# Bond Demand and the Yield-Exchange Rate Nexus: Risk Premium vs. Convenience Yield

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**Abstract**

This paper examines how demand for government bonds jointly affects bond yields and exchange rates. Exploiting government bond auctions from advanced economies to isolate demand shocks, I identify two channels: the risk premium channel, which reduces both bond and currency risk premiums, and the convenience yield channel, which increases the value of domestic safe assets. While both channels suppress yields, they have opposing effects on exchange rates. A preferred-habitat model featuring preference for liquidity demonstrates these mechanisms. The model predicts that higher auction demand lowers yields and strengthens the domestic currency by raising convenience yields. Empirical results validate these predictions. The standard positive yield-exchange rate relation, primarily driven by the risk premium channel, dampens during auctions as bond yields increasingly reflect convenience yields. These findings highlight the pivotal role of liquidity preferences in the joint dynamics of government bonds and exchange rates.

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# 1 Introduction

A well-established observation in international finance is the positive relation between bond yields and exchange rates: when domestic bond yields rise relative to foreign yields, the domestic currency typically appreciates.[1] However, recent liquidity events have challenged this relation. During the UK Gilt crisis in late 2022, rising Gilt yields coincided with a sharp depreciation of the sterling. Similarly, in March 2020, several emerging market currencies depreciated even as domestic bond yields rose. Such episodes suggest that additional economic forces influence the yield-exchange rate relation during periods of liquidity stress.

Central to this complex yield-exchange rate relation is the demand for government bonds. Studies have found that government bond demand from investors significantly affects domestic bond yields (Bernanke et al., 2004) and exchange rates (Aldunate et al., 2023). Evidence from large-scale asset purchases further supports this connection, showing how shifts in government bond demand can move both Treasury yields and the dollar exchange rate simultaneously (Neely, 2011). Yet, a critical question remains: How do shifts in bond demand affect the yield-exchange rate relation?

This paper studies the effect of government bond demand on yields and exchange rates by exploiting the structure of government bond auctions across advanced economies. Because authorities announce bond supplies before auctions, unexpected variations in auction outcomes provide a clear identification of demand shocks. Using this empirical strategy, I uncover two distinct transmission channels for bond demand: the risk premium channel, which lowers domestic bond and foreign currency risk premiums, resulting in lower bond yields and domestic currency depreciation; and the convenience yield channel, which enhances the value of domestic safe assets, leading to lower yields and currency appreciation.

[1] Greenwood et al. (2023) provide empirical evidence showing that contemporaneous exchange rate movements react similarly to changes in long-term interest rate differentials as they do to changes in short-term interest rate differentials. Lustig et al. (2019) document that the carry trade using long-term bonds is unprofitable, as exchange rate appreciation is offset by negative return differentials in long-term bonds, resulting in an insignificant average excess return.

To formalize these channels, I develop a quantity-based portfolio choice model extending Greenwood et al. (2023). The model includes both short-term and long-term bonds across two currencies. It features two types of investors: global bond investors, who trade across markets, and habitat investors, who specialize in their home bonds. Global bond investors, as the marginal investors, optimize mean-variance portfolios with an added preference for holding safe assets. Their portfolio decisions reflect both risk-return tradeoffs and the value of holding liquid securities. Habitat investors, meanwhile, have an inelastic demand for home bonds that follows an exogenous liquidity preference.

The model reveals how increases in bond demand affect yields and exchange rates through the risk premium and convenience yield channels. The risk premium channel reduces global investors' exposure to interest rate risk. As demand rises, the quantity of bonds that intermediaries must bear to clear the market decreases, lowering their overall risk exposure. This diminished exposure reduces the required risk premium on domestic bonds, leading to lower yields. The reduction in the bond risk premium also affects foreign exchange, since both assets are exposed to interest rate risk. Consequently, the required return for holding foreign currency decreases, resulting in domestic currency depreciation.

In contrast, the convenience yield channel enhances the value of domestic safe assets. As investors value government bonds for their liquidity and safety, higher demand raises the "convenience yield"—a premium reflecting the bonds' liquidity benefits. This rise in convenience yield further lowers bond yields while appreciating the domestic currency, as heightened demand for domestic bonds also boosts the perceived liquidity value of the currency. These dynamics highlight the opposing effects of the risk premium and convenience yield channels on exchange rates.

The model generates several testable predictions for the empirical analysis. First, a positive demand shock lowers bond yields through both the risk premium and convenience yield channels. Second, such a shock reduces both bond and FX risk premiums while increasing the convenience yield on domestic government bonds. Third, the impact of the shock on exchange rates depends on the relative strength of these two opposing channels. Finally, the model predicts that when variations in liquidity preference are substantial, the standard positive correlation between yields and exchange rates may weaken or even reverse.

Testing these theoretical predictions empirically presents an identification challenge, as bond demand and asset prices are equilibrium outcomes determined simultaneously. To address this challenge, I exploit the institutional features of government bond auctions across G10 economies. These auctions provide a unique setting in which demand surprises can be isolated from supply effects, because supply-side details such as issuance size and security characteristics are typically announced days in advance of the auction dates. I focus on 10-year government bond auctions, which offer the most prevalent and consistent issuance across countries for long-term bonds.

The primary measure of bond demand used in this paper is the bid-to-cover ratio, defined as the total bid amount divided by the issuance size. This ratio comprehensively captures demand by aggregating all investor bids in an auction. Its construction makes it particularly effective at revealing the liquidity aspect of government bond demand that extends beyond price sensitivity. By including bids below the cutoff price and non-competitive bids that are relatively price-inelastic, the measure reflects investors' underlying preference for the bonds' liquidity and safety features rather than purely yield-seeking motives.

The bid-to-cover ratio exhibits cross-sectional and time-series consistencies which make its deviations a reliable measure of demand shifts. While average bid-to-cover ratios show significant cross-country heterogeneity—with notably higher levels in Australian, Japanese, and New Zealand government bond auctions—deviations from country-specific averages remain remarkably stable across nations. This stability suggests that cross-sectional heterogeneity in bid-to-cover ratios is largely persistent, allowing me to focus on changes in the ratio as a consistent measure of demand innovations across countries. Furthermore, after controlling for the average ratio of past auctions, most traditional determinants of bond demand such as coupon rates, financial conditions, and macroeconomic variables lose their explanatory power, suggesting that deviations in the bid-to-cover ratio primarily reflect unexpected shifts in government bond demand.

Using changes in the bid-to-cover ratio, I examine how unexpected shifts in bond demand affect yields and exchange rates. I find that a higher bid-to-cover ratio in government bond auctions is associated with a lower 10-year benchmark bond yield and domestic currency appreciation. Several pieces of evidence support a causal interpretation of these demand effects. First, domestic bond yields exhibit no anticipatory response to the bid-to-cover ratio before the auction, indicating that this measure captures demand surprises. Second, yield responses are significant and persist post-auction. Third, U.S. Treasury yields, as a benchmark foreign yield, show only weak responses to these demand surprises, suggesting that the shifts primarily reflect demand for domestic rather than foreign bonds. Additionally, domestic currency begins appreciating on the auction day as the bid-to-cover ratio rises and continues to strengthen thereafter. These findings challenge the standard positive yield-exchange rate relationship: while higher demand lowers domestic bond yields, it strengthens the domestic currency. This pattern suggests that the convenience yield channel outweighs the risk premium channel in response to demand shocks, aligning with the model's prediction when investors derive strong liquidity value from holding government bonds.

Examining the term structure response to changes in the bid-to-cover ratio, I find that bond demand impacts yields in a distinctive 'localized' pattern. Specifically, yield changes are more pronounced at longer maturities, aligning with the model's prediction of demand shifts driven by habitat investors (Vayanos and Vila, 2021). This localized effect supports the identification of demand shocks, distinguishing them from market-wide factors that would likely affect yields more uniformly across maturities.

In contrast to the localized response in yields, the effect on convenience yields exhibits a global pattern across maturities. A higher bid-to-cover ratio for a long-term bond auction leads to higher convenience yields for domestic government bonds at both short and long tenors. The results are robust under various convenience yield measures, including Treasury bases, OIS-sovereign spreads, and investment-grade corporate bond-sovereign spreads. The distinct patterns in yields versus convenience yields are particularly informative about the nature of bond demand revealed at auctions: while the yield impact reflects maturity-specific demand from habitat investors, the uniform increase in convenience yields suggests that such demand reflects a broader preference for the liquidity and safety benefits provided by domestic government securities.

To better understand the mechanisms driving these results, I further decompose exchange rate innovations into three news components following Jiang et al. (2021): news about interest rate differentials, foreign exchange risk premiums, and convenience yield differentials. The variance decomposition of the news components shows that on auction days, convenience yield news becomes relatively more important compared to risk premium news. Specifically, the variance of convenience yield news exceeds that of risk premium news on auction days, while the opposite holds true on non-auction days.

Regression results of the exchange rate news components indicate that a unit increase in the bid-to-cover ratio appreciates the domestic currency by approximately 16 basis points. Additionally, it raises the convenience yield news by 16.7 basis points while reducing the risk premium news by 0.7 basis points. The appreciation driven by higher convenience yields is partially offset by the negative effect on risk premium news, consistent with the model's prediction that bond demand operates through both channels with opposing effects on exchange rates.

Changes in the yield-exchange rate relation during auctions further support the dual-channel framework. While bond yields positively correlate with exchange rates on both auction and non-auction days, this relation weakens during auctions. Specifically, a one percentage point increase in the 10-year government bond yield corresponds to a 0.9% appreciation in the domestic currency on auction days, compared to 1.6% on non-auction days. This dampened response is primarily due to a stronger negative relation between yields and convenience yield news during auctions, while the yield-risk premium relation remains stable. These findings suggest that as bond demand is revealed through auctions, yield changes increasingly reflect information about convenience yields, weakening the standard risk premium-driven yield-exchange rate relation.

I discuss several alternative explanations for the findings. One concern is that exchange rate movements could be driven by FX flows linked to bond demand, particularly if foreign investors dominate auctions. Theoretically, however, the positive effect of bond demand on the exchange rate does not require positive FX flows. Empirically, while foreign institutions exhibit positive flows with high auction demand, FX trading is minimal following these auctions, and FX flows do not significantly explain exchange rate movements during auctions. These results suggest that investors likely trade currency prior to the auction, with the auction itself revealing information about liquidity preference rather than FX flows. I also consider intermediary constraints and macroeconomic fundamentals as potential drivers. Tests using proxies for dealer banks' balance-sheet constraints, such as CIP deviations and market volatility, indicate that these constraints do not significantly affect the relationship between auction demand and asset prices. Additionally, while auction outcomes might reflect macro fundamentals, this explanation requires additional assumptions about the primary market participants, and could be challenging to reconcile with the negative conditional covariance between yields and exchange rates observed following the auction results.

**Related literature** The paper contributes to the active research that examines the effect of safe asset demand on exchange rates. Maggiori (2017) and Gourinchas and Rey (2022) demonstrate the "exorbitant duty" of reserve currencies, in which these currencies appreciate during bad times when global demand for safe assets increases. Engel (2016) investigates the forward premium puzzle and the persistent appreciation of high-interest-rate currencies, suggesting that liquidity demand could jointly explain these empirical regularities. Valchev (2020) offers an explanation of the uncovered interest rate parity (UIP) puzzle across different time horizons through bond convenience yields. Koijen and Yogo (2020) use a demand system approach to quantify the impact of latent asset demand on exchange rates. Jiang et al. (2021) show that the convenience yield derived by foreign investors from holding U.S. safe assets is linked to dollar appreciation, followed by subsequent depreciation. Engel and Wu (2023) provide strong empirical evidence that convenience yields for government bonds explain exchange rate movements across advanced economies. Kekre and Lenel (2024) find that flight-to-safety demand for dollar bonds induces dollar appreciation and a negative risk premium on dollar bonds. Jiang et al. (2024) incorporate safe asset demand for dollar bonds to explain exchange rate puzzles. By investigating government bonds in advanced economies beyond US Treasuries, this paper contributes to the literature by proposing that domestic safe asset demand influences exchange rates through two opposing channels: it reduces the risk premium but simultaneously increases convenience yields. The net impact of safe asset demand on exchange rates hinges on the relative strength of these channels, which may not always lead to domestic currency depreciation.[2]

The paper is closely related to the growing literature that explores the relation between bond yields and exchange rates. Lewis (2011) provides a comprehensive survey on the foreign exchange and bond markets. For relevant studies, Backus et al. (2001), Ahn (2004), Brennan and Xia (2006), Anderson et al. (2010), and Sarno et al. (2012) characterize exchange rate dynamics using affine models of the term structure of interest rates. Ang and Chen (2010) find that yield curve predictors significantly forecast foreign exchange risk premiums. Lustig et al. (2011) argue that exchange rate risk premiums are determined by exposure to a global "slope" factor, with interest rates measuring this exposure across countries. Studies by Ang

[2] Additionally, the paper is connected to the broad and expanding literature on asset demand and exchange rates. Kouri (1981) and Branson and Henderson (1985) introduce asset demand as a source of exchange rate variations. Brennan and Cao (1997) find a positive contemporaneous relationship between capital flows and stock returns, with mixed evidence on exchange rates. Evans and Lyons (2002) link exchange rate movements to foreign exchange order flow, showing that demand in currency markets can drive short-term exchange rate fluctuations. Hau and Rey (2004), Hau and Rey (2006), and Camanho et al. (2022) find that exchange rates are positively correlated with net equity flows but negatively associated with equity returns, supporting the portfolio rebalancing channel. Blanchard et al. (2005) proposes a model where asset demand shocks unrelated to fundamentals correspond to dollar appreciation. Froot and Ramadorai (2005) decompose exchange rate movements, finding that institutional flows driven by demand shocks cause temporary deviations from intrinsic values. Bräuer and Hau (2022) and Liao and Zhang (2024) suggest that currency hedging demand explains exchange rate movements. Du and Huber (2024) empirically estimate the demand for dollar assets and hedge ratios using a comprehensive dataset of institutional holdings.

and Chen (2010), Chen and Tsang* (2013), Boudoukh et al. (2016), Lustig et al. (2019), and Chernov and Creal (2023) demonstrate that yield curve variables are significant predictors of currency returns. This paper examines the relation between bond yields and exchange rates through the lens of government bond demand.

The paper also relates to research on the role of limited risk-bearing capacity in the foreign exchange market. Maggiori (2017) show that limited risk-bearing capacity among financial intermediaries leads to exchange rate movements in response to capital flows. Fang and Liu (2021) build a quantitative model to analyze the impact of financial intermediary constraints on exchange rates. Itskhoki and Mukhin (2021) incorporate asset demand shocks in partially segmented financial markets to explain exchange rate puzzles. Du et al. (2023) identify the price of risk related to tightening intermediary constraints through violations of Covered Interest Parity (CIP) in foreign exchange markets. An and Huber (2024) show that financial intermediaries with limited risk-bearing capacity require compensation for holding non-diversifiable risks induced by currency trades, and the resulting increases in risk premiums transmit to various asset classes, including Treasury bonds, that are exposed to these commonly priced risks. The theoretical framework of this paper closely aligns with Gourinchas et al. (2022) and Greenwood et al. (2023), who develop models of currency and bond markets involving preferred-habitat investors and arbitrageurs with limited risk-bearing capacity. These models examine the interest rate-exchange rate relation and the effects of monetary policies, such as quantitative easing (QE), on yields and exchange rates. A key distinction in this paper's model is the inclusion of liquidity preferences for arbitrageurs, with demand shocks reflecting the liquidity value for government bonds.[3]

Finally, the paper complements existing research on demand in government debt auctions. Hortaçsu and Kastl (2012) estimate the bond demand using detailed data from Canadian Treasury auctions and discuss the informational advantages of primary dealers. Lou et al. (2013) find a hump-shaped pattern in bond yields around U.S. Treasury auctions due to

[3] Another closely relevent studies examine how the limited risk-bearing capacity among financial intermediaries in the FX market have real impact on the corporations, for example, Jung (2023) and Keller (2024).

market frictions, such as limited risk-bearing capacity among intermediaries and slow-moving capital from investors. Beetsma et al. (2018) show that higher excess demand, measured by the bid-to-cover ratio in Euro-area government bond auctions, is associated with lower post-auction yields. Beetsma et al. (2020) examine the determinants of bid-to-cover ratios. Allen et al. (2020) and Albuquerque et al. (2024) analyze demand elasticity for government bonds using auctions. Phillot (2021) identifies Treasury supply shocks by using a narrow window around Treasury auction announcements. Ray et al. (2024) use auction demand to calibrate a New Keynesian preferred-habitat model to study the effects of quantitative easing (QE). Cole et al. (2024) investigate strategic complementarities in information acquisition for safe assets in Euro-area sovereign debt auctions.

The rest of the paper is organized as follows. Section 2 presents the theoretical framework. Section 3 takes the theory to the empirical examinations in the setting of government bond auctions. Section 4 shows the empirical results. Section 5 presents the exchange rate decomposition. Section 6 discusses the empirical results. Section 7 concludes. The Appendix provides derivations of the model equilibrium, and additional empirical results.

## 2 Model

In this section, I develop a quantity-based model with two countries to demonstrate the effect of government bond demand on bond yields and exchange rates. The analysis reveals that bond yields and exchange rates are affected by two channels of bond demand: the risk premium, arising from limited arbitrage, and the convenience yield, shaped by liquidity preference. These theoretical channels help reconcile the empirical findings documented in this paper: a positive shift in government bond demand is associated with lower bond yields, stronger domestic currency, and higher convenience yields for domestic government bonds across maturities.

The theoretical framework is a discrete-time model with linearized asset prices that builds on Greenwood et al. (2023) in two key aspects. First, shifts in bond demand affect not only the net supply of bonds but also their liquidity value. Second, marginal investors derive liquidity benefits from holding domestic and foreign safe assets.

## 2.1 Setup

### 2.1.1 Assets

Consider an economy with four assets: domestic and foreign bonds, each with both short- and long-term maturities.

**Short-term interest rates** Short-term interest rates are denoted by $i_t$ and $i_t^f$ for domestic and foreign rates, respectively. The evolution of the short-term interest rates is given by:

$$i_{t+1} = \bar{i} + \phi_i \left(i_t - \bar{i}\right) + \epsilon_{i,t+1}, \quad i_{t+1}^f = \bar{i} + \phi_i \left(i_t^f - \bar{i}\right) + \epsilon_{i,t+1}^f,$$

where $\bar{i} > 0$, $\phi_i \in (0,1)$, and $\mathrm{Var}_t[\epsilon_{i,t+1}] = \mathrm{Var}_t[\epsilon_{i,t+1}^f] = \sigma_i^2$. The correlation between $\epsilon_{i,t+1}$ and $\epsilon_{i,t+1}^f$ is denoted by $\rho \in [0,1]$.

**Long-term government bonds** Long-term bonds are modeled as perpetuities with coupon $K$.[4] The return approximation around $y = \log(K+1)$ is given by:

$$r_{t+1}^y \approx y_t - \frac{\delta}{1-\delta}(y_{t+1} - y_t), \quad \text{where } \delta = \frac{1}{K+1}.$$

The bond excess return is defined as:

$$rx_{t+1}^y = r_{t+1}^y - i_t.$$

**Foreign exchange** The exchange rate is denoted as $Q_t$, in units of foreign currency per unit of domestic currency, and $q_t$ is the log of the exchange rate. The excess return on foreign

[4] The log-linear approximation to the return for coupon bonds follows Greenwood et al. (2018).

currency is approximately:

$$rx^q_{t+1} \approx (q_t - q_{t+1}) + (i^f_t - i_t).$$

### 2.1.2 Liquidity Preference and Bond Demand

Each country has habitat investors, who exclusively invest in their home bonds. Their demand for long-term bonds follows the exogenous processes of liquidity preferences over holding domestic and foreign long-term bonds, $\lambda_t$ and $\lambda^f_t$ respectively:

$$\lambda_{t+1} = \bar{\lambda} + \phi_s(\lambda_t - \bar{\lambda}) + \epsilon_{\lambda,t+1}, \quad \lambda^f_{t+1} = \bar{\lambda} + \phi_s(\lambda^f_t - \bar{\lambda}) + \epsilon^f_{\lambda,t+1}$$

where $\text{Var}_t[\epsilon_{\lambda,t+1}] = \text{Var}_t[\epsilon^f_{\lambda,t+1}] = \sigma^2_\lambda$, and the two processes are orthogonal.

### 2.1.3 Residual Bond Supply

The residual supplies of domestic and foreign long-term bonds evolve as follows:

$$\hat{s}_{t+1} = \bar{s} + \phi_s(\hat{s}_t - \bar{s}) + \epsilon_{s,t+1}, \quad \hat{s}^f_{t+1} = \bar{s} + \phi_s(\hat{s}^f_t - \bar{s}) + \epsilon^f_{s,t+1}$$

where $\text{Var}_t[\epsilon_{s,t+1}] = \text{Var}_t[\epsilon^f_{s,t+1}] = \sigma^2_s$. The two processes are orthogonal to each other, and are also orthogonal to liquidity preference processes.[5]

### 2.1.4 Net Bond Supply

The net supplies of domestic and foreign bonds are defined as the residual bond supplies minus the liquidity demand from habitat investors. Thus, the net bond supply processes are given by:

$$s_t = \hat{s}_t - \lambda_t, \quad s^f_t = \hat{s}^f_t - \lambda^f_t.$$

[5] Note that the residual bond supply represents the net of supply and demand for bonds which includes demand shocks unrelated to changes in the liquidity preference $\lambda_t$. For example, an increase in noise traders' demand for domestic government bonds that is independent of the liquidity demand would lead to a decrease in the residual bond supply.

The net bond supply incorporates both bond demand from liquidity preferences and residual supply, which are absorbed by marginal investors in market clearing.

## 2.2 Global Bond Investors

Global bond investors choose their portfolio holdings to maximize the following objective function:

$$\max_{\mathbf{d}_t} \left\{ \mathbf{d}_t' E_t \left[ \mathbf{rx}_{t+1} \right] - \frac{1}{2\tau} \mathbf{d}_t' \text{Var}_t \left[ \mathbf{rx}_{t+1} \right] \mathbf{d}_t \right\} + m(\mathbf{d}_t),$$

where $m(\mathbf{d}_t)$ represents the investor's liquidity preference over holding domestic and foreign safe assets, which is defined as:

$$m(\mathbf{d}_t) = \gamma \left[ (1-\eta)\lambda_t d_t^y + (1-\eta)\lambda_t^f d_t^{y^f} + \eta(\lambda_t^f - \lambda_t) d_t^q \right].$$

The vector $\mathbf{d}_t = (d_t^y, d_t^{y^f}, d_t^q)'$ is the market values of bond and FX holdings. The parameter $\tau > 0$ is the risk tolerance, $\gamma \geq 0$ is the liquidity preference parameter, and $\eta \in (0, 1)$ is the relative liquidity value of short-term bonds.

### 2.2.1 Discussion: Liquidity Preference and Bond Demand

An important assumption in this model is that the demand for government bonds reflects the liquidity preference for holding safe assets. This assumption is valid because government bonds are inherently safe assets. For example, the unique nature of government bonds—backed by government authority, particularly in advanced economies—makes them insensitive to private information and less prone to adverse selection (Gorton and Pennacchi, 1990). Government debt also offers pledgeability that private firms cannot ensure during periods of aggregate uncertainty (Holmström and Tirole, 1998). Additionally, these bonds often hold collateral value, allowing them to be readily converted into short-term funding, which further reinforces their role as safe assets (Dang et al., 2020). While the model does not specify an exact mechanism by which government bond demand signals liquidity preference, it implicitly relies on the foundational properties of government bonds.[6]

For simplicity, it is assumed that habitat investors' bond demand is inelastic to bond prices, allowing the analysis to focus on the channels through which demand affects equilibrium properties. If, instead, habitat investors' bond demand were price-elastic, a liquidity preference shock that raises bond prices could reduce the quantity demanded by these investors. This would result in lower overall demand from habitat investors, thereby dampening the risk premium channel. Consequently, we would expect a more moderate response in bond yields but a stronger appreciation in the domestic exchange rate.

