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Foreign investment dynamics: The impact of benchmark-driven versus unconstrained investors on local credit conditions*

Oscar Botero-Ramírez† Andrés Murcia‡ Mauricio Villamizar-Villegas§

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Abstract

We examine the impact of foreign investor heterogeneity on local lending, focusing on Colombia from 2014 to 2023. Distinguishing between benchmark-driven and unconstrained investors, we highlight their differing responses to global and idiosyncratic shocks. Using bond-level data and the corporate credit registry, we link banks' exposure to foreign flows with firm-level lending decisions. By decomposing Colombia's weight in the J.P. Morgan GBI-EM index into valuation and exogenous components, we identify how investor behavior shapes bank balance sheets. Our main findings show that banks with greater exposure to unconstrained investors significantly expand lending during capital inflows, whereas those linked to benchmark-driven investors exhibit a more muted response. These results emphasize the role of investor composition in financial stability and provide key insights for policymakers in emerging markets.

JEL Classification: F3, F4, G01, G11, G12, G15

Keywords: Capital flows; foreign investment; investor classification; J.P. Morgan GBI-EM index; emerging markets

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1 Introduction

From the Great Financial Crisis of 2008-2009 to the inflation surge of 2021-2023, persistently low interest rates in advanced economies prompted investors to seek higher returns in emerging market economies (EMEs). Studies by Peiris (2010) and Forbes and Warnock (2012) highlight that these substantial portfolio inflows had favorable effects on local financial conditions. Among the benefits were lower sovereign bond yields, which reduced government financing costs, and a decline in fiscal debt currency mismatches due to reduced reliance on foreign currency debt. Additionally, the sell-off of sovereign bonds by local banks has been shown to increase lending through the crowding-out channel, a phenomenon extensively documented by Ilzetzki et al. (2013); Chodorow-Reich (2014); Bruno and Shin (2015b); Williams (2018), and Önder et al. (2024). Namely, as primary counterparts to foreign investors, banks adjust lending in response to inflows (or outflows), potentially amplifying the positive (negative) effects on firm investment.

However, an important part of the literature highlights the risks associated with increased foreign participation in local markets, given the heightened sensitivity and pro-cyclicality of these flows.[1] For instance, a sudden shift in international investor sentiment can trigger large scale sell-offs of local assets, leading to price declines and currency depreciation. While the macroeconomic effects of these dynamics are well-documented, fewer studies examine their influence on banking sector lending.

Our investigation contributes to this emerging literature by distinguishing between the types of foreign investors and, in particular, the trading strategies associated with each. Specifically, we classify these strategies as either active or passive depending on the use of international benchmark indices in their investment portfolio' decisions. Passive strategies, or *benchmark-driven strategies*, are highly responsive to global factors and changes in index weights, as their positions are designed to replicate specific indices. In contrast, active strategies, or *unconstrained strategies*, respond more to idiosyncratic factors. While active investors may also consider benchmark indices in their decisions, their primary objective is to outperform these indices consistently.

We argue that differences in trading strategies lead to distinct effects on the macroeconomic and financial conditions of EMEs. In response to a global financial shock, both benchmark-driven and unconstrained investors are likely to react, but benchmark-driven

[1] See Obstfeld (2012); Ebeke and Lu (2015); Ebeke and Kyobe (2015) and Cerutti et al. (2015).

investors tend to respond more rapidly. Conversely, in the case of an idiosyncratic shock, unconstrained investors typically react first. Thus, the origin of the shock influences whether these atomized strategies exacerbate booms and busts or instead act as macroeconomic stabilizers. In our analysis, we show that the banking sector takes into account the trading behavior of these flows –such as their volatility, frequency, and magnitude– and adjusts its balance sheets accordingly, with notable implications for lending decisions.

Our case study focuses on Colombia during 2014 to 2023, a country that serves as a representative example of a small open economy with foreign participation in its sovereign bond market comparable to the regional average. A key advantage of our setting is access to granular, bond-level data tracking individual foreign bondholders over time, an uncommon resource even for central banks. We also use the entire administrative corporate credit registry to assess how portfolio decisions influence credit conditions. By integrating these micro-level datasets, we link banks with varying levels of exposure to foreign flows with the specific credit they provide to firms.

For identification, we first apply the method developed by Arslanalp et al. (2020) to separate the exogenous component from the valuation component of Colombia's weight in the J.P. Morgan Government Bond Index-Emerging Markets (GBI-EM). To provide context, the GBI-EM is the dominant benchmark in global markets for EMEs, with over $300 billion USD in assets tracking the index annually, according to the 2018 J.P. Morgan's Global Index Research. Colombia, as part of a 72-country portfolio, experiences significant capital flows influenced by its time-varying weight in the index (see Romero et al., 2021). Using this decomposition, we categorize foreign investors based on their degree of indexation. To validate this classification, we compare our findings with some in-house central bank surveys of foreign investors actively participating in this market. Additionally, we test whether the use of FX (COP/USD) forward positions is less prevalent among benchmark-driven investors, given that a key feature of the GBI-EM index is its unhedged nature, exposing investors to the exchange rate risk in each country.

In a second step, we show that local banks are the primary counterparts to foreign agents in the sovereign bond market, with bank-investor relationships typically sticky and concentrated in a few banks, a phenomenon known as *fund funneling*. Specifically, we show that an increase in a bank's exposure to foreign investors, equivalent to $100 million USD, predicts an average bond sale of $75 million USD over 10 months, representing a permanent 75% reduction in the bank's bond portfolio.

We then turn to the credit market to test whether the crowding-out channel differs for banks exposed to benchmark-driven investors. To strengthen our identification, when evaluating the effects on firm credit, we employ firm-bank and firm-time fixed effects. The former control for observed and unobserved time-invariant differences in bank-firm relationships, while the latter account for time-varying credit demand. Crucially, because we observe firms with multiple banking relationships, firm-time fixed effects eliminate any demand shock affecting the same firm, consistent with the approach of Khwaja and Mian (2008).

Our results reveal that banks with higher exposure[2] to benchmark-driven investors exhibit a limited lending response during periods of high portfolio inflows, reflecting a greater sensitivity to global factors associated with these investors. In contrast, banks with higher exposure to unconstrained investors significantly increase their lending during periods of capital inflows, in line with a more pronounced sensitivity to local factors. These findings have important implications for financial stability. While flows from unconstrained investors exert a stronger influence on banks' balance sheets, they also exhibit greater procyclicality, amplifying fluctuations in loan issuance during periods of rapid inflows or outflows. Understanding these dynamics is essential for mitigating risks and ensuring the stability of the financial system.

