/S0304-4076(03)00092-7.
- Jones, C. M., Lamont, O., Lumsdaine, R. L. 1998. "Macroeconomic news and bond market volatility." *Journal of Financial Economics* 47: 315-337.
- Kim, S., & Yang, D. Y. 2008. "The Impact of Capital Inflows on Emerging East Asian Economies: Is Too Much Money Chasing Too Little Good?" *ADB Working Paper Series on Regional Economic Integration* 15: 1-34.
- Kurniasih, A., & Restika, Y. 2015. "The influence of Macroeconomic Indicators and Foreign Ownership on Government Bond Yields: A Case of Indonesia." *Mediterranean Journal of Social Sciences* 6 (5): 34-42. doi:10.5901/mjss.2015.v6n5s5p34.
- Lee, J. Y. 2000. "The Role of Foreign Investors in Debt Market Development." *Policy Research Working Paper* 2428: 1-21.
- Lopez-Mejia, A. 1999. "Large capital flows: a survey of the causes, consequences, and policy responses." *IMF Working Paper* 17: 1-54.
- Lopez, G. G., Stracca, L. 2021. "Changing patterns of capital flows." *Committee on the Global Financial System papers* 66: 1-92.
- Madura, J. 2008. *Financial Markets and Institutions*, 8<sup>th</sup> ed., South-Western Cengage, Ohio, USA.
- Miyajima, K., Mohanty, M., & Chan, T. 2015. "Emerging market local currency bonds: Diversification and stability." *Emerging Markets Review* 22: 126-139.
- Montiel, P. J. 1998. *The Capital Inflow Problem*. Economic Development Institute, World Bank.
- Patnaik, I., Malik, S., Pandey, R., & Prateek. 2013. *Foreign investment in the Indian Government bond market*. Publication Unit, National Institute of Public Finance and Policy.
- Pedroni, P. 1999. "Critical Values for Cointegration Tests In Heterogenous Panels With Multiple Regressors." *Oxford Bulletin of Economics and Statistics* 61 (S1): 653-670. doi:<https://doi.org/10.1111/1468-0084.0610s1653>.
- Peiris, S. J. 2010. "Foreign Participation in Emerging Markets' Local Currency Bond Markets", *IMF Working Paper* 10 (88): 1-19.
- Pesaran H. M., & Smith R. 1995. "Estimating long-run relationships from dynamic heterogeneous panels." *Journal of Econometrics* 68 (1): 79–113.

- Pesaran, H. M., & Shin, Y. 1998. "An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis." *Econometric Society Monographs* 31: 371-413.
- Pesaran, H. M., Shin, Y., & Smith, R. P. 1999. "Pooled Mean Group Estimation of Dynamic Heterogeneous Panels." *Journal of the American Statistical Association* 94 (446): 621-634.
- Pham, T. H. 2015. "China's sovereign bond yield: some lessons." *Applied Economics Letters* 22 (3): 223-227. doi:<http://dx.doi.org/10.1080/13504851.2014.934426>.
- Pradhan, M., Balakrishnan, R., Baqir, R., Heenan, G., Nowak, S., Oner, C., & Panth, S. 2011. "Policy Responses to Capital Flows in Emerging Markets." *Staff Discussion Note*, International Monetary Fund.
- Securities Industry and Financial Markets Association. 2021. *Capital Markets Fact Book 2021*. New York: SIFMA.
- Shin, Y., Yu, B., & Greenwood-Nimmo, M. 2014. Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework, In *Festschrift in honor of Peter Schmidt*, pp. 281-314. New York: Springer.
- Shrestha, M. B., & Bhatta, G. R. 2018. "Selecting appropriate methodological framework for time series data analysis." *The Journal of Finance and Data Science* 4: 71-89. doi:<https://doi.org/10.1016/j.jfds.2017.11.001>.
- Sienaert, A. 2012. "Foreign Investment in Local Currency Bonds: Considerations for Emerging Market Public Debt Managers." *Policy Research Working Paper* 6284: 1-18.
- United Nations Conference on Trade and Development. 1999. "Comprehensive Study of the Interrelationship between Foreign Direct Investment and Foreign Portfolio Investment." *Staff Paper* 5: 1-46.
- Warnock, F. E., & Warnock, V. C. 2009. "International capital flows and U.S. interest rates." *Journal of International Money and Finance* 28 (6): 903-919. doi:[10.1016/j.jimonfin.2009.03.002](https://doi.org/10.1016/j.jimonfin.2009.03.002).
- World Bank & International Monetary Fund. 2001. *Developing Government Bond Markets: A Handbook*. Washington: World Bank.
- Wu, T. 2005. "The Long-term Interest Rate Conundrum: Not Unraveled Yet?" FRBSF Economic Letter 2005-08: 1-4.
- Yunianto, H. 2019. *Foreign Ownership of Rupiah Government Bonds: Blessing or Curse?* Jakarta: Mandiri Sekuritas Fixed Income Department.
- Zunino, L., Bariviera, A. F., Guercio, M. B., Martinez, L. B., & Rosso, O. A. 2012. "On the efficiency of sovereign bond markets", *Physica A* 391: 4342-4349. doi:[10.1016/j.physa.2012.04.009](https://doi.org/10.1016/j.physa.2012.04.009).