In this model, short-term interest rates are assumed to be unaffected by changes in liquidity preference. The liquidity preference is associated with the holdings of government bonds. As the global investors choose holdings to optimize their objective function, the marginal liquidity benefit is reflected into equilibrium returns. The liquidity preference in the model is closely related to Krishnamurthy and Vissing-Jorgensen (2012), which considers a model in which agents derive utility from their holdings of government debt. More generally, the liquidity preference can be associated with a wedge in the Euler equation for assets, as in Jiang et al. (2021). A larger wedge reflects a higher convenience yield valued by marginal investors, leading to lower expected returns than in a scenario where the Euler equation holds without such a wedge.[7]

The parameter $\gamma \geq 0$ ensures the liquidity preference for the global bond investors. Notably, if marginal investors derive no liquidity benefit from holding assets (i.e., $\gamma = 0$), the model collapses to the baseline model in Greenwood et al. (2023). In this case, the convenience yield channel is inactive, and liquidity preference affects the asset prices only through its effect on the risk-bearing capacity of global bond investors.

Another key parameter $\eta$ is the relative liquidity value of short-term versus long-term bonds. Critically, this parameter determines the extent to which liquidity preference for

[6] Gorton (2017) provides a great review of the history and literature on safe assets, including sovereign debt.
[7] Similarly, there is an emerging strand of asset pricing literature that examines how shifts in preferences influence equilibrium returns. For example, Pástor et al. (2021) show a model in which ESG preferences affect expected returns on green assets.

holding long-term bonds is transmitted to short-term assets, including currency. In the model, I assume $0 < \eta < 1$, i.e., there is a positive yet imperfect transmission of liquidity preference from long-term to short-term bonds. If $\eta = 1$, short-term bills would be perfect substitutes in terms of liquidity value. In this limiting case, a liquidity preference shock would increase the liquidity value of short-term assets as well as domestic currency, but not the relative liquidity value of long-term bonds.

## 2.3 Equilibrium

The demand of global bond investors satisfies:

$$E_t\left[\mathbf{rx}_{t+1}\right] = \tau^{-1}\mathrm{Var}_t\left[\mathbf{rx}_{t+1}\right]\mathbf{d}_t - m'(\mathbf{d}_t),$$

where $m'(\mathbf{d}_t)$ is the derivative of the liquidity preference function. In equilibrium, bond and FX markets clear:

$$d_t^y = s_t, \quad d_t^{y^f} = s_t^f, \quad d_t^q = 0.$$

An equilibrium for the model is characterized by allocations $\{d_t^y, d_t^{y^f}, d_t^q\}$ and prices $\{y_t, y_t^f, q_t\}$ such that (1) given prices, the allocation satisfies the optimality condition of global bond investors, and (2) markets clear for domestic and foreign bonds, as well as the foreign exchange. The equilibrium expected returns for the assets are given by

$$\begin{aligned}
E_t\left[rx_{t+1}^y\right] &= \frac{1}{\tau}\left[V_y \cdot s_t + C_{y,y^f} \cdot s_t^f\right] - \gamma(1-\eta)(\lambda_t - s_t),\\
E_t\left[rx_{t+1}^{y^f}\right] &= \frac{1}{\tau}\left[C_{y,y^f} \cdot s_t + V_y \cdot s_t^f\right] - \gamma(1-\eta)(\lambda_t^f - s_t^f),\\
E_t\left[rx_{t+1}^q\right] &= \frac{1}{\tau}\left[C_{y,q} \cdot \left(s_t - s_t^f\right)\right] - \gamma\eta(\lambda_t^f - \lambda_t).
\end{aligned}$$

where $V_y \equiv \mathrm{Var}_t[rx_{t+1}^y] = \mathrm{Var}_t[rx_{t+1}^{y^f}]$, $V_q \equiv \mathrm{Var}_t[rx_{t+1}^q]$, $C_{y,y^f} \equiv \mathrm{Cov}_t[rx_{t+1}^y, rx_{t+1}^{y^f}]$, $C_{y,q} \equiv \mathrm{Cov}_t[rx_{t+1}^y, rx_{t+1}^q] = -\mathrm{Cov}_t[rx_{t+1}^{y^f}, rx_{t+1}^q]$. The long-term bond yields and exchange rate can be expressed by iterating forward and taking expectations:

$$y_t = (1-\delta)\sum_{j=0}^{\infty}\delta^j E_t[i_{t+j} + rx^y_{t+j+1}]$$

$$y^f_t = (1-\delta)\sum_{j=0}^{\infty}\delta^j E_t[i^f_{t+j} + rx^{y^f}_{t+j+1}]$$

$$q_t = \sum_{j=0}^{\infty} E_t\left[(i_{t+j} - i^f_{t+j}) + rx^q_{t+j+1}\right]$$

The domestic long-term bond yield $y_t$ is given by:

$$y_t = \underbrace{\left\{\bar{i} + \frac{1-\delta}{1-\delta\phi_i}\cdot(i_t - \bar{i})\right\}}_{\text{Expectations hypothesis}} + \underbrace{\left\{\tau^{-1}(V_y + C_{y,y^f})\cdot(\bar{s}-\bar{\lambda})\right\}}_{\text{Steady-state bond risk premium}} - \underbrace{\left\{\gamma(1-\eta)\cdot(2\bar{\lambda}-\bar{s})\right\}}_{\text{Steady-state convenience yield}}$$

$$+ \underbrace{\left\{\tau^{-1}\frac{1-\delta}{1-\delta\phi_s}\left[V_y\cdot(\hat{s}_t - \bar{s} - (\lambda_t - \bar{\lambda})) + C_{y,y^f}\cdot(\hat{s}^f_t - \bar{s} - (\lambda^f_t - \bar{\lambda}))\right]\right\}}_{\text{Time-varying bond risk premium}}$$

$$- \underbrace{\left\{\gamma(1-\eta)\frac{1-\delta}{1-\delta\phi_s}\left[2(\lambda_t - \bar{\lambda}) - (\hat{s}_t - \bar{s})\right]\right\}}_{\text{Time-varying convenience yield}}.$$

Similarly, the foreign long-term bond yield $y^f_t$ is:

$$y^f_t = \underbrace{\left\{\bar{i} + \frac{1-\delta}{1-\delta\phi_i}\cdot(i^f_t - \bar{i})\right\}}_{\text{Expectations hypothesis}} + \underbrace{\left\{\tau^{-1}(V_y + C_{y,y^f})\cdot(\bar{s}-\bar{\lambda})\right\}}_{\text{Steady-state bond risk premium}} - \underbrace{\left\{\gamma(1-\eta)\cdot(2\bar{\lambda}-\bar{s})\right\}}_{\text{Steady-state convenience yield}}$$

$$+ \underbrace{\left\{\tau^{-1}\frac{1-\delta}{1-\delta\phi_s}\left[V_y\cdot(\hat{s}^f_t - \bar{s} - (\lambda^f_t - \bar{\lambda})) + C_{y,y^f}\cdot(\hat{s}_t - \bar{s} - (\lambda_t - \bar{\lambda}))\right]\right\}}_{\text{Time-varying bond risk premium}}$$

$$- \underbrace{\left\{\gamma(1-\eta)\frac{1-\delta}{1-\delta\phi_s}\left[2(\lambda^f_t - \bar{\lambda}) - (\hat{s}^f_t - \bar{s})\right]\right\}}_{\text{Time-varying convenience yield}}.$$

The foreign exchange rate $q_t$ is given by:

$$q_t = \underbrace{\left\{ \frac{1}{1-\phi_i} \cdot \left( i_t - i_t^f \right) \right\}}_{\text{Uncovered interest rate parity}} + \underbrace{\left\{ \tau^{-1} \frac{1}{1-\phi_s} C_{y,q} \cdot \left( \hat{s}_t - \lambda_t - (\hat{s}_t^f - \lambda_t^f) \right) \right\}}_{\text{FX risk premium}} + \underbrace{\left\{ \frac{\gamma\eta}{1-\phi_s} \left( \lambda_t - \lambda_t^f \right) \right\}}_{\text{Convenience yield difference}}.$$

The equilibrium is a system of four equations with four unknowns. Appendix A.2 provides the complete model solutions. Interpreting the equilibrium effects can be challenging when both demand and residual supply risks are present. To clarify the intuition and provide testable predictions from the model, I examine simplified cases in the following sections.

## 2.4 Propositions and Empirical Implications

I present propositions based on two simplified cases that allow us to derive empirical implications from the model. The first case examines a setting without liquidity preference or residual supply risk. I then extend to a case that includes liquidity preference risk. Lastly, I outline several testable predictions to guide the empirical analysis.

### 2.4.1 Case without Liquidity Preference and Residual Supply Risk

First, solving for the solutions of $V_y$, $V_q$, $C_{y,y^f}$, and $C_{y,q}$ in a limiting case where there is no bond supply risk ($\sigma_s = 0$, $\sigma_\lambda = 0$). The limiting case provides an insightful outlook on the comparative statics, that can be carried forward to the general cases.

**Proposition 1** *If $\sigma_s^2 = \sigma_q^2 = 0$ and $\rho \in [0, 1)$, then in the equilibrium,*

$$V_y = \left( \frac{\delta}{1-\delta\phi_i} \right)^2 \sigma_i^2 > 0, \quad V_q = 2 \left( \frac{1}{1-\phi_i} \right)^2 (1-\rho)\sigma_i^2 > 0,$$

$$C_{y,y^f} = \rho \left( \frac{\delta}{1-\delta\phi_i} \right)^2 \sigma_i^2 \geq 0, \quad C_{y,q} = (1-\rho) \frac{\delta}{1-\delta\phi_i} \cdot \frac{1}{1-\phi_i} \sigma_i^2 > 0.$$

*The change in bond yield and exchange rate with respect to the change in liquidity preference* *is given by*

$$\frac{\partial y_t}{\partial \lambda_t} = -\frac{1-\delta}{1-\delta\phi_s}\left[\tau^{-1}V_y + 2\gamma(1-\eta)\right] < 0,$$
$$\frac{\partial q_t}{\partial \lambda_t} = \frac{\tau^{-1}}{1-\phi_s}(\tau\gamma\eta - C_{y,q})$$

*and* $\frac{\partial q_t}{\partial \lambda_t} > 0$ *when*

$$\gamma\eta > \frac{\tau^{-1}\delta}{1-\delta\phi_i}\left(\frac{1}{1-\phi_i}\right)(1-\rho)\sigma_i^2.$$

**Proof.** See Appendix A.2 ■

Proposition 1 in the model provides key insights into how bond demand influences bond yields and exchange rates in scenarios without bond demand or residual bond supply risk. Specifically, an exogenous change in demand for domestic long-term bonds, $\Delta\lambda_t$, affects domestic bond yields and exchange rates through two main channels: the risk premium channel and the convenience yield channel.

The risk premium channel operates as follows: An increase in bond demand reduces the quantity of bonds that global bond investors must hold to clear the market. With fewer bonds in their portfolios, these investors face less exposure to interest rate risk. Given their limited risk-bearing capacity (i.e., $\tau > 0$), the interest rate risk premium they require for holding domestic bonds—proportional to their bond holdings—declines. Consequently, higher bond demand lowers the bond risk premium on domestic long-term bonds, leading to a decrease in the equilibrium domestic bond yield.

Moreover, since both domestic bonds and foreign exchange are exposed to interest rate risk, the reduction in the interest rate risk premium from higher domestic bond demand also lowers the required return on foreign currency holdings. As a result, increased bond demand causes the domestic currency to depreciate.

The convenience yield channel, however, operates through liquidity preference: An increase in government bond demand reflects a stronger liquidity preference for holding domestic safe assets. This preference raises the convenience yield on domestic assets, including both domestic bonds and domestic currency. As the convenience yield rises, the equilibrium yield on domestic bonds decreases further, while the value of the domestic currency appreciates.

While both channels contribute to a reduction in the domestic bond yield, they have opposing effects on the exchange rate: the risk premium channel leads to a depreciation of the domestic currency, whereas the convenience yield channel results in an appreciation. The overall effect critically depends on the relative magnitude of the two channels. The proposition underscores the complex effect of government bond demand on the relation between bond yields and exchange rates.

### 2.4.2 Case with Liquidity Preference Risk

In this limiting case where bond supply and demand risks are absent, the equilibrium covariance between bond and foreign currency risk premiums is positive ($C_{yq} > 0$), indicating a positive correlation between yields and exchange rates. This positive covariance arises because short-term interest rates are the sole source of variation. Under what conditions, however, might we observe a negative yield-exchange rate covariance? To explore this, I introduce variations in liquidity preference to examine scenarios under which a negative covariance may emerge.

**Proposition 2** *If $\sigma_s^2 = 0$ and $\sigma_\lambda^2 > 0$, then in any stable equilibrium:*

$$\frac{\partial q_t}{\partial \lambda_t} = \frac{\tau^{-1}}{1-\phi_s}(C_{y,q} - \tau\gamma\eta),$$

*and $\frac{\partial q_t}{\partial \lambda_t} > 0$ when*

$$\gamma\eta > \frac{\tau^{-1}\delta}{1-\delta\phi_i}\left(\frac{1}{1-\phi_i}\right)(1-\rho)\sigma_i^2.$$

*In addition, if the above condition is satisfied, then $C_{y,q}$ decreases with $\sigma_\lambda^2$ in any stable equilibrium. Furthermore, $C_{y,q} < 0$ only if the condition above holds.*

**Proof.** See Appendix A.2. ■

Proposition 2 demonstrates that when there are variations in liquidity preference, shocks to government bond demand influence exchange rates similarly to the limiting case without bond supply and demand risk. However, in this more general setting, the covariance between bond yields and exchange rates depends critically on the balance between the risk premium and convenience yield channels. Specifically, when the convenience yield channel dominates, increased variations in liquidity preference can dampen the positive relation between yields and exchange rates, and may even turn it negative.

The proposition also suggests that a negative relation between bond yields and exchange rates is possible only when the convenience yield effect is sufficiently strong. This result emphasizes that the nature of the yield-exchange rate relation depends not only on government bond demand shocks but also on the relative strength of the convenience yield channel compared to the risk premium channel.

Interestingly, if the equilibrium covariance between yields and exchange rates is negative, that is, $C_{y,q} < 0$, the implication of a bond demand shock on risk premium will be reversed: a positive shock in $\lambda_t$ will appreciate the currency $q_t$ via a higher FX risk premium. This is because when the equilibrium covariance turns negative, the domestic bonds become a hedging asset for the foreign domestic currency. A positive demand shock reduces the supply of assets that hedge exchange rate risk for global arbitrageurs, leading to larger compensation requested for holding foreign assets.

### 2.4.3 Testable Predictions

The model propositions deliver several testable predictions about the effect of bond demand on bond yields and exchange rates. Specifically, when $\sigma_s^2 = 0$, $\sigma_\lambda^2 > 0$, and $C_{y,q} \geq 0$, the model generates the following predictions:

1. *A positive shock to bond demand reduces domestic bond yields:* $\frac{\partial y_t}{\partial \lambda_t} < 0$.

2. *A positive bond demand shock reduces the FX risk premium, and raises the convenience yields for domestic government bonds and currency.*

3. *The overall effect of a positive bond demand shock on exchange rate* $q_t$ *depends on the*

*relative strength of the two channels: if the convenience yield effect dominates, the domestic currency appreciates; otherwise, the domestic currency depreciates.*

4. *The yield-exchange rate covariance $C_{y,q}$ is dampened with an increase in $\sigma_\lambda^2$ if the convenience yield effect dominates, i.e, if $\frac{\partial q_t}{\partial \lambda_t} > 0$.*

The above predictions provide guidance for the empirical analysis in the following sections, specifically regarding the impact of bond demand shocks on yields and exchange rates. To empirically test these predictions, I leverage data from government bond auctions, using demand shocks observed in these auctions to identify their effects on bond yields and exchange rates. In the next section, I will outline the empirical strategy and detail how auction data are used to test these theoretical implications.

# 3 Empirical Settings and Data

This section presents the empirical settings for testing how bond demand shocks affect yields and exchange rates, using government bond auctions in G10 economies. These auctions enable the isolation of demand shocks due to pre-announced supply details. The bid-to-cover ratio serves as the primary measure of government bond demand at auctions. I describe the auction structure, data sources, and key determinants of the bid-to-cover ratio.

## 3.1 Government Bond Auctions

A key setting in the empirical examination is to study government bond auctions in G10 economies. Government bond auctions provide an ideal environment to isolate demand surprises from supply-side factors, because the supply information has been revealed days prior to the auction.

Figure 1 illustrates the timeline of key events leading up to a typical government bond auction. There are three key landmarks in and prior to the bond auction. First is the fiscal plan for government debt, in which the governments layout the planned issuance dates and the proposed issuance sizes for each tenor category. The fiscal plan for government debt is usually proposed at year or quarter ends as a part of the government budget with the intent of reducing the uncertainty in debt supplies. Second is the auction announcement, in which the governments announce the details of bond issuance, such as issuance size, bond maturities, and coupon rates. The announcement is made days before the auction. Note that the announced issuance size can be different from the one proposed in the fiscal plan due to changes in government budget balances. Third is the auction. During the auction, bidders submit their bids to the auctioneer (i.e. the government) within a given time frame. The auction result is released shortly after the bond auction. Successful bids are notified and corresponding bidders receive allotted securities on the settlement or issue date. The settlement or issue date is often several days after the auction.

## 3.2 Data on Government Bond Auctions

I collect the data of government bond auction results for the G10 economies: Australia, Canada, Switzerland, Germany, UK, Japan, New Zealand, Sweden, Denmark, and Norway. In particular, I use German Federal bonds as the benchmark bonds for the Euro. I omit the auctions from two of the G10 countries. First, I omit Danish government bonds due to its currency pegging with the Euro. And second, I subtract Swiss Federal bonds because their auction announcement takes place on the same day as the auction concludes, which confounds the effects of bond demand with the supply.

For the main analysis, I focus on 10-year government bond auctions.[8] 10-year government bonds are the most commonly and consistently issued long-term bonds across countries. Further, 10-year bond auctions reflect more closely the demand from investors from specific habitats, such as pension funds, insurance companies, and investment funds. The demand effect from 10-year bonds are also relatively less perturbed by conventional monetary policies compared to short-term bonds.[9] For bonds that do not have an official 10-year tenor

[8] In a robustness test which includes 5 to 10 year government bond auctions as the testing sample, the main results on the bid-to-cover ratio hold for yields and exchange rates after the auction.

[9] The effect of short-term government bills are subject to controls by monetary authorities. For example, Nagel (2016) finds that U.S. Treasury bill supplies lose their explanatory power for the liquidity premium once controlled for short-term interest rates, pointing that the central bank offsets the effect of short-term

categorization, such as Australian and New Zealand bonds, I sample the auctions for bonds that have maturities from nine to eleven years.

It is acknowledged that there is cross-country heterogeneity over the characteristics of bond auctions. For example, Norwegian bonds are auctioned under the uniform-price setting where successful bidders receive the same price despite different price schedules, while other countries are conform to the multi-price setting. Another example is the non-competitive bids. German Federal bonds, which is used as the benchmark government bond for Euro, have larger size of non-competitive bids compared to the other countries. While for some countries, the non-competitive bids are not displayed in the auction results.

Despite such cross-sectional differences, the bond auctions across these advanced economies uniformly provide a great testing environment for the demand surprises. Importantly, all of these economies provide measures to gauge the demand for government bond. One consistent measure of government bond demand is the bid-to-cover ratio, which is calculated as the total value of bids scaled by the issuance size. This measure exhibits persistence for each country of interest, where the deviations from its past auctions are stable over time. In this paper, I focus on the auctions of ten-year government bonds. This tenor has the most consistent issuance on among the long-term bond criterion across countries.

## 3.3 Other Data

G10 currency exchange rates, benchmark government bond yields, inflation-linked bond yields and breakeven inflation, and Overnight Indexed Swap (OIS) rates are from Bloomberg. The Credit Default Swap (CDS) spread data are from IHS Markit. Corporate bond yields are from Capital IQ. Intermediary capital risk factor (HKM) is from He et al. (2017). The VIX index, which is the implied volatility of the S&P 500 index, comes from the CBOE. The MSCI regional equity indexes are from Refinitiv Datastream. All financial series are reported in daily frequency, available from 2002 to 2022.

Nominal GDPs and government expenditures are sourced from FRED, which are reported

Treasury supplies.

by OECD. CPI, unemployment rates, industrial production growth are from Refinitiv Datastream. Government debt-to-GDP data are from IMF Global Debt Database. The macroeconomic series are available from 2002 to 2022.[10]

The government debt investor base dataset, provided by Arslanalp and Tsuda (2014) via the IMF, is available from 2002 to 2022. The FX spot order flow data, sourced from CLS, covers the period from 2012 to 2021. For further details on the government debt investor base and FX order flow data, see Section 6.1.

### 3.4 Measure of Government Bond Demand: Bid-to-Cover Ratio

The bid-to-cover ratio, which is the primary measure of bond demand, defined as the total amount of bids scaled by the total issuance size for the auctioned bond:

$$\text{bid-to-cover} = \frac{\text{amount of bids}}{\text{issuance size}}$$

A higher bid-to-cover ratio reflects stronger excess demand, as it indicates greater interest from bidders that is revealed by the auction. To mitigate the issue of extreme values on the right tail, I winsorize bid-to-cover ratios at the top 5% level for each country.[11]

The bid-to-cover ratio is a quantity-based demand measure. Both numerator and denominator of this measure are in terms of face values that abstract from prices. Specifically, the total amount of bids include both competitive and non-competitive bids submitted in the auction. While competitive bids are bid schedules that correspond quantities to prices, non-competitive bids do not state a particular price or yield along with the quantities. Non-competitive bids are usually rewarded at the price based on the average price of the competitive bids. The numerator also includes bids that are lower than the cutoff price and

[10] Mbaye et al. (2018) provides a comprehensive documentation of debt database construction. The variable used in my main analysis of this paper is the central government debt in percent of GDP.

[11] In general, the distribution of the bid-to-cover ratio is right-skewed, with some instances showing extremely high values. For example, Japanese government bond auctions in the third and fourth quarters of 2004 recorded bid-to-cover ratios exceeding 65, a fact that is confirmed by the Wall Street Journal and Kyodo News reports from that time.

are not fulfilled. The total issuance size of the auctioned bond is the offering amount for the bond at auction. This implies that the ratio can be lower than one when the size of bids is smaller than the issuance, i.e. under-subscribed in the auction.[12]

Based upon its construction, the bid-to-cover ratio is able to capture the liquidity aspect of government bond demand that is beyond the sensitivity of bond prices. This is because the bid-to-cover ratio includes bond demand that are situated beyond the price regime, such as low bids that may serve for the hedging motive, and noncompetitive bids that are relatively inelastic to price movements at auction. Furthermore, abstracting the bid-to-cover ratio from prices under-weighs the price-elastic preference in the measure, making the measure more prone to measuring preference for the liquidity feature of the bond.

The bid-to-cover ratio is a widely reported metric in government bond auctions across G10 countries, serving as a standardized indicator of bond demand. Its calculation is generally consistent across these economies, making the bid-to-cover ratio a reliable and comparable measure of bond demand in the cross-country analysis. Next, I examine the cross-country heterogeneity and the determinants of this demand measure in the following section.