In a third step, we gain macro-financial insights by investigating whether banks respond differently to global financial conditions depending on the type of foreign investor they engage with. We find that banks that are more tightly exposed to benchmark-driven investors tend to be more procyclical to global factors, amplifying the effects of global shocks on local credit conditions. The opposite holds for banks that are more exposed to unconstrained investors. Finally, we explore the role of macroprudential policies, specifically, foreign exposure limits, focusing on banks with higher exposure to benchmark-driven investors. Given the higher volatility of this type of foreign investor, we find that banks that buy more bonds from them to react more when in close proximity of regulatory constraints.

Overall, our study confirms that financial globalization significantly shapes domestic capital markets, particularly in EMEs. Foreign investors respond to government policies by adjusting their bond holdings based on perceived debt repayment risk. More importantly, we show that atomized foreign investors influence the domestic banking sector differently according to their trading strategies, ultimately affecting the balance sheet decisions of local banks. These findings offer valuable insights for financial regulators, supervisors, and

[2]By higher exposure, we refer to a higher trading volume in sovereign bonds

monetary authorities, especially as EMEs increasingly rely on foreign investors in local currency debt markets, increasing capital flow volatility during stress periods.

Our investigation aims to bridge the crowding-out literature with research that offers a more nuanced characterization of capital flows. Traditional analyses of foreign investor composition in emerging public debt markets classify agents based on their investment vehicles and sources of financing (Bertaut et al., 2023). A growing body of work, however, classifies foreign investors by their dependence on external reference indices when investing in these markets. Notable examples include Balston and Melin (2013), Arslanalp and Tsuda (2015), Raddatz et al. (2017), and Arslanalp et al. (2020), which use panel data on public debt holdings and global investments tracking the GBI-EM index. These studies consistently show that benchmark-driven investments amplify the impact of external factors, weakening the role of domestic fundamentals and increasing the risk of outflows disconnected from local economic conditions.

Nevertheless, some evidence in the literature suggests that passive investors also respond to local factors. For example, Balston and Melin (2013) show that while active flows respond exclusively to negative rating actions, passive flows react to both positive and negative ratings. An alternative perspective is offered in Cormier and Naqvi (2023), which suggests that a country's fundamentals (such as debt levels, fiscal deficits, GDP levels, and government partisanship) only significantly impact countries with low representation or excluded from benchmark indices. The authors argue that highly indexed countries tend to relax their fiscal discipline in the short term, as they can secure access to sovereign bond markets.

This paper is organized as follows: Section 2 provides an overview of the Colombian context and data sources. Section 3 outlines the methodology for classifying benchmark-driven investors and their FX-hedging behaviors. In Section 4 we show that local banks act as primary counterparts to foreign investors, and how increasing bank liquidity is redirected into corporate credit depending on the type of foreign investor. This section also explores the interaction between investment strategies and macroprudential policies such as foreign exposure limits. Finally, Section 5 concludes.

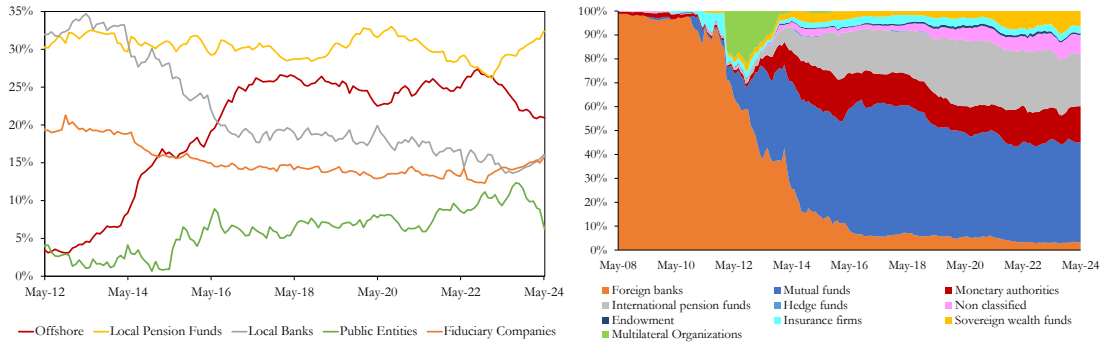
2 Colombian context and data

2.1 Colombian context

As illustrated in Figure 1a, foreign investment in Colombia's sovereign bond market experienced a substantial increase in 2014. Prior to this, foreign participation was minimal and primarily comprised foreign banks with steady but modest demand (Figure 1b). The significant rise in investment post-2014 can be attributed to three main factors:

- **Colombia's investment-grade rating:** Colombia achieved an investment-grade rating in 2011 from agencies such as S&P, Moody's, and Fitch Ratings, which enhanced its attractiveness to international investors.
- **Reforms to foreign capital investment regulations:** Substantial changes to Colombia's General Regime of Foreign Capital Investments facilitated foreign investment. A 2012 tax reform reduced income tax on government bonds for non-resident investors (from 33% to 14%) and allowed investments through local managers. Further, in 2013, the withholding tax on fixed-income securities was simplified, easing entry barriers for foreign investors.
- **Increased weight in the J.P. Morgan GBI-EM Index:** In 2014, Colombia's weight in the J.P. Morgan GBI-EM Index rose from 3.9% to 8.0%. This led to a surge in foreign demand for Colombian bonds, reshaping the portfolio composition of the entire banking system. Foreign investors expanded their market share from 3% before 2014 to over 25% by 2018, becoming the second-largest market group after local pension funds. According to Romero et al. (2021), this index adjustment led to approximately $9 billion USD in capital inflows during 2014, a year that notably recorded the highest-ever inflows to Colombia's sovereign bond market.

Figure 1: Foreign participation in the Colombian sovereign bond market



(a) Total bond holdings by entity (b) Bond holdings across foreign investors

Source: Central Securities Depository (DCV) at the Central Bank of Colombia. Panel A illustrates sovereign bond market participation across various entities, while Panel B focuses on the share held by foreign investors.

The increased participation of foreign investors has profoundly influenced local financial dynamics. One notable impact has been a reduction in bond yields, driven by heightened demand for Colombian bonds (Ocampo et al., 2020; Romero et al., 2021). Additionally, a crowding-out effect on lending has been observed, as local banks –serving as primary counterparts to foreign portfolio flows– adjust their bond holdings in response to foreign demand (Williams, 2018). This reallocation affects their lending capacity, with downstream effects on lending, investment, and spending decisions.

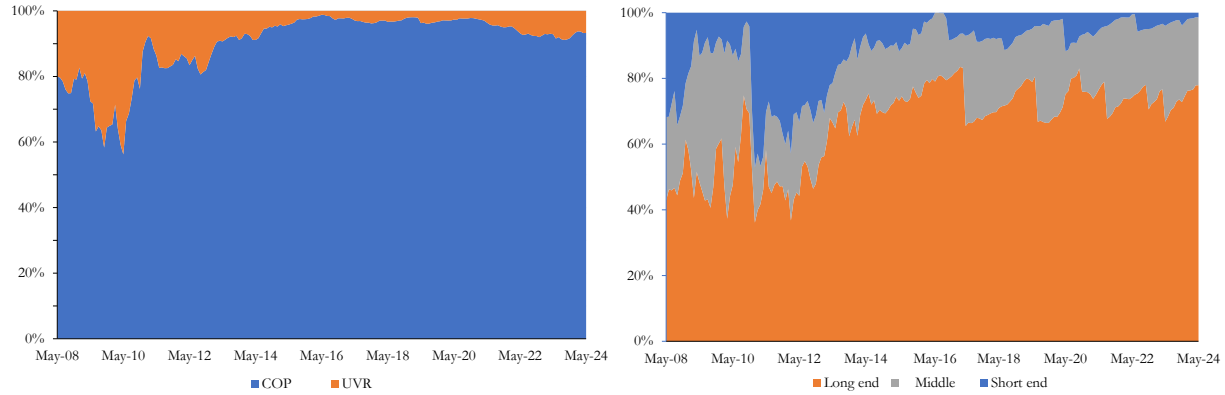
This interplay between debt market activity and credit conditions constitutes the foundation of our research, highlighting the broader financial implications of foreign participation in Colombia's sovereign bond market. Our study brings a novel perspective by distinguishing the effects of more consistent, "unconstrained", investments from those driven by benchmark-oriented flows. This distinction provides a more nuanced understanding of the financial impact of foreign investment in EMEs.

An initial characterization of foreign investors is presented in Figure 2. Before 2014, foreign banks held the largest share of sovereign bonds among foreign investors, although their overall market participation was relatively low. Since 2014, mutual funds have emerged as the dominant investors, followed by international pension funds and monetary authorities. This shift in investor composition has significantly influenced investment strategies in at least two ways. First, as shown in Figure 2a, demand for Colombian peso (COP)-denominated bonds has increased, while demand for inflation-indexed bonds has declined. Second, as illustrated in Figure 2b, bond maturities have shifted toward the longer end of the yield

curve, specifically bonds with durations of five years or more.

Notably, investors can differ in their levels of indexation to benchmark indices, which heavily influence their decisions to enter or exit a market. In particular, banks consider the duration and consistency of portfolio capital flows when making lending and other financial decisions. These dynamics are explored further in Section 4.

Figure 2: Foreign investors' bonds holdings by currency and maturity



(a) By currency

(b) By segment of the curve

Source: DCV, authors' calculations. The long end of the yield curve includes securities with a term to maturity $\geq$ 5 years. The short end includes securities with a term to maturity of $\leq$ 2 years. The middle part includes the remaining references.

2.2 Data

For the period between January 2014 and August 2023, we employ detailed granular microdata on the purchases and sales of domestic currency sovereign bonds by foreign investors. This data, recorded at the individual bond and investor level, is maintained by the Central Securities Depository (DCV, for its Spanish acronym) at the Central Bank of Colombia. The bonds are denominated either in COP or indexed to inflation. All transactions take place through four main channels: (i) Master Trader, operated by the Colombian Stock Exchange, (ii) the Electronic Trading System (SEN), exclusively used by primary dealer banks and managed by the Central Bank of Colombia, (iii) three main brokers, GFI, SET ICAP and Tradition, and (iv) the Over-the-Counter (OTC) market, where transactions take place through bilateral negotiations.

Our focus is on sovereign bonds, as they represent the largest share of Colombia's public debt. For instance, as of April 2024, sovereign bonds accounted for 60% of the country's total

debt, according to the Ministry of Finance. To the best of our knowledge, very few central banks worldwide have access to such detailed bond-level data on foreign bondholders over time, making this dataset particularly valuable for our research. In addition, we use monthly credit registry data from the Colombian Financial Superintendence (SFC, for its Spanish acronym) on new corporate sector banking loans for the same period. While the data are collected quarterly, banks are required to report all active loans on a monthly basis.

Descriptive statistics are presented in Table 1. As shown in the table, the average amount that a foreign investor trades in sovereign bonds is approximately $33 billion COP, while the mean trading volume between a local bank and foreign investors in sovereign bonds is $347 billion COP. Regarding corporate loans, the average new bank-firm loan size is $1.2 billion COP, with a mean interest rate of 17.2%, and the monthly average of new bank-firm loans is 430.

Table 1: Descriptive statistics for monthly aggregated data

	Obs	Mean	Std	Min	Max
Sovereign bonds data					
foreign investor flows (COP billion)	13,144	33	104	0	3,349
bank-foreigners flows* (COP billion)	660	347	423	0	4286
Corporate loans data					
loan amount (COP billion)	228,212	1.2	10.5	0.0	1,869
loan rate (%)	228,212	17.2	9.8	0.0	49.6
monthly bank-firm loans**	228,212	434	864	1	7,756

Note: Authors' calculations. Data on sovereign bonds are from the Central Securities Depository (DCV) and data on commercial loans are from the Colombian Financial Superintendence (SFC).
* Denotes each bank's order book with foreign clients in sovereign bonds (with higher values indicating a bank that actively trades with foreign investors).
** This refers to the monthly count of new loans given by banks to firms.

3 Identification strategy

3.1 Teasing out exogenous and valuation components

It is possible to track changes in an issuer's weight within a sovereign bond reference index. However, the underlying drivers of these movements are not always clear. For instance, currency appreciation or changes in bond prices can directly influence the issuer's weight in the index. Additionally, exogenous factors, such as decisions by the index provider, may also impact the weighting.