#### 3.4.1 Summary Statistics and Determinants of Bid-to-Cover Ratio

Table 1 provides the summary statistics of bid-to-cover ratios, as well as deviations of bid-to-cover from the average of past ten auctions ($\Delta$bid-to-cover) for each country.

The average bid-to-cover ratios are well above two, suggesting that government bond auctions usually have significant over-subscriptions for advanced economies. Furthermore, there is significant cross-country heterogeneity in the levels of bid-to-cover ratios. For instance, Australian, Japanese, and New Zealand government bond auctions have significantly larger bid-to-cover ratios compared with other countries, suggesting that their auctioned bonds are facing higher excess demand from investors given bond supplies.

However, changes in bid-to-cover ratios from their long-run averages, $\Delta$bid-to-cover, re-

[12] An exception is Norway, in which the Norges Bank reports the allotted volume instead of the issuance volume in bond auction results. That implies the reported bid-to-cover ratio is at least one, since the allotted volume is no less than the bid amount.

main consistent and stable across countries. The values do not deviate significantly from zero for any country, and the volatility is comparable across nations. This suggests that cross-sectional heterogeneity in bid-to-cover ratios is likely stable over time, making the demand measure reliable across countries. By controlling for unobserved country-specific factors and focusing on changes in the bid-to-cover ratio, I ensure a consistent measure of demand across nations.

The bid-to-cover ratio can be associated by various factors including bond characteristics as well as broader economic and financial variables. Table B.1 documents the determinants of bid-to-cover ratio. For auctioned bond characteristics, a higher coupon rate and a larger issuance size correspond to a lower bid-to-cover ratio. For financial variables, higher equity volatility and a higher CDS spread correspond to a lower bid-to-cover ratio. For economic variables, higher unemployment rate, industrial production growth, and a higher government spending correspond to a higher bid-to-cover ratio, while an increase in debt-to-GDP corresponds to a lower ratio.

After controlling for average bid-to-cover ratio for the past ten auctions, however, most of the determinants become weaker in explaining the ratio, except for change in issuance size and change in debt-to-GDP. The result suggests that the deviation of bid-to-cover ratio away from its long-run mean constitutes a demand shift for government bond.

# 4 Empirical Results

## 4.1 Effects of Bid-to-Cover Ratio on Yields and Exchange Rates

In this section, I examine how bond demand, measured by bid-to-cover ratios, affects bond yields and exchange rates.

#### 4.1.1 Baseline

To test the association between bond demand on yields and exchange rates, I conduct the regression of the following form for country $i$, auction date $t$:

$$\Delta Y_{i,t} = \alpha^Y + \gamma_i^Y + \beta^Y \Delta\text{bid-to-cover}_{i,t} + \text{controls}_{i,t} + \epsilon_{i,t}^Y$$

where $\Delta Y$ represents the dependent variable, which can be either the daily change in the 10-year bond yield $\Delta y^{(10Y)}$ or the daily change in the logged exchange rate $\Delta q$. Here, $y_i^{(10Y)}$ is the benchmark 10-year government bond yield, and $q_i$ is the log of the exchange rate in USD per unit of domestic currency $i$. $\gamma_i$ denotes country fixed effects, and $\Delta$bid-to-cover is the change in the bid-to-cover ratio relative to the average of the past ten auctions.

Control variables include coupon rates, change in bond issuance size, a US Treasury auction indicator, the bid-to-cover ratio of the latest US 10-year Treasury auction, changes in the 3-month interest rate differential, changes in the VIX, the He-Kelly-Manela capital market factor, MSCI equity returns and volatility, CPI inflation, unemployment rate, industrial production growth, government spending over GDP, and changes in the debt-to-GDP ratio. Standard errors are clustered by date.

Table 2 reports the regression results. Higher demand revealed in a 10-year domestic government bond auction, as captured by a higher bid-to-cover ratio, is associated with lower 10-year benchmark bond yields and stronger domestic currency. In the regression with yield changes, the coefficient for $\Delta$bid-to-cover is positive and statistically significant. An average one-standard deviation (0.27) increase in bid-to-cover ratio in an auction is associated with a 0.79 basis point decrease in the benchmark 10-year government bond yield based on the estimated coefficient.[13] Regressing changes in exchange rates on changes in bid-to-cover ratio, the coefficient is positive and significant, suggesting that higher excess demand for

[13] The result is comparable to empirical findings in other studies. Beetsma et al. (2018) find that with one-standard deviation increase in bid-to-cover ratio for 30-year Italian government bonds, the yield will be lower by 0.87 basis points. Ray et al. (2024) show that a one standard deviation increase in the bid-to-cover ratio in a 10-year Treasury note auction corresponds to a 1.2 basis point decline in 10-year Treasury yields.

10-year domestic government bonds leads to domestic currency appreciation. Specifically, an average one-standard deviation increase in bid-to-cover ratio in an auction is associated with a 4.05 basis point appreciation in the domestic currency. The results suggest there is an indirect and negative relation between domestic bond yields and exchange rates driven by excess bond demand, reflected by bid-to-cover ratio.

#### 4.1.2 Dynamic Effect

I examine the dynamic responses of 10-year government bond yields to the shift in demand around the auction day. I conduct the following regressions for currency $i$, auction date $t$ and days from the auction $k$:

$$\Delta y^{(10)}_{i,t-5\to t+k} = \alpha^{y,k} + \gamma_i^{y,k} + \beta^{y,k}\Delta\text{bid-to-cover}_{i,t} + \epsilon^{y,k}_{i,t-5\to t+k}$$

$$\Delta q_{i,t-5\to t+k} = \alpha^{q,k} + \gamma_i^{q,k} + \beta^{q,k}\Delta\text{bid-to-cover}_{i,t} + \epsilon^{q,k}_{i,t-5\to t+k}$$

Note that changes in bond yields are calculated as the difference from the values observed five days before the auction. Figure 2 plots the coefficients $\beta^k$ from 4 days prior to a bond auction ($k =$ -4) to 5 days after the auction ($k = 5$). Domestic bond yields respond little to the bid-to-cover ratio prior to the auction, suggesting that the measure captures a demand surprise that is revealed at the auction. The effect of bid-to-cover ratio on yields lasts for at least five days after the auction, which indicates that the effect is persistent and is less likely to be driven by mechanical frictions in the bond market. In comparison, 10-year U.S. Treasury yields, which is the benchmark for foreign yields, respond weakly to the bid-to-cover ratio in a domestic bond auction, suggesting that the effect is mostly related to demand shock for domestic bonds.

Next, I analyze the dynamic responses of exchange rates to changes in the bid-to-cover ratio during an auction. Figure 3 presents the coefficients. Similar to the responses for yields, exchange rates show insignificant responses to changes in the bid-to-cover ratio before the auction, but the currency appreciates and remains elevated following the auction. The results suggest that the bid-to-cover ratio captures the demand shock that is revealed in the auction, and a positive shock increases the value of domestic currency.

### 4.1.3 Term Structure Effect

Furthermore, I test the term structure response of domestic government bond yields on changes in bid-to-cover ratio for bond auctions. I estimate the following equation:

$$\Delta y_{i,t}^{(\tau)} = \alpha^{(\tau)} + \gamma_i^{(\tau)} + \beta^{(\tau)} \Delta \text{bid-to-cover}_{i,t} + \epsilon_{i,t}^{(\tau)}$$

where $\tau \in \{3\text{M}, 1\text{Y}, 3\text{Y}, 5\text{Y}, 7\text{Y}, 10\text{Y}\}$ is the tenor of government bonds. Figure 4 illustrates the coefficients $\beta^{(\tau)}$ for various maturities, with 90% confidence intervals. I find that the demand surprise for 10-year government bonds corresponds to yield changes that follows a "localized" pattern, in which the magnitude of yield changes is monotonically increasing for longer maturities. The pattern is consistent with the yield responses of habitat demand shifts, in which limited risk-bearing capacity restricts the full arbitrage for the demand shock at long tenor from transmitting it to shorter tenors.[14]

## 4.2 Effects of Bid-to-Cover Ratio on Convenience Yields

In this section, I examine the convenience yield responses to the bid-to-cover ratio in a 10-year government bond auction. To summarize, I find that convenience yields increase by similar magnitudes across all maturities in response to the demand surprise revealed at auction. The results suggest that the government securities across maturities are near perfect substitutes in terms of deriving the liquidity value for investors.

[14] It is acknowledged that other theoretical predictions could also contribute to the change in the slope of the yield curve. For example, a higher bid-to-cover ratio revealed in an auction may reduce the interest rate volatility, which could lead to lower term premium. Nonetheless, robustness tests are in favor of localization patterns for preferred-habitat theories: Bid-to-cover ratios in auctions of short-term bonds show larger effects on short-term bond yields, and ratios in 5-year bond auctions affect yields in a hump-shaped pattern that presents larger effect on medium-term bonds.

### 4.2.1 Convenience Yield Measure: Treasury Basis

Our primary measure of convenience yield differentials, referred to as the Treasury basis, is calculated as the yield differential between a domestic government bond and its synthetic counterpart. The synthetic bond is constructed using a foreign bond (in this case, a U.S. bond) and an FX forward. Specifically, the Treasury basis for a bond with maturity $\tau$ is given by:

$$CY_{i,t}^{(\tau)} = \tilde{y}_{i,t}^{(\tau)} - y_{i,t}^{(\tau)}$$

where $y_{i,t}^{(\tau)}$ is the domestic bond yield, and $\tilde{y}_{i,t}^{(\tau)}$ is the synthetic bond yield, calculated as:

$$\tilde{y}_{i,t}^{(\tau)} = y_{\$,t}^{(\tau)} - f_{i,t}^{(\tau)} + q_{i,t}$$

$y_{\$,t}^{(\tau)}$ represents the yield on the U.S. bond, $f_{i,t}^{(\tau)}$ is the forward exchange rate in units of USD per unit of currency $i$, and $q_{i,t}$ is the spot exchange rate. A higher Treasury basis $CY_t$ corresponds to a higher convenience yield on domestic bonds compared to foreign counterparts. The bases are computed for bonds with maturities from 3 months to 10 years. This measure is based on the methodology that are widely used in studies by Du et al. (2018), Jiang et al. (2021), and Engel and Wu (2023), which show that this differential is approximately proportional to the convenience yield differences required by investors in equilibrium.

### 4.2.2 Alternative Convenience Yield Measures

In addition, I analyze two alternative measures of the convenience yield: (1) the OIS-sovereign spread and (2) the IG corporate bond-sovereign spread. The OIS-sovereign spread is defined as the yield difference between Overnight Indexed Swap (OIS) rates and government bond yields of the same maturity, with data available for maturities ranging from 3 months to 10 years. The IG corporate bond-sovereign spread is measured as the gap between the yields-to-worst of the S&P investment-grade (IG) corporate bond index and government bond yields of equivalent maturities. I focus on three maturity groups of the bond indices:

"Short-term" (0-3 years), "medium-term" (3-5 years), and "long-term" (7-10 years).[15]

These alternative measures capture the convenience yield of domestic government bonds relative to domestic securities with similar cash flows. Both measures are widely adopted in convenience yield research, including Klingler and Sundaresan (2019), Jermann (2020), He et al. (2022), Du et al. (2023), and Hanson et al. (2024) for the OIS-sovereign spread, and Krishnamurthy and Vissing-Jorgensen (2012) and Ausubel et al. (2014) for the corporate bond-sovereign spread.

#### 4.2.3 Regression Results

I begin by estimating the regressions of the following form:

$$\Delta Z_{i,t} = \alpha^Z + \gamma_i^Z + \beta^Z \Delta \text{bid-to-cover}_{i,t} + \text{controls}_{i,t} + \epsilon_{i,t}^Z$$

where the dependent variable $\Delta Z_i$ denotes the daily changes in convenience yields. I estimate the regressions with several measures of convenience yields, including 10-year Treasury bases $\Delta CY^{(10Y)}$, 10-year OIS-sovereign spreads ($\Delta OS^{(10Y)}$), long-term IG corporate bond-sovereign spreads ($\Delta CB^{(LT)}$).

Table 3 presents the regression results, indicating that an increase in the bid-to-cover ratio is associated with a rise in convenience yields across all measures. Specifically, a one-unit increase in the bid-to-cover ratio corresponds to an increase in the Treasury basis by 0.9 to 1.2 basis points, the OIS-sovereign spread by 0.7 to 1.0 basis points, and the corporate bond-sovereign spread by 1.3 basis points. These findings provide robust evidence that convenience yields respond positively to the heightened bond demand revealed through the auction, as measured by the bid-to-cover ratio changes.

To gauge the impact of changes in the bid-to-cover ratio on convenience yields for different

[15] The S&P IG corporate bond index offers a comprehensive view of corporate bond yields across various countries covering the sampling period. The index is segmented by different maturity groups, and for the main analysis, I use the 0-3 year, 3-5 year, and 7-10 year IG corporate bond indices. I compute the yield differences with 3-year, 5-year, and 10-year government bond yields, respectively.

maturities, I estimate the regression of the following form:

$$\Delta CY_{i,t}^{(\tau)} = \alpha^{(\tau)} + \gamma_i^{(\tau)} + \beta^{(\tau)}\Delta\text{bid-to-cover}_{i,t} + \epsilon_{i,t}^{(\tau)}$$

Figure 5 plots the resulting coefficients $\beta^{(\tau)}$ with 90% confidence intervals for each maturity. The change in bid-to-cover ratio has a positive and significant effect on Treasury bases. The 10-year Treasury basis increases by 1.2 basis point for a unit increase in bid-to-cover ratio. Specifically, a one-unit increase in the bid-to-cover ratio raises the 10-year Treasury basis by 1.2 basis points. Additionally, the Treasury bases across the entire term structure exhibit a similar response, with estimated coefficients ranging from 0.75 to 1.3 for maturities between 1 year and 10 years. The results suggest that the positive excess demand shock for 10-year bonds, as revealed in the auction, corresponds to a higher liquidity preference for holding domestic government bonds. This effect extends beyond the 10-year bond, reflecting general demand over domestic safe assets.

I also investigate the term-structure effect of the bid-to-cover ratio on alternative convenience yield measures. Figure 6 displays the estimated coefficients for OIS-sovereign spreads, and Figure 7 presents the estimated coefficients for IG corporate bond-sovereign spreads, with 90% confidence intervals for each maturity group. The results from both figures indicate that convenience yields on domestic government bonds rise in response to a positive change in the bid-to-cover ratio from a 10-year government bond auction. Moreover, convenience yields increase consistently across all maturities. For example, OIS-sovereign spreads increase by 0.75 to 1 basis point per unit increase in the bid-to-cover ratio for maturities ranging from 3 months to 10 years. Similarly, the IG corporate-sovereign spread rises by approximately 0.75 basis point for short- and medium-term bonds, and by 1.5 basis points for long-term bonds. These findings suggest that a higher bid-to-cover ratio systematically reflects stronger demand for government bonds for all maturities, as they serve as safe assets, thereby driving up convenience yields.

## 4.3 Aspects of Convenience Yields

It is important to understand which components of convenience yields are affected by heightened bond demand as revealed through an auction. In this section, I focus on two key aspects: inflation expectations and the hedging properties of government bonds.

### 4.3.1 Inflation Expectations

An important perspective of convenience yields is their relation with inflation expectations. Both Li et al. (2022) and Cieslak et al. (2024) provide evidence that inflation expectations are strongly associated with the convenience yields of government bonds. A natural question arises: Does a higher bid-to-cover ratio relate to inflation expectations?

To address this question, I test the relation between bid-to-cover ratios and survey-based expected inflation rate . Specifically, I perform the regression of the following form:

$$X_{i,t} = \alpha^X + \gamma_i^X + \beta^X \Delta\text{bid-to-cover}_{i,t} + \epsilon_{i,t}^X$$

where $X$ represents the dependent variable, which includes the CPI annual inflation rate $\pi$, average expected inflation rate from Bloomberg Survey $E(\pi)$, and inflation surprise $\pi - E(\pi)$. In addition, I examine the one-period forward inflation expectations. Table 4 reports the results, which show that in bid-to-cover ratio have negative yet insignificant effect on current or next-period inflation expectations.

Next, I examine the relation between bid-to-cover ratios and market-based inflation expectations by regressing the inflation implied by inflation-linked sovereign bonds on the ratio. The regression is specified as follows:

$$\Delta IF_{i,t}^{(10Y)} = \alpha^{IF} + \gamma_i^{IF} + \beta^{IF} \Delta\text{bid-to-cover}_{i,t} + \epsilon_{i,t}^{IF}$$

where $IF^{(10Y)}$ is the 10-year breakeven inflation, measured as the yield differential between 10-year government bonds and inflation-linked bonds. The results are shown in Column 3 of Table 5.[16] A unit increase in bid-to-cover ratio in an auction is associated with a 0.6 basis point decrease in 10-year breakeven inflation. This finding suggests that higher bond demand, as revealed through bond auctions, is linked to lower inflation expectations from the market. The reduction in inflation expectations may contribute to an increase in the convenience yield of government bonds, a hypothesis supported by Li et al. (2022).[17]

Further, I test whether inflation expectations fully explain the effect of government bond demand on exchange rates. To do this, I rerun the regression of exchange rate changes on the bid-to-cover ratio, controlling for 10-year breakeven inflation changes. The results are presented in the last column of Table 5. I observe two results. First, the coefficient on the bid-to-cover ratio remains positive and significant, indicating that government bond demand from auctions is associated with additional factors beyond inflation expectations that drive domestic currency appreciation. Second, holding bond demand constant, higher breakeven inflation is weakly associated with an appreciation of the domestic currency, although this effect is less pronounced. The results indicate that while inflation expectations play a role, they do not fully explain the impact of government bond demand on exchange rates.

### 4.3.2 Hedging Property

Another important aspect of convenience yields is the hedging perspective of government bonds. Acharya and Laarits (2023) provide evidence that the convenience yield for Treasury bonds tends to increase when the Treasury provides hedging for equities, i.e. when Treasury returns exhibit a low covariance with aggregate stock market returns.

To examine whether the bid-to-cover ratio affects the hedging property of government bonds, I estimate the following regression:

$$cov(stock, bond)^{t}_{t+30,i} = \alpha^h + \gamma^h_i + \beta^h \Delta\text{bid-to-cover}_{i,t} + \epsilon^h_{i,t}$$

[16] Norway does not issue inflation-linked bonds, so we have fewer observations in these regressions.

[17] One caveat should be noted that breakeven inflation could partially capture the liquidity premium in the less liquid inflation-linked securities, as discussed by Fleckenstein et al. (2014) and Andreasen et al. (2021). It is also possible that imperfect spillovers from sovereign bonds to inflation-linked securities, due to slow-moving capital, contribute to the lower inflation expectations.

where $cov(stock, bond)^t_{t+30,i}$ represents the stock-bond covariance for currency $i$, computed as the 30-day moving covariance between MSCI market returns and change in 10-year benchmark bond yields of country $i$. A positive $cov(stock, bond)$ indicates that government bonds provide a hedge against equity market risk, as bond yields decrease (or bond prices rise) when stock market returns fall.

Table 6 presents the regression results. The first column shows that a positive change in the bid-to-cover ratio following a government bond auction corresponds to a positive stock-bond covariance. This finding suggests that government bond demand may also reflect their role as a hedge, which could increase the convenience yield. However, the relation between the bid-to-cover ratio and the stock-bond covariance is statistically weak, and it becomes insignificant when controlling for the lagged stock-bond covariance, as shown in the second column.

# 5 Exchange Rate Decomposition

In the previous section, I showed that a positive demand shock for government bonds, indicated by an increase in the bid-to-cover ratio, leads to lower bond yields and a stronger domestic currency. The next question to address is: through which channels does government bond demand impact the exchange rate? One approach to answering this is by decomposing exchange rate innovations into various news components and analyzing how the bid-to-cover ratio affects each component.

Following Froot and Ramadorai (2005) and Jiang et al. (2021), I decompose the exchange rate innovations into three components: (1) cash flow news (CF news), which consists of innovations in expected short-term interest rate differentials; (2) risk premium news (RP news), which consists of innovations in expected excess returns on holding the foreign currency; (3) and convenience yield news (CY news), which consists of innovations in expected convenience yield differentials between domestic and foreign bonds.[18] Specifically, the inno-

[18] Jiang et al. (2021) derives the decomposition equation with the assumption that Euler equations that prices domestic and foreign riskfree bonds retain non-negative wedges, i.e. marginal investors derive non-pecuniary

vations in domestic exchange rates (that is, FX news) are written as the following sum of three news components:

$$\underbrace{(\mathbb{E}_t - \mathbb{E}_{t-1})\ q_t}_{\text{FX news}} = \underbrace{(\mathbb{E}_t - \mathbb{E}_{t-1}) \sum_{\tau=0}^{\infty} (i_{t+\tau} - i^{\$}_{t+\tau})}_{\text{cash flow news}} + \underbrace{(\mathbb{E}_t - \mathbb{E}_{t-1}) \sum_{\tau=0}^{\infty} rp^{*}_{t+\tau}}_{\text{risk premium news}}$$
$$+ \underbrace{(\mathbb{E}_t - \mathbb{E}_{t-1}) \sum_{\tau=0}^{\infty} (CY_{t+\tau} - CY^{\$}_{t+\tau})}_{\text{convenience yield news}}$$

where $\mathbb{E}_t \left[\lim_{\tau \to \infty} q_{t+\tau}\right]$ is assumed to approach zero.

In this analysis, I use Treasury Premiums as a proxy for convenience yield differentials in the exchange rate decomposition. Specifically, the exchange rate $q_t$ is expressed as:

$$q_t = \mathbb{E}_t \sum_{\tau=0}^{\infty} (i_{t+\tau} - i^{\$}_{t+\tau}) + \mathbb{E}_t \sum_{\tau=0}^{\infty} rp^{*}_{t+\tau} + \mathbb{E}_t \sum_{\tau=0}^{\infty} \frac{\overline{CY}_{t+\tau}}{1-\beta}$$

where $\overline{CY}_t$ represents the mean Treasury premium across maturities from 3 months to 10 years, and $i_t - i^{\$}_t$ is measured with the 1-week forward premium. The parameter $\beta = 0.9983$ reflects the daily changes in the foreign exchange rate in response to changes in $x_t$, which acts as a closer substitute for the daily basis. I further decompose the exchange rate using the VAR approach from Froot and Ramadorai (2005). This decomposition is represented as follows:

$$\begin{bmatrix} q_t \\ i_t - i^{\$}_t \\ \frac{\overline{CY}_t}{1-\beta} \end{bmatrix} = \begin{bmatrix} \Gamma_{0,1} \\ \Gamma_{0,2} \\ \Gamma_{0,3} \end{bmatrix} + \begin{bmatrix} \Gamma_{1,1} & \Gamma_{1,2} & \Gamma_{1,3} \\ \Gamma_{2,1} & \Gamma_{2,2} & \Gamma_{2,3} \\ \Gamma_{3,1} & \Gamma_{3,2} & \Gamma_{3,3} \end{bmatrix} \begin{bmatrix} q_{t-1} \\ i_{t-1} - i^{\$}_{t-1} \\ \frac{\overline{CY}_{t-1}}{1-\beta} \end{bmatrix} + \begin{bmatrix} u_{1,t} \\ u_{2,t} \\ u_{3,t} \end{bmatrix}$$

Following Froot and Ramadorai (2005), the estimation controls for lagged effects in blocks over different time intervals. Specifically, the blocks include: 1 day, 2-5 days, 6-10 days, and 11-25 days. With the estimated coefficients $\Gamma$ and VAR residuals $u$, I decompose the foreign

benefits on holding riskfree bonds.

exchange rate into several news components:

$$N_q = N_{RP} + N_{CY} + N_{ID}$$

where the news terms are defined as follows: $N_{ID} = \mathbf{e}_2'(I - \Gamma)^{-1}\mathbf{u}$ captures the cashflow news related to interest rate differentials, $N_{CY} = \mathbf{e}_3'(I - \Gamma)^{-1}\mathbf{u}$ reflects the convenience yield news, and $N_{RP} = (\mathbf{e}_1'(I - \Gamma) - (\mathbf{e}_2 + \mathbf{e}_3)')\,(I - \Gamma)^{-1}\mathbf{u}'$ accounts for the news related to foreign currency risk premiums.

Table 7 reports the decomposed variance of exchange rate innovations into each news component, for 10-year government bond auction days versus non-auction days. First, variance of risk premium news is lower while variance of convenience yield news is higher on auction days compared to non-auction days. Second, variance of convenience yield news (46.01) is larger than that of risk premium news (38.57) in auction days, while it is the opposite in non-auction days. The results suggest that convenience yield news become dominant during bond auctions when information about bond demand is revealed.

To examine the effect of government bond demand on components of exchange rate innovations, I conduct the regressions of the following form:

$$News_{i,t} = \alpha^n + \gamma_i^n + \beta^n \Delta\text{bid-to-cover}_{i,t} + \epsilon_{i,t}^n$$

where $News$ can be cashflow, risk premium, or convenience yield news. Panel A of Table 8 reports the regression results. A higher bid-to-cover ratio in a 10-year government bond auction leads to domestic currency appreciation primarily through its positive and significant effect on convenience yield news, while it has a negative yet insignificant effect on risk premium news. Specifically, a one-unit increase in the bid-to-cover ratio raises convenience yield news by 16.7 basis points and lowers risk premium news by 0.7 basis points. The negative impact on risk premium news offsets some of the appreciating effect from the increased convenience yields. These findings align with theoretical predictions from the model: greater demand for government bonds reduces the foreign currency risk premium and raises the convenience yield on domestic bonds. While the lower risk premium weakens the domestic currency, the higher convenience yield strengthens it.

How does government bond auction demand affect the relation between bond yields and exchange rates? I investigate the relation by regressing exchange rates on benchmark 10-year bond yields for bond auction and compare the results to non-auction days. Panels B and C of Table 8 show that bond yields are positively associated with the domestic exchange rate on both day types. Yet, the relation is weaker on auction days. Specifically, one percentage point increase in the 10-year bond yield corresponds to a 1.59% appreciation in the domestic currency on non-auction days, compared to 0.899% on auction days. This weaker relation during auctions is primarily driven by convenience yield news. Bond yields are negatively related to convenience yield news on both days, but the effect is much stronger on auction days (-1.096 vs. -0.269). Meanwhile, bond yields positively affect risk premium news with a similar magnitude on both days (1.855 vs. 1.993). The result implies that on auction days when demand for government bonds is revealed, yield changes contain more information about convenience yields that dampens the effect of risk premium channels on yields and exchange rates.

Also note that on non-auction days, yield changes are positively and significantly related to cashflow news. This suggests that the contemporaneous relation between bond yields and exchange rates is also influenced by changes in short-term interest rates. By focusing on bond auctions, the effect of cashflow news is mitigated, as yield changes during auctions are more likely to reflect risk premiums and convenience yields for government bonds, rather than short-term interest rate fluctuations.

To summarize, the exchange rate decomposition results show that preferences for domestic bonds, as revealed through government bond auctions, affect bond yields and exchange rates through two key channels. On one hand, higher bond demand lowers bond yields and reduces the risk premium on foreign currency, creating a positive relation between bond yields and exchange rates. On the other hand, higher demand increases the liquidity value of domestic bonds, which dampens this positive relation by appreciating the domestic currency.

# 6 Discussion

In this section, I discuss several alternative explanations for the empirical findings.

## 6.1 Currency Demand vs. Bond Demand

One alternative explanation is that exchange rates may be primarily driven by currency inflows from global investors when demand for domestic government bonds is high. For instance, if auction participants are predominantly foreign investors with zero initial domestic assets, and participating in the auction requires them to hold domestic currency, a bond demand shock would mechanically create an inflow of the currency. If the currency's value is sensitive to these flows, the currency would appreciate when bond demand rises. This currency demand channel complements but distinguishes from the bond demand channels, such as the risk premium and convenience yield channels, which affect the exchange rate through an increased valuation of the currency without necessarily requiring a currency inflow.[19]

### 6.1.1 Examining with Foreign Ownership of Government Debt

To empirically address this concern, I begin by using sovereign bond ownership data to examine whether a higher proportion of foreign ownership is associated with a stronger exchange rate response. The sovereign bond ownership data, provided by Arslanalp and Tsuda (2014), contains detailed information about the investor base for sovereign bonds across advanced economies. This dataset is reported quarterly and covers the entire sample period of this analysis. It has been used in various studies, including investigations into how investor composition affects the price elasticity of sovereign debt (Fang et al., 2022).

Using this dataset, I test whether the presence of higher foreign ownership amplifies the

[19] In the model, an FX inflow implies a net supply in the foreign exchange market, which global arbitrageurs are required to hold in order for the FX market to clear.

effect of government bond demand. The hypothesis is that if currency demand is the primary driver of exchange rate movements due to changes in the bid-to-cover ratio, exchange rates should be more sensitive to changes in the bid-to-cover ratio in auctions with higher levels of foreign ownership. The regression is specified as follows:

$$\Delta q_{i,t} = \alpha^q + \gamma_i^q + \beta_1^q \Delta\text{bid-to-cover}_{i,t} + \beta_2^q \Delta\text{bid-to-cover}_{i,t} \times \Delta FO_{i,t} + \beta_3^q \Delta FO_{i,t} + \epsilon_{i,t}^q$$

where $\Delta FO$ represents the quarterly change in foreign ownership. The foreign ownership of government debt is calculated as the value of foreign holdings of general government debt scaled by the total value of government debt. Foreign ownership is further broken down into four categories by investor type: *All* denotes total ownership, $NonBank$ denotes ownership by non-bank institutions, $Bank$ represents ownership by banks, and $Official$ refers to ownership by central banks. If currency demand is a significant driver of the exchange rate response to bond demand, we would expect $\beta_2^q > 0$.

Table B.2 reports the results. The interaction between bond demand and ownership structure does not significantly affect exchange rate responses. In addition, the coefficient for the change in the bid-to-cover ratio remains similar in magnitude to the baseline regression. These results suggest that the exchange rate response to bond demand is not significantly amplified by foreign ownership composition, implying that currency demand alone may not fully explain the relation between government bond demand and exchange rate movements.

### 6.1.2 Examining with FX Spot Order Flows

Next, I use the FX order flow data from CLS to test the high-frequency response of exchange rates to currency inflows at government bond auctions. The CLS FX spot order flow data contains the daily dollar values of buy and sell orders between bank dealers and their customers in 17 currencies from September 2012 to September 2021. The customer groups include non-bank financial institutions and funds.[20] This data has been widely used

[20] The dataset also includes flows from corporates, but due to insufficient observations, I exclude this group from the main analysis.

in studies of exchange rates, such as Hasbrouck and Levich (2021), Ranaldo and Somogyi (2021), Roussanov and Wang (2023), and An and Huber (2024).

Specifically, I construct the net flows $\widetilde{Flowi,t}$ for currency $i$ on date $t$, defined as the buy volume minus sell volume of order flows for currency $i$ with respect to the U.S. dollar. Following Froot and Ramadorai (2005) and Roussanov and Wang (2023), I compute the normalized daily net flows $Flowi,t$ by scaling the net flows with the 60-day rolling standard deviation of past flows:

$$Flow_{i,t} = \frac{\widetilde{Flow}_{i,t}}{\sigma(\widetilde{Flow}_{i,t})_{t-61}^{t-1}}$$

Using this measure of net FX flows, I test whether the effect of government bond demand on exchange rates is driven by currency demand. The regression is specified as:

$$\Delta q_{i,t} = \alpha^{q,F} + \gamma_i^{q,F} + \beta_1^{q,F} \Delta \text{bid-to-cover}_{i,t} + \beta_2^{q,F} \Delta Flow_{i,t}^{j} + \epsilon_{i,t}^{q,F}$$

where $j$ denotes the type of counterparty, including investment funds, non-bank financial institutions, and banks. The null hypothesis is that $\beta_1^{q,F} = 0$ after controlling for $\Delta Flow$, meaning that the effect of the bid-to-cover ratio on exchange rates is driven by currency flows.

Table B.3 reports the regression results. The first three columns report the contemporaneous regressions of changes in exchange rates on net currency flows from funds, non-bank financial institutions, and banks. A positive currency flow from funds and non-bank financial institutions is associated with an appreciation of the currency. In contrast, a positive currency flow from banks is linked to currency depreciation, possibly because banks, as primary dealers, absorb flows initiated by other counterparties. These results are consistent with previous studies, such as Evans and Lyons (2002) and Ranaldo and Somogyi (2021), which found that FX order flows significantly explain exchange rate movements.

However, the explanatory power of currency flows becomes less significant during bond auctions, while the coefficient for changes in the bid-to-cover ratio remains significant and positive. This result suggests that government bond demand, as revealed through auctions, is a dominant factor driving exchange rate movements on auction days, and its effect is not fully explained by currency flows.

## 6.2 Investor Composition on Bond Demand at Auctions

The government debt ownership and FX order flows data provide an opportunity to explore an important and relevant question regarding government bond demand: whose demand is driving the auctions?

To answer this, I test whether investor composition shifts in response to a higher bid-to-cover ratio in a bond auction. The regression is specified in the following form:

$$Own^j_{i,t+1} = \alpha^O_j + \gamma^O_{i,j} + \beta^O_j \Delta\text{bid-to-cover}_{i,t} + \text{controls}_{i,t} + \epsilon^O_{i,j,t+1}$$

where $Own$ denotes bond ownership in percentage points, including both foreign and domestic ownership, and $j$ denotes the investor type. I examine changes in bond ownership one quarter after the auction ($t+1$) to mitigate timing issues. The results, presented in Appendix Table B.5, show a significant shift in the investor base from domestic to foreign investors when the bid-to-cover ratio is higher. Specifically, a one-unit increase in the bid-to-cover ratio is associated with a 0.58% increase in foreign ownership and a corresponding decrease in domestic ownership of government debt. This shift is primarily driven by non-bank investors: A one-unit increase in the bid-to-cover ratio is linked to a 0.64% increase in foreign non-bank ownership and an almost equivalent decline in domestic non-bank holdings.

Next, I examine the high-frequency response of currency demand using FX order flows, particularly how flows respond to a heightened bid-to-cover ratio around auction dates. The following regression is used for currency $i$, auction date $t$, and days to the auction ($k$):

$$Flow^j_{i,t-5\to t+k} = \alpha^{Flow,k}_j + \gamma^{Flow,k}_{i,j} + \beta^{Flow,k}_j \Delta\text{bid-to-cover}_{i,j,t} + \epsilon^{Flow,k}_{i,j,t-5\to t+k}$$

Appendix Figure B.3 displays the regression coefficients $\beta_j^{Flow,k}$ for $k = t-4$ to $t+5$, with 90% confidence intervals. Notably, investment funds show positive flows into the domestic currency beginning one day prior to the auction when the bid-to-cover ratio is higher than average. This finding is consistent with Appendix Table B.5, which shows that higher bid-to-cover ratios are associated with greater ownership by foreign non-bank holders, including investment funds. However, neither these funds nor other counterparties exhibit significant FX inflows following auctions with high demand. The pattern suggests that investors trade the currency prior to auctions, with auction outcomes primarily reflecting information about liquidity preference rather than FX flows.

## 6.3 Balance-Sheet Constraints

One may argue that heightened demand for government bonds results in a tightening of financial intermediaries' balance-sheet constraints, leading to domestic currency appreciation. Specifically, dealer banks may need to accommodate the demand shock in the government bond market by using their available balance sheet space. As compensation for this, intermediaries would demand a higher risk premium on foreign currency, resulting in an increase in the value of domestic currency.

However, in theory, whether this constraint tightening occurs depends critically on the assumption that banks are holding zero or net short positions of government bonds. In fact, if dealer banks hold net long positions in government bonds—which is the case in many advanced economies such as the U.S. (Du et al., 2023)—higher government bond demand would relax their balance-sheet constraints rather than tighten them. In this scenario, a demand shock would likely lead to domestic currency depreciation rather than appreciation.

Even in cases where banks hold net short positions in government bonds, the tightening of balance-sheet constraints is inconsistent with the empirical observation of a higher convenience yield. This is because real assets, such as government bonds, occupy balance sheet space, whereas synthetic instruments do not. As a result, intermediaries would charge a higher risk premium on government bonds, thereby increasing bond yields relative to synthetic ones.[21]

Empirically, I find that proxies for balance-sheet constraints among financial intermediaries have a weak association with changes in the sensitivity of exchange rate responses to demand shocks. Specifically, I run the following regression:

$$X_{i,t} = \alpha^X + \gamma_i^X + \beta_1^X \Delta\text{bid-to-cover}_{i,t} + \beta_2^X \Delta\text{bid-to-cover}_{i,t} \times \Delta B_{i,t} + \beta_3^X \Delta FO_{i,t} + \epsilon_{i,t}^X$$

where $X$ represents the dependent variables of interest, including 10-year benchmark yields, exchange rates, and 10-year Treasury bases. $B$ denotes the proxy for balance-sheet constraints. I use several proxies, such as changes in absolute 3-month covered interest rate parity (CIP) deviations under LIBOR rates, changes in the VIX, and changes in domestic MSCI market return volatility.[22] If balance-sheet constraints explain the impact of the bid-to-cover ratio on yields and exchange rates, we would expect a larger effect of the bid-to-cover ratio when balance-sheet capacity proxies indicate tighter conditions (i.e., $\beta_2^X$ significantly different from zero). This is because the intermediaries would be more sensitive to demand shocks with tighter constraints, and this effect would be reflected in the interaction term in the regression.

Table B.4 presents the regression results. Panel A reports the results using changes in absolute CIP deviations to proxy for intermediary constraints, Panel B uses changes in the VIX index, and Panel C uses MSCI market volatilities. The coefficients for the interaction terms are insignificant, while the coefficient for the bid-to-cover ratio remains significant across the regressions. The findings suggest that intermediary constraints do not fully account for the

[21] It is important to note that balance-sheet constraints differ from risk-bearing capacity because the cost induced by occupying balance-sheet space does not depend on the direction of the bank's positions. For example, He et al. (2022) discuss cases where banks are required to allocate the same amount of balance-sheet space to both long and short bond positions.

[22] The use of CIP deviations as a proxy for balance-sheet constraints is related to Du et al. (2018) and Du et al. (2023), who show that violations of CIP arbitrage measure the shadow cost of intermediary constraints. The use of volatility measures as proxies for balance-sheet constraints is related to Fang and Liu (2021), who show that higher volatility leads to tighter value-at-risk (VaR) constraints for financial intermediaries.

effects of bond demand on yields and exchange rates.

## 6.4 Sovereign Risk

It is possible that the bid-to-cover ratio captures the sovereign credit risk component of government bonds. Specifically, a high bid-to-cover ratio may indicate lower perceived credit risk associated with domestic bonds. If this is the case, a higher bid-to-cover ratio would correspond to lower yields and stronger currency due to a reduced risk of sovereign default.

However, two points warrant further examination. First, the sovereign default risk is relatively stable and small among advanced economies, meaning that fluctuations in credit risk are unlikely to be a primary driver of variations in the bid-to-cover ratio. This suggests that the impact of credit risk on yields and exchange rates might be muted in this context.

Second, when empirically examining credit default swap (CDS) spreads on domestic sovereign bonds across the sampled countries, I find that a higher bid-to-cover ratio is associated with a positive, if any, change in credit risk. In particular, I examine the relation with the following regression:

$$\Delta CDS_{i,t}^{(\tau)} = \alpha^{(\tau)} + \gamma_i^{(\tau)} + \beta_{CDS}^{(\tau)} \Delta \text{bid-to-cover}_{i,t} + \epsilon_{i,t}^{(\tau)}$$

where $\Delta CDS$ denotes the daily change in CDS spread, $\tau \in \{1\text{Y}, 3\text{Y}, 5\text{Y}, 7\text{Y}, 10\text{Y}\}$ is the tenor of credit default swap. Figure 8 displays the regression coefficients for various tenors, with 90% confidence intervals. The point estimates of the coefficients suggest that a unit increase in the bid-to-cover ratio is associated with an increase in CDS spread by 0 to 4 basis points. This finding contradicts the hypothesis that a high bid-to-cover ratio reflects lower sovereign risk.

Instead, it is plausible that the increase in CDS spreads is capturing other factors, such as the widening convenience yield of sovereign bonds. To explore this further, I ran contemporaneous regressions of bond yields and corporate bond-sovereign yield spread on CDS spreads. The results, presented in Table B.6, reveal two key findings. First, higher CDS spreads are associated with lower government bond yields, not higher ones, as might be expected if the spreads were driven primarily by sovereign credit risk. Second, higher CDS spreads are linked to a widening spread between corporate and government bond yields. These results suggest that CDS spreads in the sampled advanced economies are more likely reflecting broader credit market conditions, including credit spreads, rather than purely sovereign credit risk. The results suggest that the positive response in CDS spreads on elevated auction demand for government bonds likely reflects an increasing convenience yield on sovereign bonds.

### 6.5 Information about Macro Fundamentals

Arguably, there may be an "information effect" embedded in the bid-to-cover ratio revealed through bond auctions. In other words, the auction could convey not only preferences for government bonds as safe assets but also private information about economic fundamentals, such as the expected path of future short-term interest rates.[23] If this is the case, the bid-to-cover ratio's impact on exchange rates could reflect the influence of macroeconomic fundamentals.

However, this explanation relies on additional assumptions about the primary market participants. For instance, it assumes that bidders in the auctions possess private information about macroeconomic fundamentals that significantly deviates from what is already incorporated in the secondary market. Moreover, this interpretation is difficult to reconcile with empirical findings. Specifically, in my model, macroeconomic fundamentals are tied to short-term interest rate processes. If a higher bid-to-cover ratio lowers bond yields by signaling a lower future path for short rates, the corresponding effect on exchange rates would also be negative. This prediction contradicts the empirical observation of a positive effect on exchange rates, posing a challenge to the "information effect" explanation.[24]

[23] Nakamura and Steinsson (2018) present a similar argument regarding Fed announcements.

[24] It is acknowledged that other macroeconomic fundamentals, such as total factor productivity, may influence exchange rates, though their role lies beyond the scope of the theoretical framework discussed in this paper. Obstfeld and Rogoff (1998) and Obstfeld (2000) document that exchange rates often follow a random walk and appear disconnected from macro fundamentals. While several studies, including Anderson et al. (2003) and Faust et al. (2007), demonstrate high-frequency exchange rate responses to macroeconomic news. It is plausible that high-frequency news influences exchange rates indirectly by affecting investors' asset demand

# 7 Conclusion

This paper examines how government bond demand impacts bond yields and exchange rates. There are two main channels. First, increased demand for domestic government bonds reduces the risk premium required by marginal investors to hold long-term domestic bonds and risky foreign assets. Consequently, bond yields decrease, and the domestic currency depreciates in the spot market against foreign currencies. Second, heightened demand for domestic bonds signals a stronger liquidity preference for holding domestic assets, including the domestic currency. This boosts the liquidity value of domestic assets, leading to lower yields and an appreciation of the domestic currency. I develop a theoretical framework to explain these mechanisms and provide empirical evidence to support both channels.

The findings could offer notable implications for researchers investigating exchange rates through the lens of asset demand and supply. For example, the use of yield curve control or bond purchases as exchange rate intervention tools may not follow the predictions of UIP if these policies also affect the liquidity value of the currency.

A key area for future exploration is how the government's dynamic response to rising convenience yields influences asset markets. For instance, does the government adjust its bond issuance based on changes in demand, and do investors account for potential future increases in issuance size? Furthermore, how do the interactions between the government and investors affect bond yields and exchange rates in equilibrium? These questions offer valuable directions for future research.

rather than through a direct link to fundamentals, thereby impacting the FX risk premium, as suggested by Itskhoki and Mukhin (2021). For instance, Evans and Lyons (2008) find that two-thirds of the impact of macroeconomic news is transmitted indirectly via order flows. Similarly, Chahrour et al. (2024) discover that noisy news about macro fundamentals can result in significant UIP deviations.

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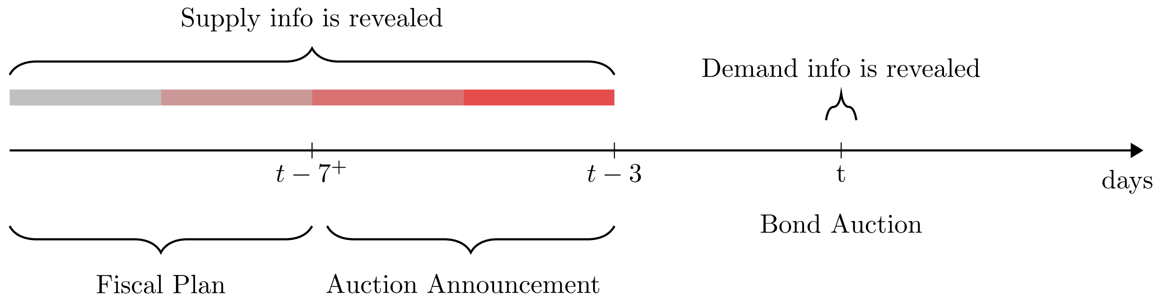
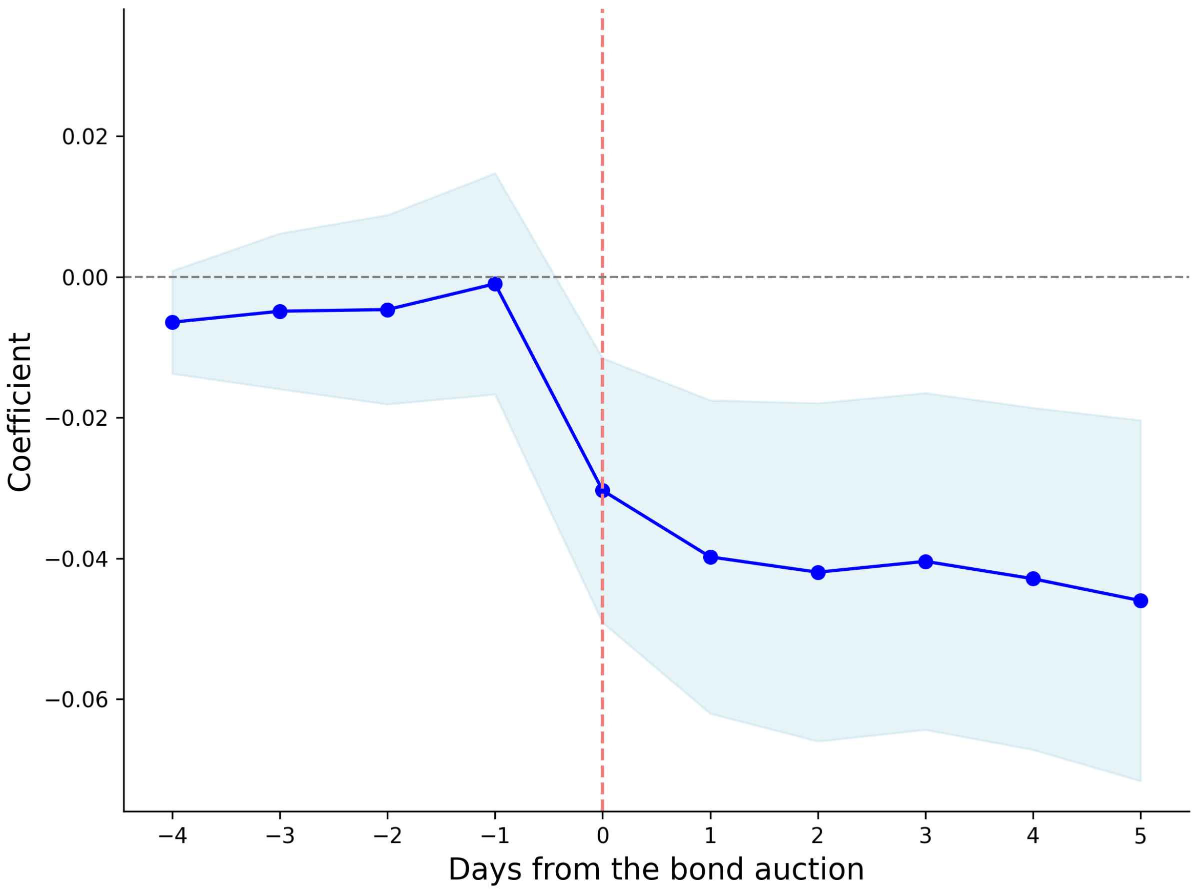
# Figures and Tables

**Figure 1: Timeline of Government Bond Auctions**




This figure illustrates the timeline of a typical government bond auction process. First, the government releases the *fiscal plan* outlining the planned issuance dates and proposed issuance sizes across different maturities for government debt. This plan is often part of the budget proposal at year or quarter-end. Days before the auction, the government releases *auction announcements* about specific issuance details for the bond, including the issuance size, bond maturity, and coupon rates. Note that the announced size may vary from the initial fiscal plan subject to budgetary adjustments. On the day of the *bond auction*, bidders submit their bids within a set timeframe. The auction results are released shortly after the auction's conclusion. Successful bidders receive the allotted securities on the settlement or issue date typically several days later.