We focus on the case of the dominant benchmark index in local-currency emerging debt markets, the J.P. Morgan GBI-EM Index. Unlike a fixed-weight index, the GBI-EM assigns

weights based on the market capitalization of each issuer's eligible bonds. As a result, an issuer's weight in the index is not constant but fluctuates monthly in response to changes in market variables - such as exchange rates and bond prices - as well as the index's rebalancing rules. As proposed by Arslanalp et al. (2020), changes in an issuer's weight within this index can be decomposed into two components: a valuation component and an exogenous component. Specifically, the monthly variation in a country's weight is determined by:

$$\Delta w_{ct+1} = \underbrace{(w_{ct} * \frac{R_{ct}}{R_{bt}} - w_{ct})}_{\text{valuation}} + \underbrace{(w_{ct+1} - w_{ct} * \frac{R_{ct}}{R_{bt}})}_{\text{exogenous}}, \tag{1}$$

where w_{ct} represents the weight of issuer c in month t, R_{ct} denotes the monthly returns of issuer c's references included in the index, and R_{bt} refers to the monthly returns of the references of all issuers within the index.

Intuitively, the first term of the expression represents the valuation component, capturing the portion of an issuer's monthly weight variation due to the relative appreciation or depreciation of its currency and bonds compared to other issuers in the index. The second term, the exogenous component, accounts for residual weight variations arising from the index's rebalancing rules.

In this context, since the GBI-EM is a market-capitalization index, a purely benchmark-driven investor would trade bonds only if weight changes were driven by the exogenous component, which can be calculated using publicly available J.P. Morgan data (Figure 3). The intuition behind this is that weights in this index automatically adjust to changes in the valuation component. Because valuation changes are also automatically reflected in the investor's exposure to an issuer's bonds, there's no need to trade bonds due to weight adjustments from that component. This dynamic contrasts with that of a fixed-weight index. Investors tracking this type of index would adjust their holdings in response to changes in their portfolio value, since they seek to adjut their exposure to a constant weight, i.e., one that doesn't adjust to valuation changes.

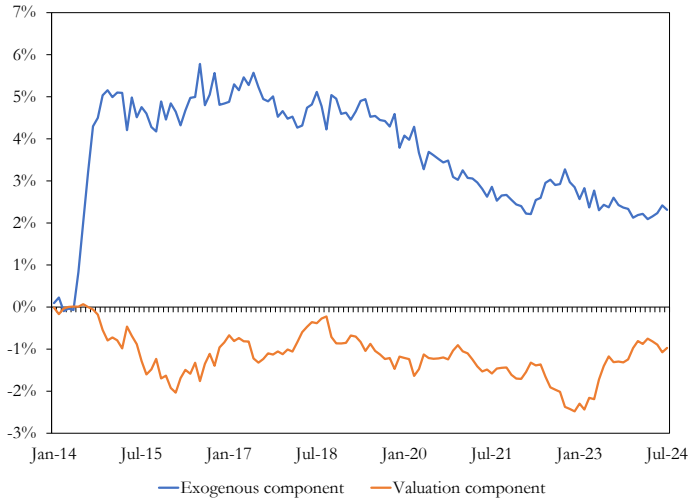
Consider an ilustrative example where issuer c's weight in the index is 4.00% at the start of a given month. Assuming the issuer's currency appreciates by 1.00% against the dollar and its bond basket gains 0.50%, the total return of its references in the index would be 1.50% (R_{ct} as in equation 1). Suppose all issuers in the index have a 1.20% return (R_{ct}). In that case, the valuation component of issuer c's weight change would be 1.02%. Assuming

the exogenous component is zero - meaning no changes from the index rebalancing rules - issuer c's exposure would rise to 5.02% by the end of the month.

In that case, fixed-weight investors would react by selling bonds to adjust their exposure to the original 4.00% weight. In contrast, investors tracking a market-capitalization index don't need to adjust for the valuation component, as the weight is not fixed and adjusts automatically to this component. However, this group of investors would trade bonds if the exogenous component differs from zero. Since their holdings don't automatically adjust to this change, they need to realign with the new index weights set by the exogenous component (per index rebalancing rules). This is the key difference between investors tracking a fixed-weight index and those following a market-capitalization index.

We also compare foreign investor flows in the sovereign bond market with this component for Colombia. Some additional exercises to control for macroeconomic and financial variables that can influence these flows are included.

Figure 3: Cumulative components of the variation of Colombia's weight in the GBI-EM index



Source: J.P. Morgan and authors' calculations based on equation (1).

As an initial step, we estimate the following monthly panel regression where the dependent variable is the trading flows of each foreign investor in the sovereign bond market[3]:

[3]The monthly net flows of each foreign investor f in the sovereign bond spot market are standardized by their standard deviation, with missing values assigned to months preceding the investor's entry.

$$Bonds_{ft} = \alpha_f + \beta_1 \, GBI_exog_t + v_f \, GBI_exog_t + \sum_j \beta_j X_{jt} + e_{ft}, \tag{2}$$

where α_f denotes investor fixed effects, and the term GBI_exog_t represents the exogenous component of Colombia's weight variation in the GBI-EM index, as described in equation (1). To account for the heterogeneity in how each investor f responds to GBI_exog_t, we employ a mixed linear model with a random slope. This approach estimates the average coefficients for each explanatory variable while also capturing the investor-specific deviations. Specifically, the random effect term v_f reflects how investor f's response to GBI_exog_t deviates from the average slope (β_1) across all investors, as specified in equation (2).

This specification leverages the panel data's comprehensive scope to assess and regulate the degree of indexation among agents in the investor pool, based on the assumption that there are no unobserved variables correlated with GBI_exog_t. By controlling for key macroeconomic and financial variables affecting portfolio flows, the model enables a more refined classification of investors based on their sensitivity to index fluctuations.

For controls (X_{jt}), we include a group of variables widely used in the literature due to their importance as drivers of portfolio investment decisions: (i) the returns of the USD-expressed portfolio of Colombian sovereign bonds referenced in the GBI-EM index, (ii) the spread between the returns of the 10-year Colombian sovereign bonds and US Treasuries, (iii) monthly returns of the nominal COP/USD exchange rate, (iv) the monthly spread between Colombia's 5-year CDS and the average CDS of a pool of Latin American countries (Brazil, Chile, Mexico and Peru), and (v) the monthly average of the VIX index (Chicago Board Options Exchange Volatility Index).

These variables are selected to control for financial factors that could influence portfolio allocation decisions. Regression results for equation (2) are presented in Appendix A. Overall, the signs of the coefficients for the control variables align with the financial intuition underlying their role as drivers of investment decisions.