**Figure 2: Dynamic Effect of Bid-to-Cover Ratio on Domestic Government Bond Yields**

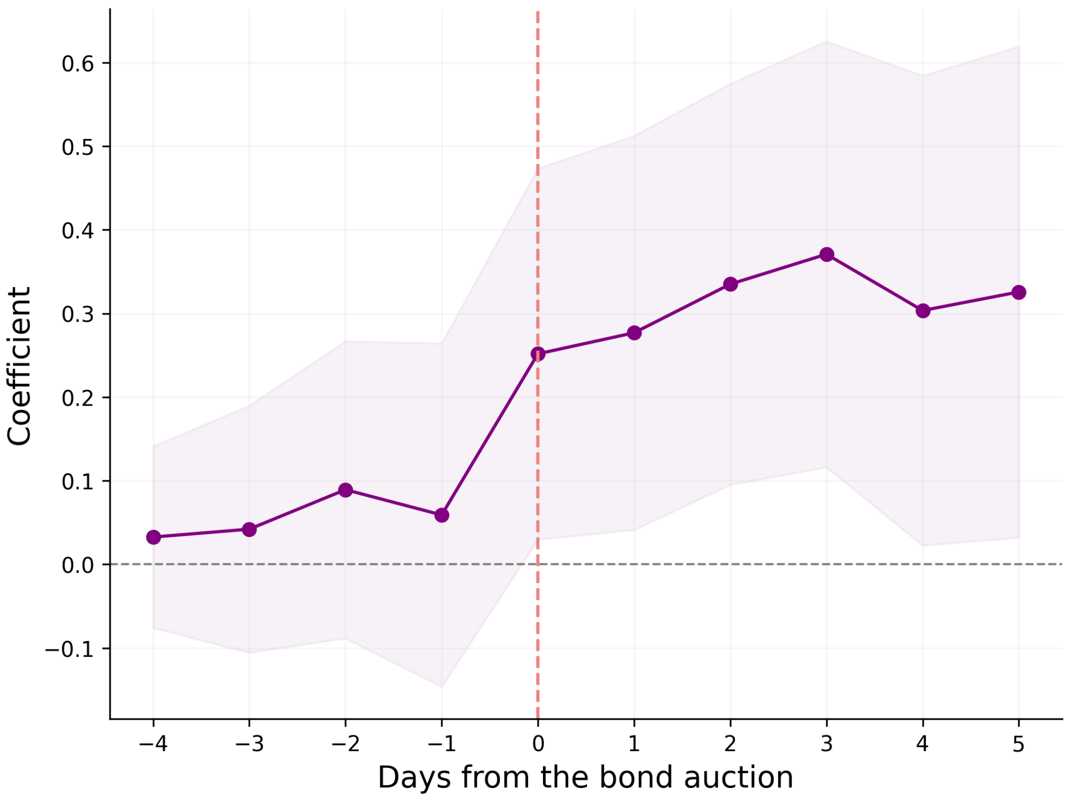



This figure plots the estimated coefficients $\beta^{y,k}$ and their 90% confidence intervals from the following regression for currency $i$, auction date $t$, and days relative to the auction $k$:

$$\Delta y^{(10)}_{i,t-5\rightarrow t+k} = \alpha^{y,k} + \gamma^{y,k}_i + \beta^{y,k}\Delta\text{bid-to-cover}_{i,t} + \epsilon^{y,k}_{i,t-5\rightarrow t+k}$$

where $y^{(10)}$ represents the 10-year benchmark government bond yield, and $\gamma^k_i$ are currency fixed effects. $\Delta$bid-to-cover denotes the change in the bid-to-cover ratio for a 10-year government bond auction relative to the average ratio over the past ten auctions. Changes in bond yields $\Delta y$ are calculated as the difference between yields five days before the auction and $k$ days to the auction. The figure plots the coefficients for $k \in [-4, 5]$. Standard errors are clustered by auction date.

**Figure 3: Dynamic Effect of Bid-to-Cover Ratio on Exchange Rates**

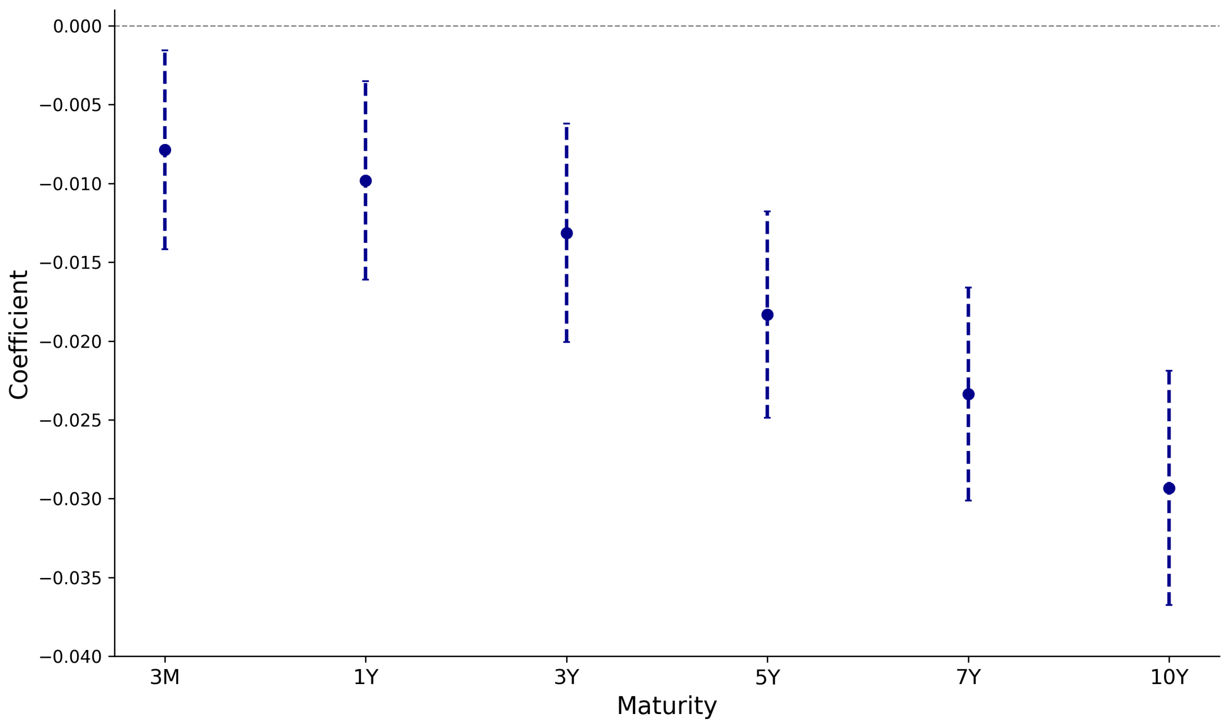



This figure plots the estimated coefficients $\beta^{q,k}$ and their 90% confidence intervals from the following regression for currency $i$, auction date $t$, and days relative to the auction $k$:

$$\Delta q_{i,t-5\rightarrow t+k} = \alpha^{q,k} + \gamma_i^{q,k} + \beta^{q,k}\Delta\text{bid-to-cover}_{i,t} + \epsilon_{i,t-5\rightarrow t+k}^{q,k}$$

where $q_i$ denotes the logarithm of exchange rate in units of US dollars per unit of currency $i$. A higher $q_i$ means currency $i$ appreciates. $\gamma_i^{q,k}$ are currency fixed effects. $\Delta$bid-to-cover denotes the change in the bid-to-cover ratio for a 10-year government bond auction relative to the average ratio over the past ten auctions. Changes in the currency value $\Delta q$ are calculated as the difference between the exchange rates five days before the auction and $k$ days to the auction. The figure plots the coefficients for $k \in [-4, 5]$. Standard errors are clustered by auction date.

**Figure 4: Term Structure Effect of Bid-to-Cover Ratio on Government Bond Yields**

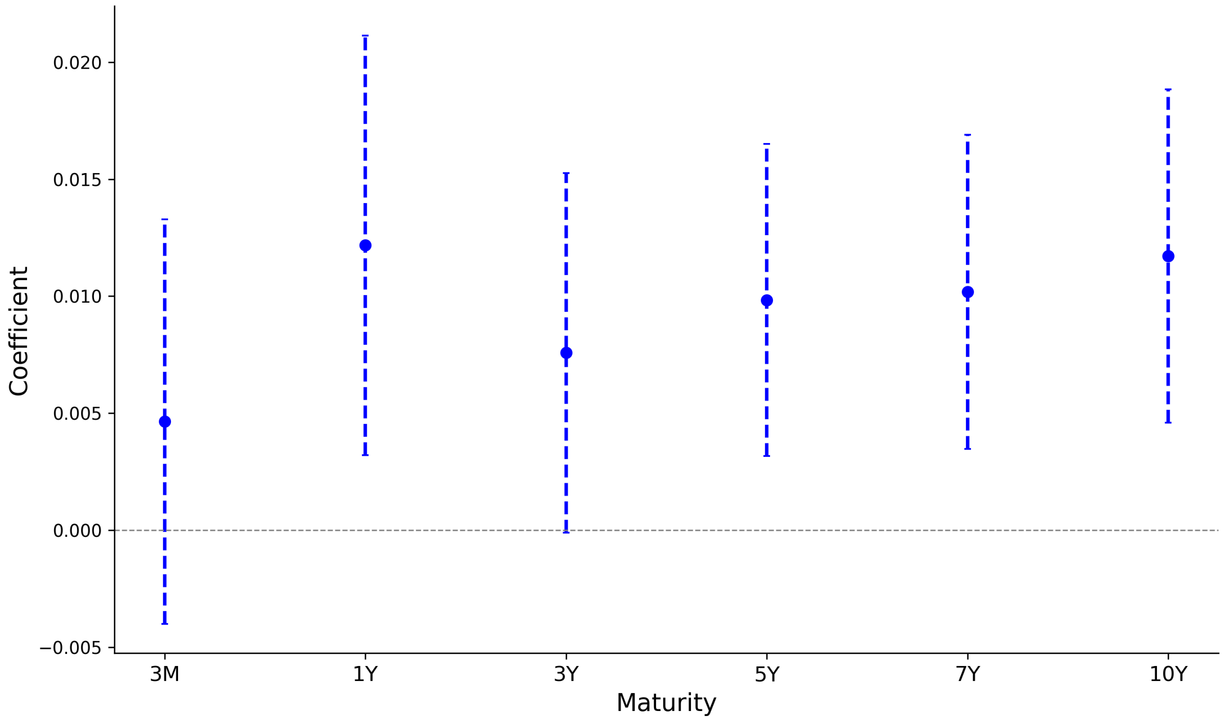



This figure plots the estimated coefficients $\beta^{(\tau)}$ and their 90% confidence intervals from the following regression for currency $i$, auction date $t$, and tenor $\tau$:

$$\Delta y_{i,t}^{(\tau)} = \alpha^{(\tau)} + \gamma_i^{(\tau)} + \beta^{(\tau)} \Delta \text{bid-to-cover}_{i,t} + \epsilon_{i,t}^{(\tau)}$$

where $y_i$ represents the benchmark government bond yield. $\tau$ denotes the tenor of the government bond, where $\tau \in \{3\text{M, 1Y, 3Y, 5Y, 7Y, 10Y}\}$. $\gamma_i^{(\tau)}$ are currency fixed effects. $\Delta$bid-to-cover denotes the change in the bid-to-cover ratio for a 10-year government bond auction relative to the average ratio over the past ten auctions. Standard errors are clustered by auction date.

**Figure 5: Term Structure Effect of Bid-to-Cover Ratio on Treasury Bases**




This figure plots the estimated coefficients $\beta^{CY,(\tau)}$ and their 90% confidence intervals from the following regression for currency $i$, auction date $t$, and tenor $\tau$:

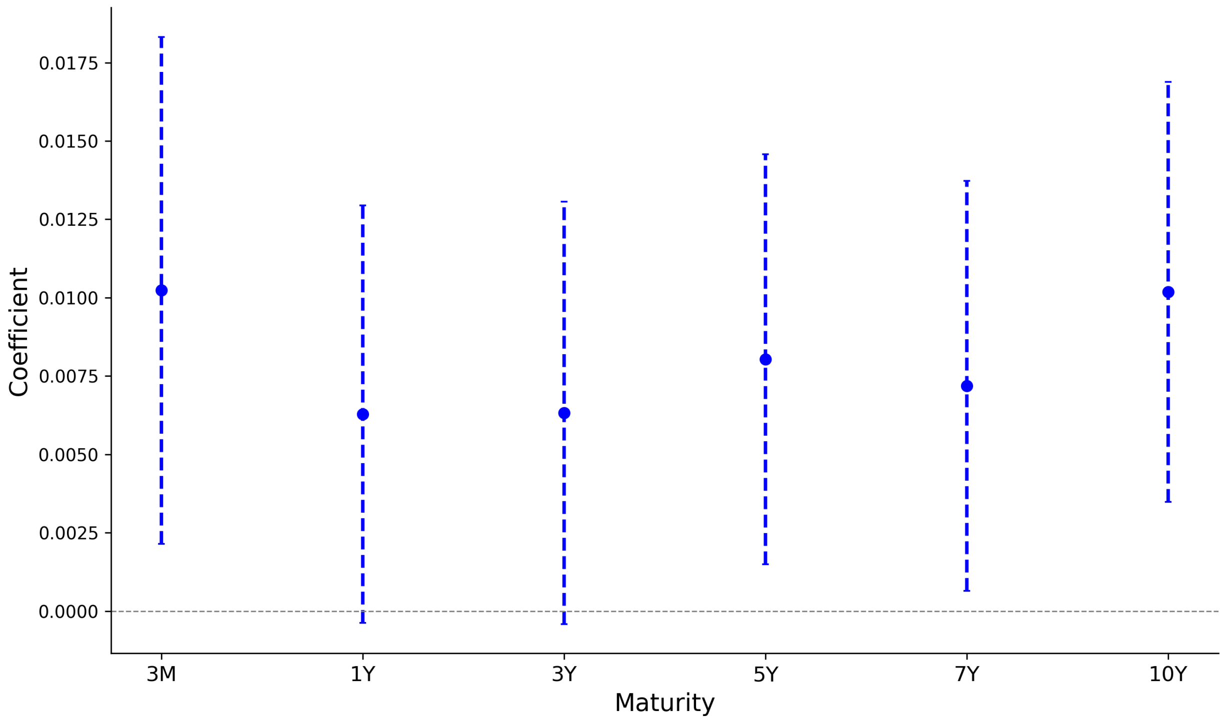
$$\Delta CY_{i,t}^{(\tau)} = \alpha^{CY,(\tau)} + \gamma_i^{CY,(\tau)} + \beta^{CY,(\tau)} \Delta \text{bid-to-cover}_{i,t} + \epsilon_{i,t}^{CY,(\tau)}$$

where $CY_i$ is the Treasury basis of the government bond, computed as the yield difference between the government bond and its synthetic counterpart constructed with the foreign bond and the currency forward:

$$CY_{i,t}^{(\tau)} = \tilde{y}_{i,t}^{(\tau)} - y_{i,t}^{(\tau)} = (y_{\$,t}^{(\tau)} - f_{i,t}^{(\tau)} + q_{i,t}) - y_{i,t}^{(\tau)}$$

where $y_{i,t}^{(\tau)}$ denotes the domestic gvoernment bond yield, and $\tilde{y}_{i,t}^{(\tau)}$ denotes the yield of synthetic bond. $y_{\$,t}^{(\tau)}$ represents the yield on the U.S. Treasury, $f_{i,t}^{(\tau)}$ is the logarithm of forward exchange rate in units of USD per unit of currency $i$, and $q_{i,t}$ is the logged spot exchange rate. $\tau \in \{$3M, 1Y, 3Y, 5Y, 7Y, 10Y$\}$ denotes the tenor of the bond. $\Delta$bid-to-cover is the change in the bid-to-cover ratio for a 10-year government bond auction relative to the average ratio over the past ten auctions. Standard errors are clustered by auction date.

**Figure 6: Term Structure Effect of Bid-to-Cover Ratio on OIS-Sovereign Spreads**




This figure plots the estimated coefficients $\beta^{OS,(\tau)}$ and their 90% confidence intervals from the following regression for currency $i$, auction date $t$, and tenor $\tau$:

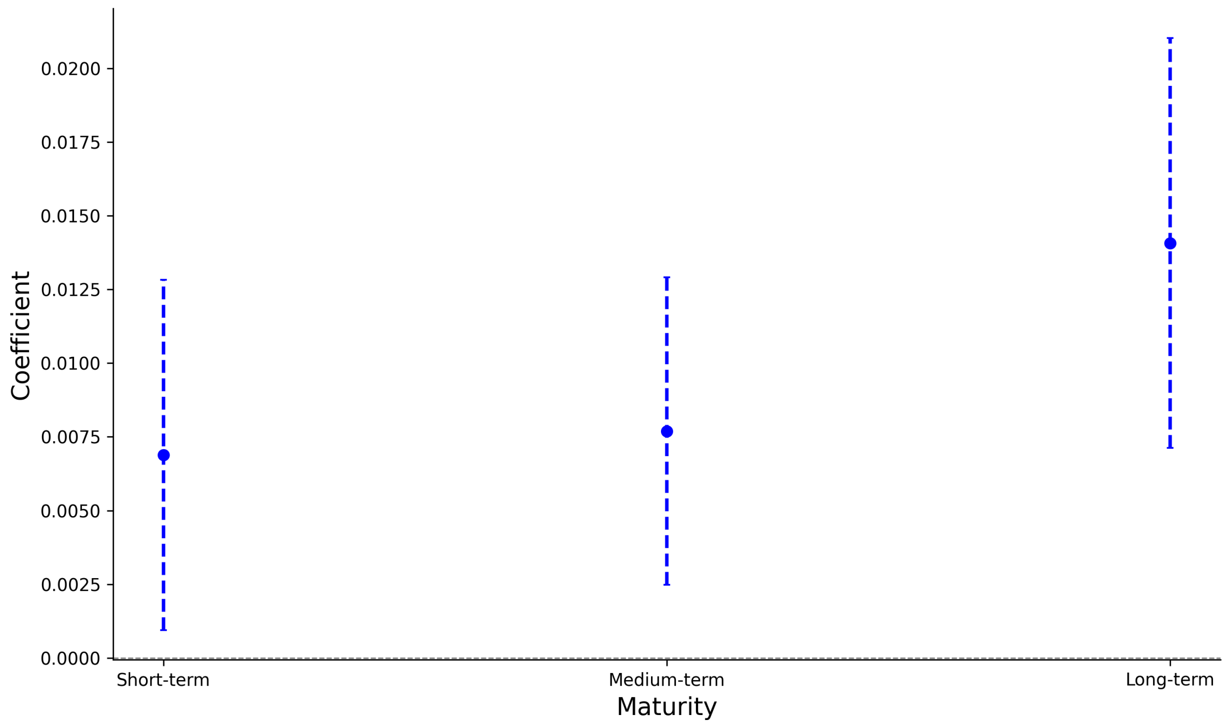
$$\Delta OS_{i,t}^{(\tau)} = \alpha^{OS,(\tau)} + \gamma_i^{OS,(\tau)} + \beta^{OS,(\tau)} \Delta \text{bid-to-cover}_{i,t} + \epsilon_{i,t}^{OS,(\tau)}$$

where $OS$ denotes the OIS-sovereign spread , computed as the yield difference between the overnight-indexed swap and government bond of the same maturity:

$$OS_{i,t}^{(\tau)} = OIS_{i,t}^{(\tau)} - y_{i,t}^{(\tau)}$$

where $OIS_{i,t}^{(\tau)}$ represents the OIS yield, $y_{i,t}^{(\tau)}$ is the domestic bond yield. $\tau$ denotes the tenor of the OIS or the bond. $\Delta$bid-to-cover denotes the change in the bid-to-cover ratio for a 10-year government bond auction relative to the average ratio over the past ten auctions. Standard errors are clustered by auction date.

**Figure 7: Term Structure Effect of Bid-to-Cover Ratio on Investment Grade (IG) Corporate-Sovereign Spreads**




This figure plots the estimated coefficients $\beta^{CB,(\tau)}$ and their 90% confidence intervals from the following regression for currency $i$, auction date $t$, and tenor $\tau$:

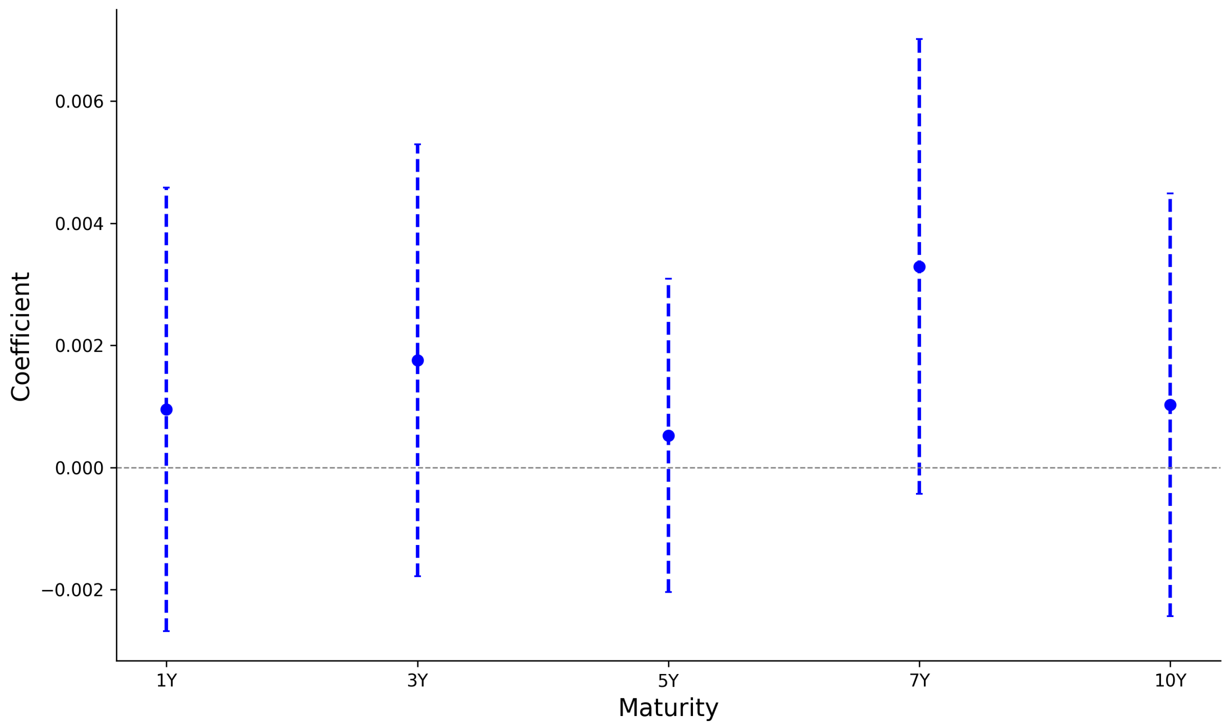
$$\Delta CB_{i,t}^{(\tau)} = \alpha^{CB,(\tau)} + \gamma_i^{CB,(\tau)} + \beta^{CB,(\tau)} \Delta \text{bid-to-cover}_{i,t} + \epsilon_{i,t}^{CB,(\tau)}$$

where $CB$ is the Investment Grade (IG) corporate-sovereign spread, calculated as the yield difference between IG corporate bonds and government bonds of similar maturities:

$$CB_{i,t}^{(\tau)} = y_{i,t}^{C,(\tau)} - y_{i,t}^{(\tau)}$$

$y_{i,t}^{C,(\tau)}$ is the yield-to-worst of the S&P IG corporate bond index, and $y_{i,t}^{(\tau)}$ is the domestic government bond yield. The tenor $\tau$ refers to the maturity range of the corporate bond index (the government bond), with short-term covering 0-3 years (3-year), medium-term covering 3-5 years (5-year), and long-term covering 7-10 years (10-year). $\Delta$bid-to-cover is measured as the difference between the current 10-year bond auction's bid-to-cover ratio and the average of the previous ten auctions. Standard errors are clustered by auction date.

**Figure 8: Term Structure Effect of Bid-to-Cover Ratio on Credit Default Swap (CDS) Spreads**




This figure plots the estimated coefficients $\beta^{CDS,(\tau)}$ and their 90% confidence intervals from the following regression for currency $i$, auction date $t$, and tenor $\tau$:

$$\Delta CDS_{i,t}^{(\tau)} = \alpha^{CDS,(\tau)} + \gamma_i^{CDS,(\tau)} + \beta^{CDS,(\tau)} \Delta\text{bid-to-cover}_{i,t} + \epsilon_{i,t}^{CDS,(\tau)}$$

where $CDS$ is the credit default swap spread. $\tau \in \{1\text{Y}, 3\text{Y}, 5\text{Y}, 7\text{Y}, 10\text{Y}\}$ is the tenor of the CDS. $\Delta$bid-to-cover is measured as the difference between the current 10-year bond auction's bid-to-cover ratio and the average of the previous ten auctions. Standard errors are clustered by auction date.

Table 1: **Summary Statistics of Bid-to-Cover Ratio**

| | N | Mean | Std | 25% | Median | 75% |
|---|---|---|---|---|---|---|
| **Panel A: bid-to-cover** | | | | | | |
| Australia (AUD) | 423 | 3.346 | 0.899 | 2.695 | 3.172 | 3.935 |
| Canada (CAD) | 124 | 2.276 | 0.159 | 2.164 | 2.273 | 2.381 |
| Germany (EUR) | 215 | 1.270 | 0.311 | 1.048 | 1.229 | 1.439 |
| United Kingdom (GBP) | 165 | 2.151 | 0.413 | 1.820 | 2.150 | 2.420 |
| Japan (JPY) | 252 | 2.977 | 0.688 | 2.499 | 2.956 | 3.481 |
| Norway (NOK) | 126 | 2.506 | 0.676 | 2.015 | 2.424 | 2.966 |
| New Zealand (NZD) | 317 | 2.904 | 1.191 | 2.036 | 2.723 | 3.600 |
| Sweden (SEK) | 279 | 2.728 | 1.029 | 1.883 | 2.554 | 3.502 |
| **Panel B: Δbid-to-cover** | | | | | | |
| Australia (AUD) | 423 | 0.002 | 0.236 | -0.173 | -0.019 | 0.161 |
| Canada (CAD) | 124 | -0.000 | 0.074 | -0.046 | -0.002 | 0.054 |
| Germany (EUR) | 215 | -0.002 | 0.241 | -0.166 | -0.026 | 0.147 |
| United Kingdom (GBP) | 165 | -0.001 | 0.141 | -0.087 | -0.018 | 0.084 |
| Japan (JPY) | 252 | 0.020 | 0.238 | -0.112 | -0.008 | 0.120 |
| Norway (NOK) | 126 | 0.019 | 0.278 | -0.167 | -0.003 | 0.140 |
| New Zealand (NZD) | 317 | 0.012 | 0.398 | -0.290 | -0.021 | 0.214 |
| Sweden (SEK) | 279 | 0.019 | 0.356 | -0.233 | -0.033 | 0.248 |

This table reports the summary statistics of bid-to-cover ratios for 10-year government bond auctions across different countries/currencies. The sampling period covers 2002 to 2022. Germany is selected to represent government bonds associated with the Euro. Δbid-to-cover denotes changes in the bid-to-cover ratio relative to the average ratio over the past ten auctions.

## Table 2: Regressions of Bid-to-Cover Ratio on Bond Yields and Exchange Rates

| (in %) | $\Delta y_{i,t}^{10Y}$ | $\Delta q_{i,t}$ | $\Delta y_{i,t}^{10Y}$ | $\Delta q_{i,t}$ |
|---|---|---|---|---|
| $\Delta$bid-to-cover$_i$ | -0.029*** | 0.157** | -0.027*** | 0.156*** |
| | (0.004) | (0.062) | (0.004) | (0.058) |
| $Coupon_i$ | | | -0.000 | 0.019 |
| | | | (0.001) | (0.013) |
| $\Delta IssueSize_i$ | | | -0.005* | 0.061 |
| | | | (0.003) | (0.045) |
| $\Delta IRD_{i,t}^{3M}$ | | | 0.176*** | 0.374 |
| | | | (0.047) | (0.433) |
| $AucYld$ | | | -0.162*** | -0.002 |
| | | | (0.025) | (0.319) |
| $AUC_{US}$ | | | -0.000 | 0.070 |
| | | | (0.004) | (0.053) |
| bid-to-cover$_{US}$ | | | 0.001 | 0.044 |
| | | | (0.002) | (0.031) |
| $\Delta VIX$ | | | 0.011 | -1.349*** |
| | | | (0.019) | (0.299) |
| $HKM$ | | | 0.269** | 8.727*** |
| | | | (0.112) | (1.649) |
| $R_i^{equity}$ | | | 0.521*** | -1.071 |
| | | | (0.110) | (2.125) |
| $VOL_i$ | | | 0.069 | -0.948 |
| | | | (0.215) | (3.375) |
| $IF_i$ | | | 0.023 | -0.247 |
| | | | (0.103) | (1.342) |
| $UNP_i$ | | | -0.002 | -0.082 |
| | | | (0.006) | (0.087) |
| $IP_i$ | | | 0.010 | -0.357 |
| | | | (0.017) | (0.314) |
| $GOV_i$ | | | -0.047 | 1.364 |
| | | | (0.096) | (1.573) |
| $\Delta Debt_i$ | | | 0.000 | -0.003 |
| | | | (0.000) | (0.004) |
| Currency FE | Yes | Yes | Yes | Yes |
| N | 1901 | 1901 | 1826 | 1826 |
| $R^2$ (within) | 0.031 | 0.004 | 0.137 | 0.106 |

This table reports the results for regressions of the following form:

$$\Delta Y_{i,t} = \alpha^Y + \gamma_i^Y + \beta^Y \Delta\text{bid-to-cover}_{i,t} + \text{controls}_{i,t} + \epsilon_{i,t}^Y$$

where $\Delta Y_i \in \{\Delta q_i, \Delta y_i^{(10Y)}\}$ is the dependent variable, $\Delta y_i^{(10Y)}$ is the daily change in 10-year government bond yield for country $i$, $\Delta q_i$ is the daily change in log of the exchange rate in units of USD per unit of currency $i$. $\Delta$bid-to-cover is the change of the bid-to-cover ratio from the average of the past ten auctions. $\gamma_i$ are currency fixed effects. Control variables include the coupon rate of the auctioned bond ($Coupon$), the difference between the average auction yield and the benchmark yield ($AucYld$), the change in issuance size from the previous auction ($\Delta IssueSize$), the change in 3-month interest rate differential between the domestic and US rates ($\Delta IRD^{3M}$), the 7-year or above US Treasury auction indicator ($AUC_{US}$), and the bid-to-cover ratio of the most recent US 10-year Treasury auction (bid-to-cover$_{US}$), the change in VIX ($\Delta VIX$), the capital market factor from He et al. (2017)($HKM$), MSCI equity returns ($R^{equity}$), MSCI 30-day equity volatility ($VOL$), CPI inflation ($IF$), the unemployment rate ($UNP$), industrial production growth ($IP$), government expenditures as a percentage of GDP ($GOV$), and the change in the debt-to-GDP ratio ($\Delta Debt$). Standard errors clustered by auction date are in parentheses, *p<0.1; **p<0.05; ***p<0.01.

## Table 3: Regressions of Bid-to-Cover Ratio on Convenience Yields

| | $\Delta CY_{i.t}^{(10Y)}$ | | $\Delta OS_{i.t}^{(10Y)}$ | | $\Delta CB_{i.t}^{(LT)}$ | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $\Delta$bid-to-cover$_i$ | 0.012*** | 0.009** | 0.010** | 0.007* | 0.014*** | 0.013*** |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| $Coupon_i$ | | 0.000 | | -0.000 | | 0.000 |
| | | (0.001) | | (0.001) | | (0.001) |
| $\Delta IssueSize_i$ | | 0.003 | | 0.003 | | 0.001 |
| | | (0.003) | | (0.002) | | (0.003) |
| $\Delta IRD_{i,t}^{3M}$ | | -0.041 | | -0.048 | | -0.042 |
| | | (0.040) | | (0.036) | | (0.050) |
| $AucYld$ | | 0.031 | | 0.003 | | 0.065*** |
| | | (0.024) | | (0.023) | | (0.022) |
| $AUC_{US}$ | | -0.002 | | -0.004 | | 0.003 |
| | | (0.004) | | (0.004) | | (0.003) |
| bid-to-cover$_{US}$ | | -0.000 | | 0.000 | | -0.001 |
| | | (0.002) | | (0.002) | | (0.002) |
| $\Delta VIX$ | | -0.075*** | | -0.044** | | -0.024 |
| | | (0.021) | | (0.020) | | (0.018) |
| $HKM$ | | 0.181 | | 0.306** | | -0.046 |
| | | (0.136) | | (0.126) | | (0.124) |
| $R_i^{equity}$ | | -0.556*** | | -0.547*** | | -0.258** |
| | | (0.136) | | (0.114) | | (0.111) |
| $VOL_i$ | | 0.033 | | -0.073 | | -0.508** |
| | | (0.316) | | (0.213) | | (0.227) |
| $IF_i$ | | 0.053 | | -0.049 | | -0.018 |
| | | (0.125) | | (0.092) | | (0.079) |
| $UNP_i$ | | 0.000 | | 0.001 | | -0.002 |
| | | (0.006) | | (0.005) | | (0.007) |
| $IP_i$ | | -0.002 | | 0.010 | | -0.003 |
| | | (0.019) | | (0.017) | | (0.018) |
| $GOV_i$ | | -0.053 | | 0.062 | | 0.074 |
| | | (0.112) | | (0.096) | | (0.074) |
| $\Delta Debt_i$ | | 0.000 | | -0.000 | | 0.000 |
| | | (0.000) | | (0.000) | | (0.000) |
| Currency FE | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 1751 | 1691 | 1750 | 1706 | 1500 | 1434 |
| $R^2$ (within) | 0.005 | 0.042 | 0.004 | 0.043 | 0.009 | 0.032 |

This table reports the results for regressions of the following form:

$$\Delta Z_{i,t} = \alpha^Z + \gamma_i^Z + \beta^Z \Delta\text{bid-to-cover}_{i,t} + \text{controls}_{i,t} + \epsilon_{i,t}^Z$$

where the dependent variable $\Delta Z_i$ denotes the daily change in a convenience yield measure. Columns 1 and 2 report results for 10-year Treasury bases ($\Delta CY^{(10Y)}$), columns 3 and 4 for 10-year OIS-sovereign spreads ($\Delta OS^{(10Y)}$), and columns 5 and 6 for long-term IG corporate bond-sovereign spreads ($\Delta CB^{(LT)}$). Standard errors clustered by auction date are in parentheses. $^*$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01.

**Table 4: Bid-to-Cover Ratio, Inflation, and Survey-Based Inflation Expectations**

| | $\pi_t$ | $E(\pi_t)$ | $\pi_t - E(\pi_t)$ | $\pi_{t+1}$ | $E(\pi_{t+1})$ | $\pi_{t+1} - E(\pi_{t+1})$ |
|---|---|---|---|---|---|---|
| $\Delta$bid-to-cover | -0.225 | -0.210 | -0.023 | -0.197 | -0.200 | -0.004 |
| | (0.138) | (0.134) | (0.020) | (0.148) | (0.144) | (0.019) |
| Currency FE | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 1843 | 1829 | 1829 | 1843 | 1830 | 1830 |
| $R^2$ (within) | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 |

The first three columns of this table report the results for the following regressions:

$$X_{i,t} = \alpha^X + \gamma_i^X + \beta^X \Delta\text{bid-to-cover}_{i,t} + \epsilon_{i,t}^X$$

where $X$ represents the dependent variable, which includes the CPI annual inflation rate $\pi$, average expected inflation rate from Bloomberg Survey $E(\pi)$, and inflation surprise $\pi - E(\pi)$. The next three columns report the regression results for one-period forward inflation rate and expectations:

$$X_{i,t+1} = \alpha^{X,1} + \gamma_i^{X,1} + \beta^{X,1} \Delta\text{bid-to-cover}_{i,t+1} + \epsilon_{i,t+1}^{X,1}$$

Standard errors clustered by auction date are in parentheses, $^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

**Table 5: Bid-to-Cover Ratio and Market-Based Inflation Expectations**

| | $\Delta y_{i,t}^{TIPS,(10Y)}$ | $\Delta y_{i,t}^{(10Y)}$ | $\Delta IF_{i,t}^{(10Y)}$ | $\Delta q_{i,t}$ |
|---|---|---|---|---|
| $\Delta$bid-to-cover | -0.016*** | -0.022*** | -0.006** | 0.201** |
| | (0.005) | (0.005) | (0.003) | (0.079) |
| $\Delta IF_t^{(10)}$ | | | | 1.144* |
| | | | | (0.687) |
| Currency FE | Yes | Yes | Yes | Yes |
| N | 1327 | 1327 | 1327 | 1327 |
| $R^2$ (within) | 0.007 | 0.016 | 0.003 | 0.009 |

The first three columns of this table report the results for the following regressions:

$$\Delta X_{i,t} = \alpha^{IF,X} + \gamma_i^{IF,X} + \beta^{IF,X} \Delta\text{bid-to-cover}_{i,t} + \epsilon_{i,t}^{IF,X}$$

where $\Delta X$ represents the dependent variable, which includes the daily changes in 10-year inflation-linked bond yields $y^{TIPS,(10Y)}$, 10-year government bond yields $y^{(10Y)}$, and 10-year implied breakeven inflation $IF^{(10Y)}$. The last column reports the results for the following regression:

$$\Delta q_{i,t} = \alpha^{IF,q} + \gamma_i^{IF,q} + \beta_1^{IF,q} \Delta\text{bid-to-cover}_{i,t} + \beta_2^{IF,q} \Delta IF_{i,t}^{(10Y)} + \epsilon_{i,t}^{IF,q}$$

where the dependent variable is $\Delta q$. Standard errors clustered by auction date are in parentheses, $^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

**Table 6: Bid-to-Cover Ratio and Stock-Bond Covariance**

| | $cov(stock_i, bond_i)^t_{t+30}$ | $cov(stock_i, bond_i)^t_{t+30}$ |
|---|---|---|
| $\Delta$bid-to-cover | 0.415* | -0.008 |
| | (0.216) | (0.183) |
| $cov(stock, bond)^{t-30}_t$ | | -0.548*** |
| | | (0.045) |
| Currency FE | Yes | Yes |
| N | 1887 | 1885 |
| $R^2$ (within) | 0.002 | 0.310 |

This table reports the results for the following regressions:

$$cov(stock, bond)^t_{t+30,i} = \alpha^h + \gamma^h_i + \beta^h_1 \Delta\text{bid-to-cover}_{i,t} + cov(stock, bond)^{t-30}_{t,i} + \epsilon^h_{i,t}$$

where the dependent variable $cov(stock, bond)^t_{t+30,i}$ is the stock-bond covariance, computed as the 30-day moving covariance between MSCI market returns and change in 10-year government bond yields of country $i$. Standard errors clustered by auction date are in parentheses, $^*$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01.

**Table 7: Variance Decomposition of Exchange Rates**

| | V(RP News) | V(ID News) | V(CY News) | 2Cov(RP,ID) | 2Cov(RP,CY) | 2Cov(ID,CY) |
|---|---|---|---|---|---|---|
| Auction days | 38.57 | 0.01 | 46.01 | -0.24 | 38.96 | -0.48 |
| Non-auction days | 51.92 | 0.01 | 41.08 | -0.34 | 46.72 | -0.43 |

This table reports the variance decomposition of daily innovations in the log of exchange rates in the panel. The exchange rate innovations are decomposed with into the following components:

$$\underbrace{(\mathbb{E}_t - \mathbb{E}_{t-1})\ q_t}_{\text{FX news}} = \underbrace{(\mathbb{E}_t - \mathbb{E}_{t-1}) \sum_{\tau=0}^{\infty} (i_{t+\tau} - i^{\$}_{t+\tau})}_{\text{cash flow (CF) news}} + \underbrace{(\mathbb{E}_t - \mathbb{E}_{t-1}) \sum_{\tau=0}^{\infty} rp^*_{t+\tau}}_{\text{risk premium (RP) news}}$$

$$+ \underbrace{(\mathbb{E}_t - \mathbb{E}_{t-1}) \sum_{\tau=0}^{\infty} (CY_{t+\tau} - CY^{\$}_{t+\tau})}_{\text{convenience yield (CY) news}}$$

The VAR is estimated for each currency using a sample from 2002 to 2022. The VAR includes the average Treasury bases across maturities $\overline{CY}$, 1-week forward discount rates $i - i^*$, and the log of exchange rates $q$. The discount factor for the convenience yield is $\beta = 0.9983$. Auction days refer to the sample restricted to days with 10-year government bond auctions. Non-auction days are trading days other than auction days.

**Table 8: Regressions on Decomposed Exchange Rate News**

**Panel A: Bid-to-Cover Ratios**

| (in %) | FX News | RP News | CY News | CF News |
|---|---|---|---|---|
| Δbid-to-cover | 0.161*** | -0.007 | 0.167** | 0.001 |
| | (0.06) | (0.05) | (0.07) | (0.00) |
| Currency FE | Yes | Yes | Yes | Yes |
| N | 1898 | 1898 | 1898 | 1898 |
| $R^2$ (within) | 0.004 | 0.000 | 0.005 | 0.001 |

**Panel B: Yields on Auction Days**

| (in %) | FX News | RP News | CY News | CF News |
|---|---|---|---|---|
| $\Delta y^{10Y}$ | 0.899** | 1.993*** | -1.096** | 0.002 |
| | (0.45) | (0.39) | (0.47) | (0.00) |
| Currency FE | Yes | Yes | Yes | Yes |
| N | 1898 | 1898 | 1898 | 1898 |
| $R^2$ (within) | 0.004 | 0.022 | 0.006 | 0.000 |

**Panel C: Yields on Non-Auction Days**

| (in %) | FX News | RP News | CY News | CF News |
|---|---|---|---|---|
| $\Delta y^{10Y}$ | 1.591*** | 1.855*** | -0.269** | 0.004*** |
| | (0.19) | (0.15) | (0.11) | (0.00) |
| Currency FE | Yes | Yes | Yes | Yes |
| N | 43699 | 43699 | 43699 | 43699 |
| $R^2$ (within) | 0.011 | 0.014 | 0.000 | 0.001 |

Panel A of this table reports the results for the following regressions:

$$News_{i,t} = \alpha^{n,b} + \gamma_i^{n,b} + \beta^{n,b}\Delta\text{bid-to-cover}_{i,t} + \epsilon_{i,t}^{n,b}$$

where $News$ is the dependent variable, including FX news, cash flow news, risk premium news, and convenience yield news. Panels B and C report the results for the following regressions:reports the results for the following regressions:

$$News_{i,t} = \alpha^{n,y} + \gamma_i^{n,y} + \beta^{n,y}\Delta y_{i,t}^{(10Y)} + \epsilon_{i,t}^{n,y}$$

where $News$ is the dependent variable. Panel B reports the regression results for the sample restricted to days with 10-year government bond auctions (auction days). Panel C reports the results for the sample other than auction days. Standard errors clustered by auction date are in parentheses, *p<0.1; **p<0.05; ***p<0.01.

# A Appendix: Model

## A.1 Solving for the equilibrium

The equilibrium can be written as a system of four equations and four unknowns:

$$V_y = \delta^2 \left[ \frac{\sigma_i^2}{(1-\delta\phi_i)^2} + \frac{\left[ C_{y,y^f}^2 (\sigma_\lambda^2 + \sigma_s^2) + \sigma_\lambda^2 (V_y + 2\tau\gamma(1-\eta))^2 + \sigma_s^2 (V_y + \tau\gamma(1-\eta))^2 \right]}{\tau^2 (1-\delta\phi_s)^2} \right] \tag{A.1}$$

$$V_q = \frac{2\sigma_i^2(1-\rho)}{(1-\phi_i)^2} + \frac{2\left( C_{y,q}^2 \sigma_s^2 + \sigma_\lambda^2 (C_{y,q} - \eta\gamma\tau)^2 \right)}{\tau^2 (1-\phi_s)^2} \tag{A.2}$$

$$C_{y,y^f} = \delta^2 \left[ \frac{\rho\sigma_i^2}{(1-\delta\phi_i)^2} + \frac{\left[ 2C_{y,y^f} (\sigma_\lambda^2 (V_y + 2\tau\gamma(1-\eta)) + \sigma_s^2 (V_y + \tau\gamma(1-\eta))) \right]}{\tau^2 (1-\delta\phi_s)^2} \right] \tag{A.3}$$

$$\begin{aligned} C_{y,q} = & \frac{\delta\sigma_i^2(1-\rho)}{(1-\phi_i)(1-\delta\phi_i)} + \frac{-\eta\gamma\tau\sigma_\lambda^2 \left[ -C_{y,y^f} + (V_y + 2\gamma\tau(1-\eta)) \right]}{\tau^2 (1-\phi_s)(1-\delta\phi_s)} \\ & + \frac{C_{y,q} \left[ -C_{y,y^f} (\sigma_s^2 + \sigma_\lambda^2) + V_y (\sigma_s^2 + \sigma_\lambda^2) + \gamma\tau(1-\eta)(\sigma_s^2 + 2\sigma_\lambda^2) \right]}{\tau^2 (1-\phi_s)(1-\delta\phi_s)} \end{aligned} \tag{A.4}$$

Let's start by solving the $\Delta \equiv V_y - C_{y,y^f} + \bar{\Delta}$, where $\bar{\Delta} = \frac{\gamma\tau(1-\eta)\left(2\sigma_\lambda^2 + \sigma_s^2\right)}{\sigma_\lambda^2 + \sigma_s^2}$ is the adjustment term related to the liquidity preference. Combining (A.1), (A.2) and $\bar{\Delta}$, we have

$$\Delta = A_{Vy}\Delta^2 + K_{Vy}$$

where

$$A_{Vy} = \frac{\delta^2 (\sigma_\lambda^2 + \sigma_s^2)}{\tau^2 (1-\delta\phi_s)^2}$$

and

$$K_{Vy} = \frac{\delta^2\gamma^2\sigma_\lambda^2\sigma_s^2(1-\eta)^2}{(\sigma_\lambda^2 + \sigma_s^2)(1-\delta\phi_s)^2} + \frac{\delta^2\sigma_i^2(1-\rho)}{(1-\delta\phi_i)^2} + \frac{\gamma\tau(1-\eta)(2\sigma_\lambda^2 + \sigma_s^2)}{\sigma_\lambda^2 + \sigma_s^2}.$$

which is a quadratic function with respect to $\Delta$. When there is no residual supply risk $\sigma_s = 0$, the constant term is $K_{Vy} = \frac{\delta^2\sigma_i^2(1-\rho)}{(1-\delta\phi_i)^2} + 2\gamma\tau(1-\eta)$. if instead there is no liquidity preference risk $\sigma_\lambda = 0$, the term becomes $K_{Vy} = \frac{\delta^2\sigma_i^2(1-\rho)}{(1-\delta\phi_i)^2} + \gamma\tau(1-\eta)$. This result suggests there is an asymmetric impact of bond supply risk with respect to liquidity preference risk.