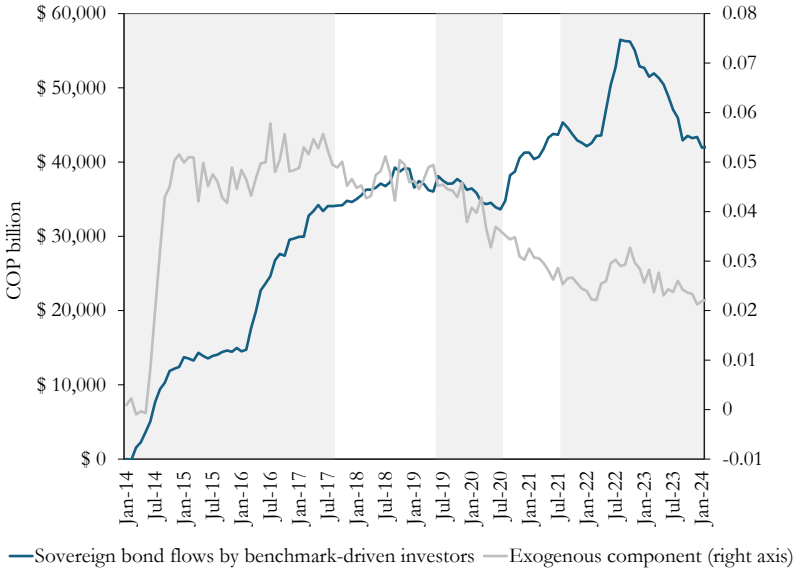
3.2 Classification of investors

We now classify foreign investors based on their degree of indexation, using the estimated predictors of the random component for GBI_exog_t (v_f, as defined in equation (2)). Since v_f measures the extent to which investor f's response to GBI_exog_t deviates from the average slope across all investors, we categorize investors with a positive v_f as benchmark-driven. The

intuition behind this classification is that investors with a positive v_f are more sensitive to changes in GBI_exog_t, meaning they closely follow the index and thus are more likely to be benchmark-driven. Investors with a zero or negative v_f are classified as unconstrained.

Figure 4 shows that benchmark-driven investors' sovereign bond positions generally track Colombia's weight variation in the GBI-EM index (gray areas), except during two brief periods in 2018 and 2021. These divergences may reflect exogenous factors, such as new benchmark-driven investors increasing their exposure to Colombian sovereign bonds. Furthermore, the flows of benchmark-driven and unconstrained investors exhibit a low correlation coefficient of 0.2 during the sample period. This suggests that it is appropriate to classify these two groups of investors separately, as they exhibit distinct behaviors in the sovereign bond market[4]. This outcome aligns with expectations, as flows from both groups would be anticipated to have a low but positive correlation.

Figure 4: Cumulative bonds flows: benchmark-driven vs exogenous component



Source: DCV and JP Morgan, authors' calculations. Grey areas correspond to periods during which both series present a high and positive correlation.

To further examine the types of investors classified as benchmark-driven, we analyze the distribution of each foreign investor type, as in the central bank's own classification[5],

[4]Upon analyzing the 30-day moving correlation between the flow series of both types of foreigners, it is observed that it remains persistently low, with some occasional increases during specific global stress events.

[5]The Central Bank of Colombia categorizes foreign investors based on the type of investment vehicle they

(rows in Table 2) between unconstrained and benchmark-driven agents. Results from the baseline panel regression (column 3 in Table 2) reveal that approximately 50% of mutual funds track the GBI-EM index. However, this 50% constitutes the majority of the benchmark-driven group due to their significant share (41%) of total foreign holdings (column 2 in Table 2). Additionally, we find that other major groups within the foreign investor base –such as international pension funds and monetary authorities– are more predominantly benchmark-driven.

A big portion of benchmark-driven investors are agents that could face higher liquidity risks and tend to adopt short-term return strategies under redemption pressures. Since mutual funds are primarily composed of retail investors, they are particularly susceptible to frequent and sometimes unexpected withdrawals, leading to pro-cyclical trading behavior (Timmer, 2018; Hui, 2019; Fong et al., 2022). Furthermore, mutual funds are the most reactive to both internal and external factors among foreign investors (Bertaut et al., 2023).

Additionally, since 2023, the International Affairs Unit at the Central Bank of Colombia has surveyed foreign investors on whether they follow any benchmark index when investing in sovereign bonds. According to these surveys (column 4 in Table 2), approximately 59% of foreign investors in sovereign bonds are indexed to the GBI-EM, which aligns with the results from the baseline panel regression.

Differences between the results from the central bank surveys and the baseline panel by type of foreign agent, could be attributed to the fact that the surveys were directed to a group of investors among the main participants in the sovereign bond market. Thus, they do not encompass the entire base of investors as the baseline panel does.

use and the sources of their funds. This classification includes groups such as mutual funds, international pension funds, and monetary authorities, among others.

Table 2: Distribution of sovereign bonds holdings between benchmark-driven and unconstrained investors (% of holdings per group - as of April-2024)

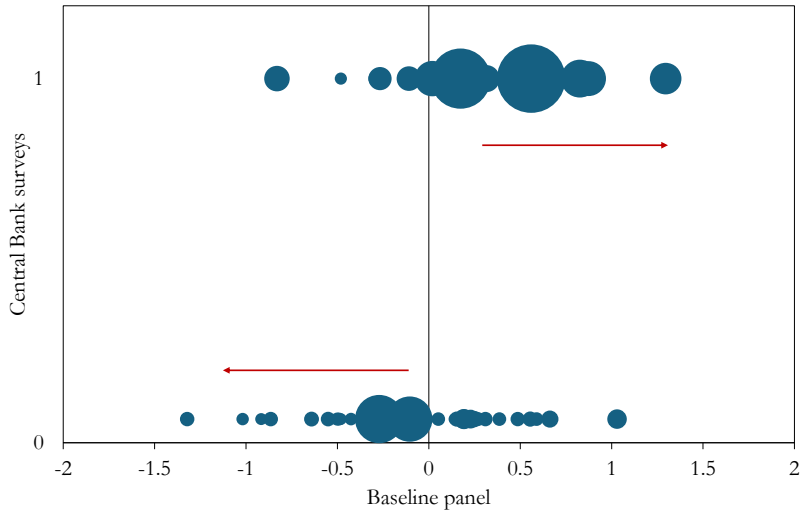
Type of foreign agent	% of bond holdings	Benchmark-driven	
		Baseline panel	central bank surveys
Mutual funds	41%	51%	61%
Int. pension funds	21%	77%	59%
Monetary authorities	15%	62%	91%
Others	23%	32%	31%
Total	100%	53%	59%

Note: Authors' calculations. The table shows the participation of each type of foreign investor, as classified by the central bank, in the total holdings of foreign investors (second column). The last two columns display the participation of benchmark-driven investors within the total holdings of each type of foreign investor. Each row represents a different type of foreign investor, with the final row indicating the total sovereign bond holdings by foreigners. The results are based on our baseline panel and central bank surveys.

To evaluate the goodness of fit of the baseline panel, we plot each foreign investor's responses from the central bank surveys against their random component (v_f, as defined in equation (2)) extracted from the baseline panel estimation, as shown in Figure 5. The graph reveals a clear pattern: investors with positive random components are more likely to be classified as benchmark-driven according to the central bank surveys, while those with negative random components are typically classified as unconstrained investors[6].

[6]This relationship is further supported by a positive and statistically significant coefficient (at the 10% level) of the random component (v_f) on foreign investors' responses from the central bank surveys in a logit regression.

Figure 5: Investor classification according to central bank surveys and baseline panel



Source: DCV and JP Morgan, authors' calculations. The Y-axis represents each foreign investor's response in the central bank surveys, where a value of 1 indicates the investor identified as benchmark-driven, and a value of 0 indicates otherwise. The X-axis shows the random component from our baseline specification: positive values correspond to investors classified as benchmark-driven, while negative values indicate those classified as unconstrained. Each point on the graph represents a foreign investor, with the size of the points proportional to the investor's bond holdings relative to the total holdings of all foreign investors.

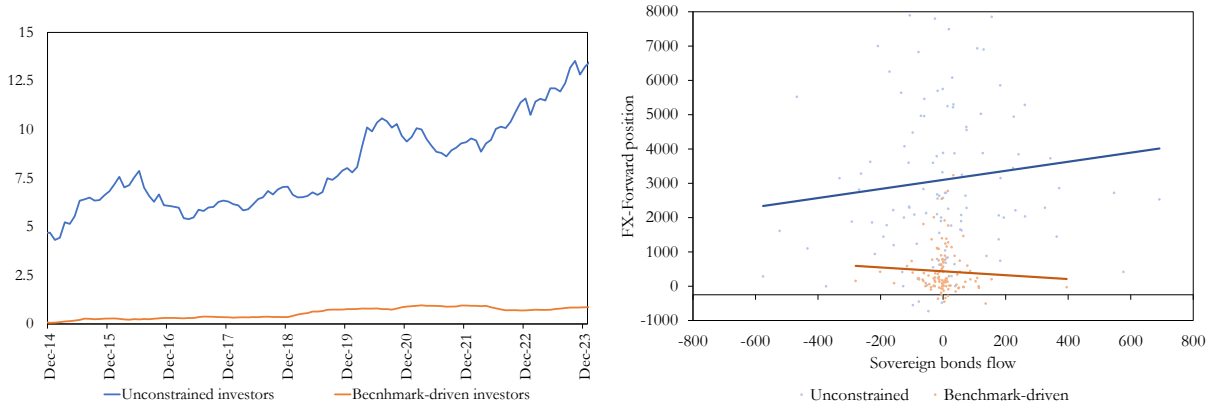
3.3 FX hedging analysis

We assess the robustness of the previous identification approach by examining how COP/USD forward positions respond differently to purchases of sovereign bonds by benchmark-driven versus unconstrained investors. In principle, benchmark-driven investors should not purchase COP/USD forwards when investing in sovereign bonds, as they are purely following an unhedged exposure in local currency. This is one of the main features of the GBI-EM Index, which exposes investors to each country's exchange rate risk. In practical terms, their net forward position (long minus short contracts) should not change significantly in response to bond purchases. Alternatively, we expect unconstrained investors to be more active in the forward FX market.

As shown in panel (a) of Figure 6, the ratio of monthly net COP/USD forward positions - i.e., net purhases of COP/USD forward contracts in a given month - to net sovereign bond purchases is close to zero for benchmark-driven investors, while unconstrained agents keep a significantly higher ratio, with monthly net forward positions between 5 - 13 times as large as their net bond positions. In a similar vein, panel (b) shows a significant upward slope between monthly bond purchases and net forward positions for unconstrained investors, while

benchmark-driven investors show a non-significant downward slope.

Figure 6: Net FX forward position and sovereign bond flows by investor type



(a) Ratio of FX-forwards to sovereign bonds (b) Slope of FX-forwards to sovereign bonds

Source: Central Bank of Colombia and authors' calculations. For comparability, FX forwards are converted into COP using the average COP/USD exchange rate for each month. Panel A shows the ratio of the monthly foreign investors' net COP/USD forward positions to their net bond purchases, distinguishing between unconstrained and benchmark-driven investors. Panel B presents the slope between these two variables for both investor groups.

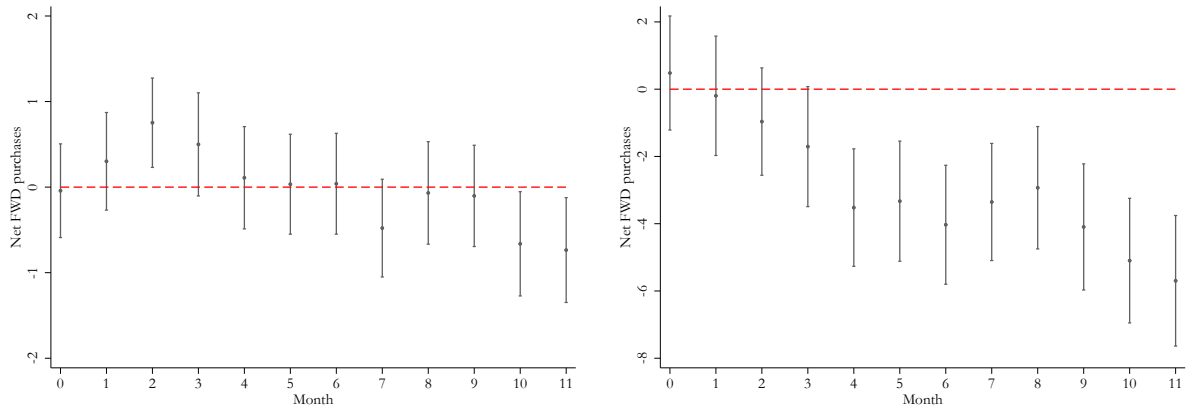
To formally test this relationship, we regress the monthly foreign investor f's net COP/USD forward positions on its corresponding net sovereign bond purchases, assuming that f is the final user of both instruments, as follows:

$$FXforward_{f,t+h} = \alpha_f^h + \beta_1^h Bonds_{f,t-1} + \beta_2^h (D_f^{indexed} * Bonds_{f,t-1}) + \sum_j \beta_k^h X_{k,t-1} + e_{f,t+h} \quad (3)$$

where $D_f^{indexed}$ is a dummy variable switched on if the foreign investor is benchmark-driven. We control for agent fixed-effects (α_f) and the same set of control variables ($X_{k,t}$) employed in the previous section: (i) the returns of the USD-expressed portfolio of Colombian sovereign bonds referenced in the GBI-EM index, (ii) the spread between the returns of the 10-year Colombian sovereign bonds and US Treasuries, (iii) the monthly returns of the COP/USD exchange rate, (iv) the monthly spread between Colombia's 5-year CDS and the average CDS of a pool of Latin American countries, and (v) the monthly average of the VIX index. Following Jordà (2005) method of local projections, we examine dynamic effects by estimating sequential regressions in which the dependent variable is shifted forward each month (for $h = 0 - 11$ months).

Results are plotted in Figure 7. Panel (a) shows the marginal effect of sovereign bond purchases (by all foreign investors) on net forward positions, which in general show a positive and significant impact, albeit short-lived. More relevant to our identification strategy is panel (b) which shows the incremental effect of bond purchases by benchmark-driven investors (β_2^h in equation 3). As shown, the effect of the interaction term is negative and statistically significant, which means that the hedging effect (positive forward position) is being driven by the group of unconstrained agents (i.e., for $D_f^{indexed} = 0$).

Figure 7: FX-forward position of foreign investors in response to bond purchases



(a) Marginal effect of bond purchases

(b) Incremental effect $D_i^{indexed}$

Note: Authors' calculations. The Figure shows coefficients from the regression as presented in equation (3), with robust confidence intervals significant at a 5 percent level.

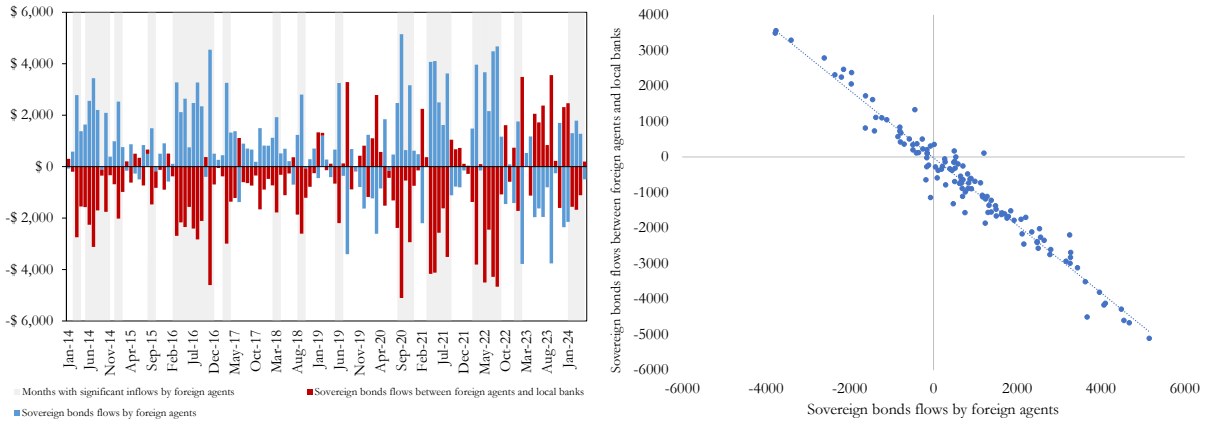
4 Results

In this section, we examine the role of local banks as the primary counterparts to foreign investors in the Colombian sovereign bond market and the implications of this for credit supply. First, we show that banks systematically adjust their bond holdings in response to foreign investor flows, acting as liquidity absorbers. Next, we analyze whether these shifts in sovereign bond holdings translate into changes in corporate lending, providing evidence of a crowding-out effect in the credit market. Finally, we explore whether this effect differs depending on the type of foreign investor, distinguishing between benchmark-driven and unconstrained agents.

4.1 Foreign investor's counterparts

Since 2014, the primary counterparts in transactions conducted by foreign investors in the Colombian sovereign bond market have been local banking institutions. As a result, when a foreign agent buys sovereign bonds, there is often a corresponding transaction of nearly equal magnitude in the opposite direction by local banks, as shown in Figure 8a. This inverse relationship is reflected in a high negative correlation between foreign investor bond flows and offshore-bank transactions, as illustrated in Figure 8b. To give an order of magnitude, around one-third of the assets of local banks are invested in Colombian sovereign bonds, underscoring the significance of this market for banking institutions.

Figure 8: Bond flows by foreign investors and local banks



(a) Bond flows by offshore agents and banks. (b) Correlation of offshore and banks bond flows.

Source: Central bank of Colombia and authors' calculations. **Note:** Grey areas in panel (a) correspond to periods of high inflows by foreign investors in sovereign bonds.

More formally, to corroborate that local banks are the main counterpart of foreign agents in the sovereign bond market, we estimate the following regression:

$$Bonds_{i,t+h}^{banks} = \alpha_i^h + \alpha_t^h + \beta_1^h exposure_{it} + \beta_2^h D_t^{flows} + \beta_3^h (D_t^{flows} * exposure_{it}) + e_{i,t+h} \qquad (4)$$

where $Bonds_{i,t+h}^{banks}$ represents the net bond purchases (flows) by local bank i, $exposure_{it}$ denotes each bank's order book with foreign clients (with a high exposure indicating a bank that actively trades with foreign investors). The variable $exposure_{it}$ captures the extent to which a given bank trades sovereign bonds with all foreign investors. It is constructed as the total volume of gross transactions - purchases plus sales - between bank i and foreign clients in a given month. By standardizing $exposure_{it}$ we ensure that an impulse shock corresponds

to a one-standard-deviation increase, facilitating interpretation in the regression analysis. Further, D_t^{flows} is a dummy variable activated either during periods of sizable portfolio inflows (greater than the 75^{th} percentile) or outflows (lower than the 25^{th} percentile). We employ robust standard errors and control for bank fixed effects (α_i) and time fixed effects (α_t).