The quadratic equation has two solutions:

$$\Delta^* = \frac{1 \pm \sqrt{1 - 4A_{Vy}K_{Vy}}}{2A_{Vy}}$$

where the condition to have a real root is $1 - 4A_{Vy}K_{Vy} \geq 0$.

There are two equilibrium solutions in this model, one is stable and the other unstable. In this paper, we focus on the stable solution. The stable solution is an equilibrium which sustains a small perturbation. Specifically, if the corresponding fixed point function $F(\Delta)$, which satisfies $\Delta^* = F(\Delta^*)$ and is differentiable around the neighborhood of $\Delta^*$, has a slope less than one at the equilibrium point $\Delta^*$, then the solution is stable; otherwise it is unstable, meaning that with a small perturbation $\epsilon > 0$ the solution would diverge from $\Delta^*$.

To examine the stability of the solution in this quadratic equation, we can take the first derivative of the function $F(\Delta) = A_{Vy}\Delta^2 + K_{Vy}$. For any stable equilibrium, we require

$$F'(\Delta^*) = 2A_{Vy}\Delta^* < 1$$

It can be shown that the stable equilibrium corresponds to the solution with a smaller value, that is

$$\Delta^* = \frac{1 - \sqrt{1 - 4A_{Vy}K_{Vy}}}{2A_{Vy}}.$$

Interestingly, $\Delta^*$ does not approach zero when $\rho \to 1$ with respect to $\bar{\Delta}$. This is because, even at the limit where $\rho \to 1$, we have $V_y > C_{y,y^f}$. The intuition is as follows: Even when the correlation of short rates becomes perfect, long-term bonds are facing orthogonal supply risks that affect their respective convenience yields, reducing the correlation. If $\gamma = 0$, the convenience yield channel is shut down and we will have $C_{y,y^f} \to V_y$ when $\rho \to 1$.

Next, we obtain $C_{y,q}$ by substituting $\Delta^*$ into (A.4). We can express $C_{y,q}$ as a fixed-point linear function. Specifically, we have

$$C_{y,q} = A_{Cyq}C_{y,q} + B_{Cyq}$$

where

$$A_{Cyq} = \frac{\delta\left(\sigma_\lambda^2 + \sigma_s^2\right)\Delta^*}{\tau^2\left(1-\phi_s\right)\left(1-\delta\phi_s\right)}$$

and

$$B_{Cyq} = \frac{\delta\sigma_i^2(1-\rho)}{(1-\delta\phi_i)(1-\phi_i)} + \frac{\delta\eta\gamma\sigma_\lambda^2\left(\bar{\Delta} - \Delta^* - 2(1-\eta)\gamma\tau\right)}{\tau\left(1-\phi_s\right)\left(1-\delta\phi_s\right)}$$

The equilibrium solution is thus given by

$$C_{y,q}^* = \frac{B_{Cyq}}{1 - A_{Cyq}}$$

Since this function is linear, the stable equilibrium solution requires $A_{Cyq} < 1$.

$C_{y,q}$ describes the relation between the bond risk premium and the exchange rate risk premium. This term is crucial in determining the effect of supply and demand shocks on the equilibrium exchange rate. Specifically, the effect of residual supply and liquidity preference for domestic long-term bonds on the exchange rate is respectively

$$\frac{\partial q_t}{\partial \hat{s}_t} = \frac{\tau^{-1}C_{y,q}^*}{(1-\phi_s)}, \quad \frac{\partial q_t}{\partial \lambda_t} = \frac{\gamma\eta - \tau^{-1}C_{y,q}^*}{(1-\phi_s)}$$

The proofs of propositions that regulate the signs of the derivatives will be provided in the following sections.

Substituting $V_y$ with $\Delta^* - \bar{\Delta} + C_{y,y^f}$ into (A.3), we can obtain $C_{y,y^f}$ as a function of its quadratic term. In particular,

$$C_{y,y^f} = A_{Cyy^f}(C_{y,y^f})^2 + B_{Cyy^f}(C_{y,y^f}) + K_{Cyy^f}$$

where

$$A_{Cyy^f} = \frac{2\delta^2\left(\sigma_\lambda^2 + \sigma_s^2\right)}{\tau^2\left(1-\delta\phi_s\right)^2}, \quad B_{Cyy^f} = \frac{2\delta^2\left(\sigma_\lambda^2 + \sigma_s^2\right)\Delta^*}{\tau^2\left(1-\delta\phi_s\right)^2}, \quad K_{Cyy^f} = \frac{\delta^2\rho\sigma_i^2}{\left(1-\delta\phi_i\right)^2}$$

The equilibrium solutions are

$$C^*_{y,y^f} = \frac{(1-B_{Cyy^f}) \pm \sqrt{(1-B_{Cyy^f})^2 - 4A_{Cyy^f}K_{Cyy^f}}}{2A_{Cyy^f}}$$

where $C^*_{y,y^f}$ has a real root when $(1-B_{Cyy^f})^2 - 4A_{Cyy^f}K_{Cyy^f} \geq 0$. To examine the stability of the equilibrium, we can take on the derivative of the fixed point function on the right-hand side with respect to $C_{y,y^f}$ at $C^*_{y,y^f}$. Specifically, if $C^*_{y,y^f}$ satisfies

$$2A_{Cyy^f}(C^*_{y,y^f}) + B_{Cyy^f} = \frac{2\delta^2\left(2C^*_{y,y^f} + \Delta^*\right)\left(\sigma_\lambda^2 + \sigma_s^2\right)}{\tau^2\left(1-\delta\phi_s\right)^2} < 1$$

Then $C^*_{y,y^f}$ is a stable equilibrium. Since $C^*_{y,y^f}$ is bounded below by zero, we require for any stable equilibrium

$$\frac{2\delta^2\left(\sigma_\lambda^2 + \sigma_s^2\right)\Delta^*}{\tau^2\left(1-\delta\phi_s\right)^2} < 1$$

The corresponding stable solution is thus given by

$$C^*_{y,y^f} = \frac{(1-B_{Cyy^f}) - \sqrt{(1-B_{Cyy^f})^2 - 4A_{Cyy^f}K_{Cyy^f}}}{2A_{Cyy^f}}$$

In the limiting case when $\rho \to 0$, $K_{Cyy^f} \to 0$ and $C^*_{y,y^f} \to 0$ while the other solution approaches $2(1-B_{Cyy^f}) > 0$, which validates the stability of this solution.

Finally, the equilibrium solutions for $V_y$ and $V_q$ are:

$$V_y^* = \Delta^* - \bar{\Delta} + C^*_{y,y^f}, \quad V_q^* = \frac{2\sigma_i^2\left(1-\rho\right)}{\left(1-\phi_i\right)^2} + \frac{2\left((C^*_{y,q})^2\sigma_s^2 + \sigma_\lambda^2\left(C^*_{y,q} - \eta\gamma\tau\right)^2\right)}{\tau^2\left(1-\phi_s\right)^2}.$$

## A.2 Proofs

**Proof of Proposition 1.**

It is straightforward to show that when $\sigma_s^2 = 0$ and $\sigma_\lambda^2 = 0$, Equations (A.1) to (A.4) can be collapsed into the following expressions:

$$V_y^* = \frac{\delta^2 \sigma_i^2}{(1-\delta\phi_i)^2} \tag{A.5}$$

$$V_q^* = \frac{2\sigma_i^2 (1-\rho)}{(1-\phi_i)^2} \tag{A.6}$$

$$C_{y,y^f}^* = \frac{\rho \delta^2 \sigma_i^2}{(1-\delta\phi_i)^2} \tag{A.7}$$

$$C_{y,q}^* = \frac{\delta \sigma_i^2 (1-\rho)}{(1-\phi_i)(1-\delta\phi_i)} \tag{A.8}$$

Recall the equilibrium exchange rate is

$$q_t = \frac{1}{1-\phi_i} \cdot \left(i_t - i_t^f\right) + \tau^{-1} \frac{1}{1-\phi_s} C_{y,q} \cdot \left(\hat{s}_t - \lambda_t - (\hat{s}_t^f - \lambda_t^f)\right) + \frac{\gamma\eta}{1-\phi_s} \left(\lambda_t - \lambda_t^f\right)$$

In equilibrium, the change in exchange rate in response to residual supply shock is

$$\frac{\partial q_t}{\partial \hat{s}_t} = \frac{\tau^{-1} C_{y,q}^*}{1-\phi_s} > 0$$

and the change in exchange rate in response to liquidity preference shock is

$$\frac{\partial q_t}{\partial \lambda_t} = \frac{\gamma\eta - \tau^{-1} C_{y,q}^*}{(1-\phi_s)} = \frac{\gamma\eta - \tau^{-1} \frac{\delta\sigma_i^2(1-\rho)}{(1-\phi_i)(1-\delta\phi_i)}}{(1-\phi_s)}$$

Since $\phi_s < 1$, we have $\frac{\partial q_t}{\partial \lambda_t} > 0$ when

$$\gamma\eta - \tau^{-1} \frac{\delta\sigma_i^2 (1-\rho)}{(1-\phi_i)(1-\delta\phi_i)} > 0.$$

■

**Proof of Proposition 2.**

When $\sigma_s^2 = 0$ and $\sigma_\lambda^2 > 0$, the stable equilibrium solution of $\Delta$ is:

$$\Delta^* = \frac{1 - \sqrt{1 - 4\tilde{A}\tilde{K}}}{2\tilde{A}}$$

where $\tilde{A} = \frac{\delta^2 \sigma_\lambda^2}{\tau^2 (1-\delta\phi_s)^2}$, $\tilde{K} = \delta^2 \frac{(1-\rho)\sigma_i^2}{(1-\delta\phi_i)^2} + 2\gamma\tau(1-\eta)$. The stable equilibrium solution for $C_{y,q}$ is given by

$$C_{y,q}^* = \frac{\frac{\delta^2 (1-\rho)\sigma_i^2}{\tau^2 (1-\delta\phi_i)(1-\phi_i)} - \frac{\Delta^* \delta\eta\gamma\sigma_\lambda^2}{\tau(1-\phi_s)(1-\delta\phi_s)}}{1 - \frac{\Delta^* \delta\sigma_\lambda^2}{\tau^2 (1-\phi_s)(1-\delta\phi_s)}}$$

The stable equilibrium requires the denominator of $C_{y,q}^*$ to be positive. The exchange rate change in response to the liquidity preference shock is given by

$$\frac{\partial q_t}{\partial \lambda_t} = \frac{\gamma\eta - \tau^{-1} C^*_{y,q}}{(1-\phi_s)}$$

$\frac{\partial q_t}{\partial \lambda_t} > 0$ when $\gamma\eta\tau - C^*_{y,q}$ is positive. We can divide both elements of this problem by $\gamma\eta\tau$ and get $1 - \frac{C^*_{y,q}}{\gamma\eta\tau}$. The denominator of $\frac{C^*_{y,q}}{\gamma\eta\tau}$ is given by

$$\gamma\eta\tau - \frac{\Delta^*\delta\gamma\eta\sigma^2_\lambda}{\tau\left(1-\phi_s\right)\left(1-\delta\phi_s\right)}.$$

Therefore, the problem $\gamma\eta\tau - C^*_{y,q}$ can be rewritten as

$$\left(\gamma\eta\tau - \frac{\Delta^*\delta\gamma\eta\sigma^2_\lambda}{\tau\left(1-\phi_s\right)\left(1-\delta\phi_s\right)}\right) - \left(\frac{\delta^2(1-\rho)\sigma_i^2}{\tau^2(1-\delta\phi_i)(1-\phi_i)} - \frac{\Delta^*\delta\eta\gamma\sigma^2_\lambda}{\tau\left(1-\phi_s\right)\left(1-\delta\phi_s\right)}\right)$$

Cancelling out the second term, the problem is collapsed to

$$\gamma\eta\tau - \frac{\delta^2(1-\rho)\sigma_i^2}{\tau^2(1-\delta\phi_i)(1-\phi_i)}$$

Thus, $\frac{\partial q_t}{\partial \lambda_t} > 0$ when the above term is greater than zero.

Next, we want to show that $C^*_{y,q}$ is decreasing in $\sigma^2_\lambda$ if $\gamma\eta\tau > \frac{\delta^2(1-\rho)\sigma_i^2}{\tau^2(1-\delta\phi_i)(1-\phi_i)}$. Examining $C^*_{y,q}/(\gamma\eta\tau)$ is analogous. Note that if the above condition hold, then

$$\xi(\sigma^2_\lambda) \equiv \frac{C^*_{y,q}(\sigma^2_\lambda)}{\gamma\eta\tau} = \frac{\frac{\delta^2(1-\rho)\sigma_i^2}{\tau^2(1-\delta\phi_i)(1-\phi_i)} - \frac{\Delta^*\delta\eta\gamma\sigma^2_\lambda}{\tau(1-\phi_s)(1-\delta\phi_s)}}{\gamma\eta\tau - \frac{\Delta^*\delta\gamma\eta\sigma^2_\lambda}{\tau(1-\phi_s)(1-\delta\phi_s)}}$$

Let

$$F(\sigma^2_\lambda) = \frac{\Delta^*\delta\eta\gamma\sigma^2_\lambda}{\tau\left(1-\phi_s\right)\left(1-\delta\phi_s\right)}.$$

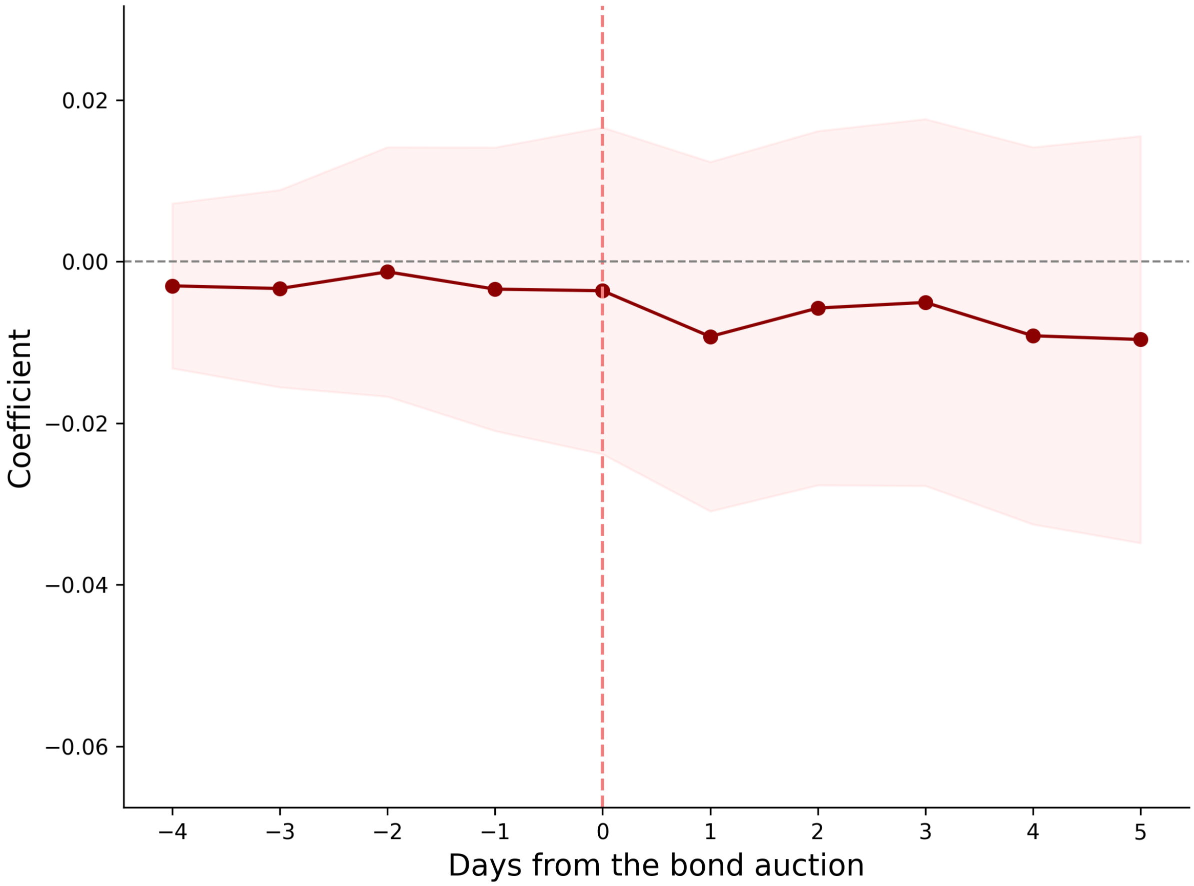
It is obvious that $F'(\sigma^2_\lambda) > 0$. One can show that, under the quotient rule:

$$\xi'(\sigma^2_\lambda) = \frac{F'(\sigma^2_\lambda)\left(\frac{\delta^2(1-\rho)\sigma_i^2}{\tau^2(1-\delta\phi_i)(1-\phi_i)} - \gamma\eta\tau\right)}{(\gamma\eta\tau - F(\sigma^2_\lambda))^2} < 0.$$

Finally, we want to show that $C^*_{y,q} < 0$ only if $\gamma\eta\tau > \frac{\delta^2(1-\rho)\sigma_i^2}{\tau^2(1-\delta\phi_i)(1-\phi_i)}$ in any stable equilibrium. Suppose instead $C^*_{y,q} < 0$ when $\gamma\eta\tau < \frac{\delta^2(1-\rho)\sigma_i^2}{\tau^2(1-\delta\phi_i)(1-\phi_i)}$. Because $\gamma\eta\tau - \frac{\Delta^*\delta\eta\gamma\sigma^2_\lambda}{\tau(1-\phi_s)(1-\delta\phi_s)} > 0$ in any stable equilibrium, then $\frac{\delta^2(1-\rho)\sigma_i^2}{\tau^2(1-\delta\phi_i)(1-\phi_i)} - \frac{\Delta^*\delta\eta\gamma\sigma^2_\lambda}{\tau(1-\phi_s)(1-\delta\phi_s)}$ must also be positive. But this implies that both the numerator and denominator of $C^*_{c,q}$ are positive, which leads to a contradiction. ■

# B Additional Figures and Tables

**Figure B.1: Dynamic Effect of Bid-to-Cover Ratio on US Treasury Yields**

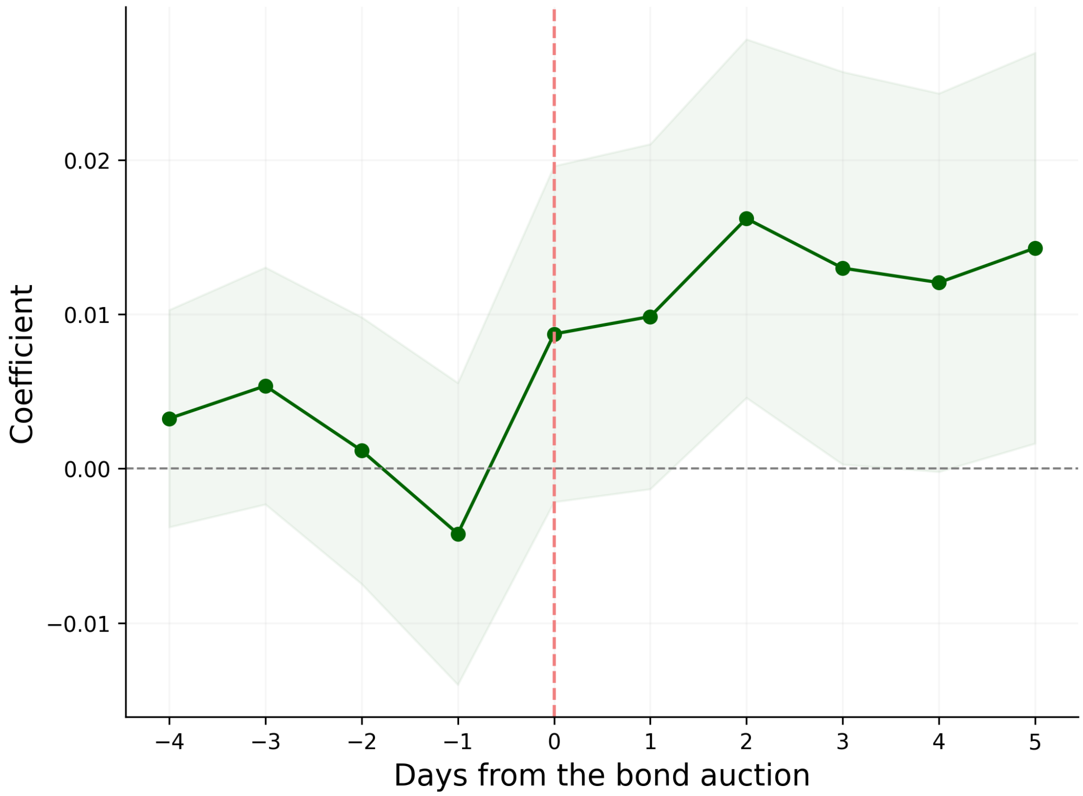



This figure plots the estimated coefficients $\beta^{y^{\$},k}$ and their 90% confidence intervals from the following regression for currency $i$, auction date $t$, and days relative to the auction $k$:

$$\Delta y^{(10)}_{\$,t-5\to t+k} = \alpha^{y^{\$},k} + \gamma_i^{y^{\$},k} + \beta^{y^{\$},k}\Delta\text{bid-to-cover}_{i,t} + \epsilon^{y^{\$},k}_{i,t-5\to t+k}$$

where $y^{(10)}_{\$}$ represents the benchmark 10-year US Treasury yield, and $\gamma_i^k$ are currency fixed effects. $\Delta$bid-to-cover denotes the change in the bid-to-cover ratio for a 10-year government bond auction relative to the average ratio over the past ten auctions. Changes in bond yields $\Delta y$ are calculated as the difference between yields five days before the auction and $k$ days to the auction. The figure plots the coefficients for $k \in [-4, 5]$. Standard errors are clustered by auction date.

**Figure B.2: Dynamic Effect of Bid-to-Cover Ratio on Treasury Bases**

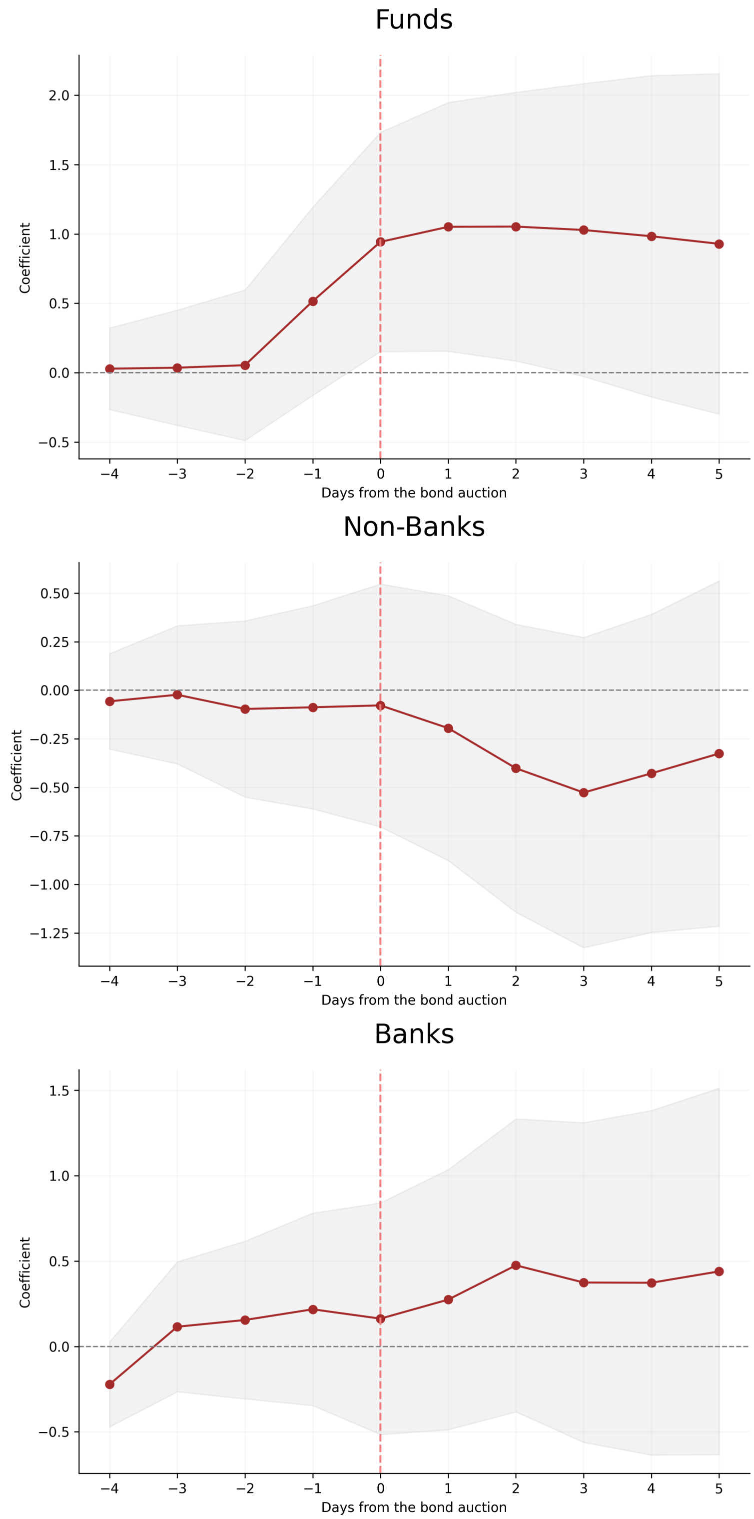



This figure plots the estimated coefficients $\beta^{CY,k}$ and their 90% confidence intervals from the following regression for currency $i$, auction date $t$, and days relative to the auction $k$:

$$\Delta CY^{(10)}_{i,t-5\to t+k} = \alpha^{CY,k} + \gamma_i^{CY,k} + \beta^{CY,k}\Delta\text{bid-to-cover}_{i,t} + \epsilon^{CY,k}_{i,t-5\to t+k}$$

where $CY_i^{(10)}$ represents the benchmark 10-year Treasury basis. $\Delta$bid-to-cover denotes the change in the bid-to-cover ratio for a 10-year government bond auction relative to the average ratio over the past ten auctions. Changes in bond yields $\Delta CY$ are calculated as the difference between Treasury bases five days before the auction and $k$ days to the auction. The figure plots the coefficients for $k \in [-4, 5]$. Standard errors are clustered by auction date.

**Figure B.3: Dynamic Effects of Bid-to-Cover Ratio on Net FX Order Flows**




This figure plots the regression coefficients $\beta_j^{Flow,k}$ for counterparty group $j$ and 90% confidence intervals of changes in net FX order flows for each investor group compared to five days prior to the bond auction on changes in bid-to-cover ratio at 10-year government bond auctions:

$$Flow^j_{i,t-5\to t+k} = \alpha_j^{Flow,k} + \gamma_{i,j}^{Flow,k} + \beta_j^{Flow,k}\Delta\text{bid-to-cover}_{i,j,t} + \epsilon_{i,j,t-5\to t+k}^{Flow,k}$$

## Table B.1: Determinants of Bid-to-Cover Ratio

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| $\overline{\text{bid-to-cover}}^{10}_{i,t-1}$ | 0.742*** | | | | 0.692*** |
| | (0.033) | | | | (0.038) |
| $Coupon_i$ | | -0.061*** | | | -0.015 |
| | | (0.018) | | | (0.019) |
| $\Delta IssueSize_i$ | | -0.282*** | | | -0.325*** |
| | | (0.052) | | | (0.047) |
| $AucYld$ | | 0.348 | | | -0.283 |
| | | (0.377) | | | (0.353) |
| $IRD^{3M}_{i,t-1}$ | | -0.007 | | | -0.019 |
| | | (0.025) | | | (0.024) |
| $IRD^{10Y}_{i,t-1}$ | | -0.021 | | | 0.020 |
| | | (0.049) | | | (0.050) |
| $AUC_{US}$ | | -0.128* | | | 0.002 |
| | | (0.067) | | | (0.060) |
| bid-to-cover$_{US}$ | | 0.028 | | | -0.019 |
| | | (0.034) | | | (0.031) |
| $VIX$ | | | -0.000 | | -0.003 |
| | | | (0.003) | | (0.003) |
| $HKM$ | | | 2.372* | | 2.200** |
| | | | (1.237) | | (1.121) |
| $R^{equity}_i$ | | | -0.340 | | -2.674 |
| | | | (1.803) | | (1.641) |
| $VOL_i$ | | | -11.606** | | -2.189 |
| | | | (5.072) | | (4.751) |
| $CDS^{10Y}_i$ | | | -0.395*** | | -0.002 |
| | | | (0.065) | | (0.070) |
| $IF_i$ | | | | -1.299 | -1.586 |
| | | | | (1.358) | (1.389) |
| $UNP_i$ | | | | 0.272*** | 0.165 |
| | | | | (0.104) | (0.105) |
| $IP_i$ | | | | 1.507*** | 0.399 |
| | | | | (0.352) | (0.336) |
| $GOV_i$ | | | | 7.328*** | 3.275* |
| | | | | (1.488) | (1.670) |
| $\Delta Debt_i$ | | | | -0.029*** | -0.012*** |
| | | | | (0.005) | (0.004) |
| Currency FE | Yes | Yes | Yes | Yes | Yes |
| N | 1901 | 1860 | 1784 | 1894 | 1745 |
| $R^2$ (within) | 0.209 | 0.033 | 0.033 | 0.032 | 0.238 |

This table reports the regression results for determinants of bid-to-cover ratios. The dependent variable is the bid-to-cover ratio for 10-year government bond auctions in country $i$. Independent variables include the average bid-to-cover ratio from the past ten auctions ($\overline{\text{bid-to-cover}}^{10}$), the coupon rate of the auctioned bond ($Coupon$), the difference between the average auction yield and the benchmark yield ($AucYld$), the change in issuance size from the previous auction ($\Delta IssueSize$), the 3-month interest rate differential between the domestic and US rates ($IRD^{3M}$), the 10-year interest rate differential ($IRD^{10Y}$), the 7-year or above US Treasury auction indicator ($AUCUS$), and the bid-to-cover ratio of the most recent US 10-year Treasury auction (bid-to-cover$_{US}$), VIX ($VIX$), the capital market factor ($HKM$), MSCI equity returns ($R^{equity}$), MSCI volatility ($VOL$), the 10-year CDS spread ($CDS^{10Y}$), CPI inflation ($IF$), the unemployment rate ($UNP$), industrial production growth ($IP$), government expenditures as a percentage of GDP ($GOV$), and changes in the debt-to-GDP ratio ($\Delta Debt$). Standard errors clustered by auction dates are in parentheses. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

**Table B.2: Regressions on Exchange Rates with Foreign Bond Ownership**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\Delta$bid-to-cover | 0.170*** | 0.167** | 0.170*** | 0.168** |
| | (0.065) | (0.065) | (0.065) | (0.066) |
| $\Delta$bid-to-cover$\times\Delta FO^{All}$ | -0.024 | | | |
| | (0.029) | | | |
| $\Delta FO^{All}$ | 0.003 | | | |
| | (0.009) | | | |
| $\Delta$bid-to-cover$\times\Delta FO^{NonBank}$ | | -0.012 | | |
| | | (0.028) | | |
| $\Delta FO^{NonBank}$ | | 0.013 | | |
| | | (0.009) | | |
| $\Delta$bid-to-cover$\times\Delta FO^{Bank}$ | | | -0.089 | |
| | | | (0.110) | |
| $\Delta FO^{Bank}$ | | | -0.009 | |
| | | | (0.028) | |
| $\Delta$bid-to-cover$\times\Delta FO^{Official}$ | | | | -0.032 |
| | | | | (0.048) |
| $\Delta FO^{Official}$ | | | | -0.026** |
| | | | | (0.013) |
| Currency FE | Yes | Yes | Yes | Yes |
| N | 1781 | 1781 | 1781 | 1781 |
| $R^2$ (within) | 0.005 | 0.006 | 0.005 | 0.008 |

This table reports the results for the regressions of the following form:

$$\Delta q_{i,t} = \alpha^{FO,q} + \gamma_i^{FO,q} + \beta_1^{FO,q}\Delta\text{bid-to-cover}_{i,t} + \beta_2^{FO,q}\Delta\text{bid-to-cover}_{i,t}\times\Delta FO_{i,t} + \beta_3^{FO,q}\Delta FO_{i,t} + \epsilon_{i,t}^{FO,q}$$

where the dependent variable is $\Delta q$. $\Delta FO$ denotes the quarterly change in the foreign ownership of domestic general government debt, as the value of foreign holdings of general government debt scaled by the total value of government debt. Foreign ownership is further broken down into four categories by investor type: *All* refers to total ownership, *NonBank* refers to ownership by non-bank institutions, *Bank* represents ownership by banks, and *Official* refers to ownership by central banks. Standard errors clustered by auction date are in parentheses, *p<0.1; **p<0.05; ***p<0.01.

**Table B.3: Regressions on Exchange Rates with FX Flows**

| | Contemporaneous | | | During Auctions | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Δbid-to-cover | | | | 0.258*** | 0.252*** | 0.263*** |
| | | | | (0.092) | (0.093) | (0.092) |
| $Flow^{Fund}$ | 0.018*** | | | 0.015 | | |
| | (0.004) | | | (0.018) | | |
| $Flow^{Nonbank}$ | | 0.036*** | | | 0.002 | |
| | | (0.005) | | | (0.022) | |
| $Flow^{Bank}$ | | | -0.019*** | | | -0.008 |
| | | | (0.005) | | | (0.017) |
| Currency FE | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 18386 | 18223 | 18414 | 956 | 947 | 956 |
| $R^2$ (within) | 0.001 | 0.006 | 0.001 | 0.013 | 0.011 | 0.012 |

Columns (1) to (3) of this table report the results for the following regressions to examine the contemporaneous relations between exchange rates and foreign exchange (FX) flows:

$$\Delta q_{i,t} = \alpha^F + \gamma_i^F + \beta^F \Delta Flow_{i,t} + \epsilon_{i,t}^F$$

where the dependent variable is $\Delta q_i$. $Flow_i$ is the normalized daily net FX spot order flows, measured as the net buy volume of order flows for currency $i$ from USD, scaled by the 60-day rolling volatility. $Fund$ refers to FX order flows from investment funds, $NonBank$ to non-bank financial institutions, and $Bank$ to dealer banks.
Columns (4) to (6) report the results of the following regressions:

$$\Delta q_{i,t} = \alpha^{q,F} + \gamma_i^{q,F} + \beta_1^{q,F} \Delta\text{bid-to-cover}_{i,t} + \beta_2^{q,F} \Delta Flow_{i,t} + \epsilon_{i,t}^{q,F}$$

where the dependent variable is $\Delta q_i$, Δbid-to-cover is the change of the bid-to-cover ratio from the average of the past ten auctions. Standard errors clustered by auction date are in parentheses, $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

**Table B.4: Regressions with Intermediary Constraints**

| | $\Delta y^{(10Y)}$ | $\Delta q$ | $\Delta CY^{(10Y)}$ |
|---|---|---|---|
| **Panel A** | | | |
| $\Delta\|CIP\|^{libor}\times\Delta$bid-to-cover | -0.226 | -0.011 | 0.160 |
| | (0.145) | (0.019) | (0.157) |
| $\Delta$bid-to-cover | -0.030*** | 0.002*** | 0.011*** |
| | (0.004) | (0.001) | (0.004) |
| $\Delta\|CIP\|^{libor}$ | -0.023 | -0.006 | -0.051 |
| | (0.034) | (0.005) | (0.042) |
| Currency FE | Yes | Yes | Yes |
| N | 1866 | 1866 | 1724 |
| $R^2$ (within) | 0.036 | 0.006 | 0.010 |
| **Panel B** | | | |
| $\Delta VIX \times \Delta$bid-to-cover | 0.055 | 0.009 | -0.032 |
| | (0.059) | (0.011) | (0.072) |
| $\Delta$bid-to-cover | -0.030*** | 0.001** | 0.010** |
| | (0.005) | (0.001) | (0.004) |
| $\Delta VIX$ | -0.033** | -0.023*** | -0.079*** |
| | (0.015) | (0.003) | (0.017) |
| Currency FE | Yes | Yes | Yes |
| N | 1875 | 1875 | 1728 |
| $R^2$ (within) | 0.034 | 0.062 | 0.019 |
| **Panel C** | | | |
| $\Delta VOL_{MSCI} \times \Delta$bid-to-cover | -0.118 | 0.000 | -0.021 |
| | (0.077) | (0.017) | (0.082) |
| $\Delta$bid-to-cover | -0.030*** | 0.002** | 0.012*** |
| | (0.004) | (0.001) | (0.004) |
| $VOL_{MSCI}$ | -0.037 | -0.005 | 0.072*** |
| | (0.023) | (0.005) | (0.023) |
| Currency FE | Yes | Yes | Yes |
| N | 1901 | 1901 | 1751 |
| $R^2$ (within) | 0.034 | 0.006 | 0.011 |

This table report the results for the following regressions:

$$\Delta X_{i,t} = \alpha^X + \gamma_i^X + \beta_1^X \Delta\text{bid-to-cover}_{i,t} + \beta_2^X \Delta\text{bid-to-cover}_{i,t} \times \Delta B_{i,t} + \beta_3^X \Delta FO_{i,t} + \epsilon_{i,t}^X$$

where $\Delta X$ represents the dependent variable, including the daily changes in 10-year bond yields $y^{(10Y)}$, logged exchange rates $q$, and 10-year Treasury bases $CY^{(10Y)}$. $B$ denotes the proxy for balance-sheet constraints, where Panel A uses the absolute 3-month covered interest rate parity (CIP) deviations under LIBOR rates, Panel B uses the VIX index, and Panel C uses the MSCI equity volatility index. Standard errors clustered by auction date are in parentheses, *p<0.1; **p<0.05; ***p<0.01.

### Table B.5: Bid-to-Cover Ratio and Changes in Government Bond Ownership

| (in %) | $\Delta FO^{All}_{it+1}$ | $\Delta FO^{Official}_{it+1}$ | $\Delta FO^{Bank}_{it+1}$ | $\Delta FO^{NonBank}_{it+1}$ | $\Delta DO^{All}_{it+1}$ | $\Delta DO^{Official}_{it+1}$ | $\Delta DO^{Bank}_{it+1}$ | $\Delta DO^{NonBank}_{it+1}$ |
|---|---|---|---|---|---|---|---|---|
| $\Delta$bid-to-cover$_i$ | 0.572*** | -0.087 | 0.026 | 0.634*** | -0.572*** | 0.261 | -0.208 | -0.625*** |
| | (0.217) | (0.118) | (0.057) | (0.216) | (0.217) | (0.185) | (0.194) | (0.204) |
| $Coupon_i$ | 0.264*** | 0.041 | 0.020 | 0.203*** | -0.264*** | -0.305*** | 0.162*** | -0.120** |
| | (0.048) | (0.032) | (0.013) | (0.048) | (0.048) | (0.054) | (0.044) | (0.051) |
| $\Delta IssueSize_i$ | 0.068 | -0.110* | -0.018 | 0.195 | -0.068 | -0.145 | 0.078 | -0.001 |
| | (0.135) | (0.065) | (0.033) | (0.136) | (0.135) | (0.093) | (0.165) | (0.154) |
| $\Delta IRD^{3M}_{i,t}$ | 2.251** | 0.801 | -0.234 | 1.683 | -2.251** | -0.086 | 1.499 | -3.664*** |
| | (1.056) | (0.590) | (0.199) | (1.329) | (1.056) | (0.745) | (1.027) | (1.176) |
| $AucYld$ | 3.734*** | 1.439* | 0.643** | 1.652 | -3.734*** | -2.382** | 0.108 | -1.460 |
| | (1.320) | (0.778) | (0.255) | (1.371) | (1.320) | (1.214) | (1.169) | (1.317) |
| $AUC_{US}$ | -0.138 | 0.047 | -0.025 | -0.160 | 0.138 | 0.096 | 0.099 | -0.057 |
| | (0.165) | (0.109) | (0.050) | (0.165) | (0.165) | (0.202) | (0.172) | (0.178) |
| bid-to-cover$_{US}$ | -0.004 | -0.015 | 0.010 | 0.001 | 0.004 | -0.031 | -0.021 | 0.057 |
| | (0.086) | (0.066) | (0.029) | (0.087) | (0.086) | (0.078) | (0.081) | (0.097) |
| $\Delta VIX$ | 0.097 | 0.852 | -0.036 | -0.718 | -0.097 | 0.947 | -0.106 | -0.938 |
| | (0.834) | (0.580) | (0.257) | (0.826) | (0.834) | (0.871) | (0.774) | (0.886) |
| $HKM$ | 7.339* | 4.180* | -0.942 | 4.101 | -7.339* | -3.243 | 0.657 | -4.753 |
| | (4.333) | (2.396) | (0.849) | (4.127) | (4.333) | (4.024) | (4.250) | (5.688) |
| $R^{equity}_i$ | -0.563 | -0.631 | -1.236 | 1.303 | 0.563 | -2.501 | 1.544 | 1.521 |
| | (4.967) | (2.889) | (1.136) | (5.312) | (4.967) | (4.725) | (5.058) | (5.516) |
| $VOL_i$ | -26.956** | -30.987*** | -2.240 | 6.274 | 26.953** | 62.383*** | 31.725*** | -67.155*** |
| | (10.531) | (5.872) | (2.658) | (9.474) | (10.531) | (13.055) | (10.414) | (10.534) |
| $IF_i$ | 3.987 | 1.440 | -3.540*** | 6.087* | -3.987 | -23.589*** | 4.052 | 15.549*** |
| | (3.357) | (1.760) | (0.935) | (3.694) | (3.357) | (2.903) | (3.396) | (3.733) |
| $UNP_i$ | 0.740*** | -0.074 | -0.026 | 0.841*** | -0.740*** | 0.914*** | 0.405* | -2.059*** |
| | (0.285) | (0.139) | (0.053) | (0.274) | (0.285) | (0.319) | (0.241) | (0.354) |
| $IP_i$ | 0.924 | -1.473*** | -0.564*** | 2.962*** | -0.924 | -0.891 | 1.095 | -1.129 |
| | (0.992) | (0.497) | (0.215) | (1.034) | (0.992) | (0.905) | (0.860) | (0.832) |
| $GOV_i$ | 12.457** | -5.497 | -0.057 | 18.012** | -12.458** | 1.387 | -13.538*** | -0.306 |
| | (5.822) | (3.389) | (0.890) | (7.556) | (5.822) | (4.071) | (4.615) | (4.909) |
| $\Delta Debt_i$ | 0.005 | 0.012* | 0.005** | -0.012 | -0.005 | 0.027** | -0.021** | -0.010 |
| | (0.009) | (0.006) | (0.002) | (0.011) | (0.009) | (0.012) | (0.009) | (0.010) |
| Currency FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 1732 | 1732 | 1732 | 1732 | 1732 | 1732 | 1732 | 1732 |
| $R^2$ (within) | 0.055 | 0.027 | 0.022 | 0.040 | 0.055 | 0.152 | 0.058 | 0.109 |

This table presents the regression results for the following specification:

$$Own^j_{i,t+1} = \alpha^O_j + \gamma^O_{i,j} + \beta^O_j \Delta\text{bid-to-cover}_{i,t} + \text{controls}_{i,t} + \epsilon^O_{i,j,t+1}$$

where the dependent variable $Own_{i,t+1}$ represents the next-quarter ownership in percentage points for government debt of country $i$. $FO$ denotes the ownership by foreign investors, and $DO$ denotes the ownership by domestic investors. $j$ denotes the investor type: $All$ refers to total ownership, $NonBank$ refers to ownership by non-bank institutions, $Bank$ represents ownership by banks, and $Official$ refers to ownership by central banks. Standard errors clustered by auction date are in parentheses, *p<0.1; **p<0.05; ***p<0.01.

**Table B.6: Credit Default Swap (CDS) Spreads, Bond Yields, and Corporate Bond Spreads**

| | Government bond yields | | | Corpbond-sovereign spreads | | |
|---|---|---|---|---|---|---|
| | $\Delta y^{(10Y)}$ | $\Delta y^{(5Y)}$ | $\Delta y^{(3Y)}$ | $\Delta CB^{(LT)}$ | $\Delta CB^{(MT)}$ | $\Delta CB^{(ST)}$ |
| $\Delta CDS^{(10Y)}$ | -0.288*** | | | 0.166*** | | |
| | (0.029) | | | (0.036) | | |
| $\Delta CDS^{(5Y)}$ | | -0.390*** | | | 0.132*** | |
| | | (0.051) | | | (0.027) | |
| $\Delta CDS^{(3Y)}$ | | | -0.273*** | | | 0.135*** |
| | | | (0.027) | | | (0.025) |
| Currency FE | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 37788 | 40034 | 36825 | 30189 | 32878 | 33141 |
| $R^2$ (within) | 0.014 | 0.018 | 0.012 | 0.002 | 0.003 | 0.003 |

This table presents the results for the contemporaneous regressions of bond yields and IG corporate bond-sovereign yield spreads on CDS spreads. The dependent variables for the first three columns $\Delta y$ are the daily changes in government bond yields. The yields have bond maturities of 10-year, 5-year, and 3-year, respectively. The dependent variables for the next three columns $\Delta CB$ are the IG corporate bond-sovereign yield spreads. The yield spreads are categorized as long-term ($LT$), medium-term ($MT$), and short-term ($ST$). Standard errors clustered by auction date are in parentheses, *p<0.1; **p<0.05; ***p<0.01.