The coefficient of interest for this specification is β_3^h. Since β_3^h is the coefficient for the interaction term between D_t^{flows} and $exposure_{it}$, it captures the impact of an increased trading activity with foreigners on banks' bond flows, during periods of sizable portfolio inflows. Intuitively, a negative and statistically significant β_3^h would imply that banks actively adjust their bond portfolios in response to significant offshore inflows, reflecting their role as primary counterparts to these transactions.

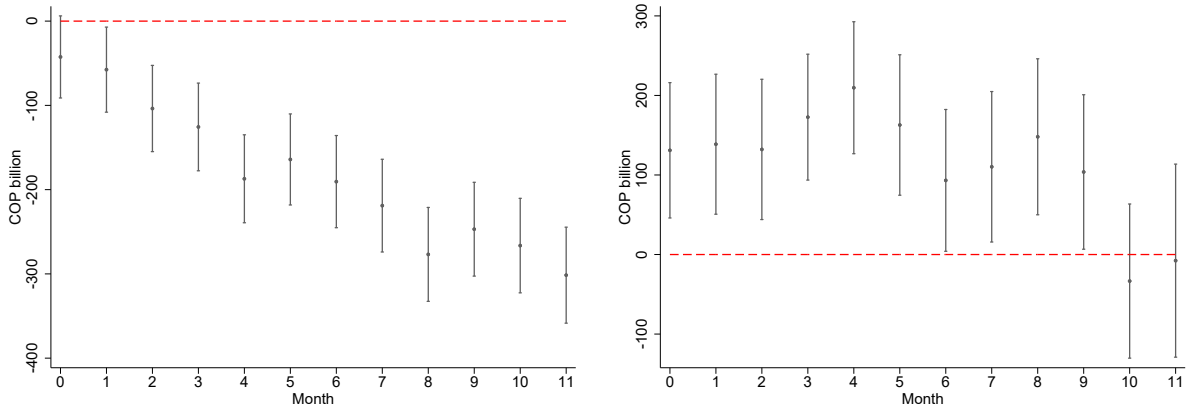
Our findings reveal that in fact local banks sell (purchase) significant amounts of sovereign bonds following substantial portfolio inflows (outflows). As shown in Figure 9a, when banks increase their transactions with foreign investors in sovereign bonds, the impact on their bond flows is both negative and statistically significant. Specifically, a 1-standard deviation increase in a bank's exposure to foreign investors, equivalent to $423 billion COP (approximately $100 million USD at an exchange rate of 4,200 COP/USD), predicts a bond sale of $300 billion COP ($75 million USD) on average over a 10-month period. This accounts for 75% of the initial shock amount, representing a large and permanent reduction in the bank's bond portfolio. Symmetrically, panel 9b shows that banks purchase after portfolio outflows, but in a lesser extent. In this scenario, the impact of an increase in their transactions with foreigners is positive and significant. Particularly, a 1-standard deviation increase in a bank's exposure to foreign investors, predicts a bond purchase of $100 billion COP ($25 million USD) over a 10-month period.

In Appendix B, we explore whether the impact on sovereign bond flows varies depending on the type of foreign investor (benchmark-driven or unconstrained) the bank is trading with. We find that transactions with unconstrained investors lead to a more substantial and persistent effect on banks' bond portfolios compared to benchmark-driven investors, resulting in a greater impact on bank liquidity.

Foreign investors usually know their counterparts in the sovereign bond market. Despite the existence of different negotiation systems for sovereign bonds in Colombia - including blind, semi-blind, and over-the-counter (OTC) platforms - foreign investors typically trade through the OTC market, as we show in Appendix C. This helps explain why they conduct the majority of their transactions with local banks. Further, in Appendix D we show that

investor-bank relations tend to be sticky, with few banks accounting for the majority of foreign investors' trading volume.

Figure 9: Local banks' net bond purchases in response to portfolio flows



(a) Portfolio inflows

(b) Portfolio outflows

Note: Authors' calculations. The figure shows the interaction term coefficient between D_t^{flows} and $exposure_{it}$ as presented in equation (4), with robust confidence intervals significant at a 5 percent level.

4.2 Effects on credit (crowding-out channel)

The previous subsection showed a surge (decline) in bank liquidity following episodes of portfolio inflows (outflows). Building on this, we now investigate whether this additional or reduced liquidity is effectively redirected into corporate sector loans, thereby confirming the presence of a crowding-out effect in the credit market. Specifically, we analyze whether changes in sovereign bond holdings by banks influence their lending behavior. To address this question, we estimate the following specification:

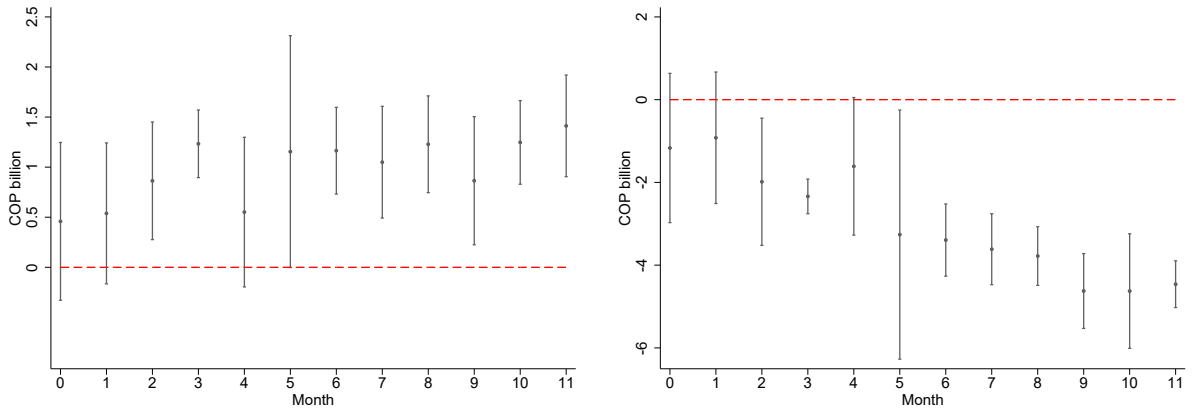
$$Loan_{ji,t+h} = \alpha_{ji}^h + \alpha_{jt}^h + \beta_1^h exposure_{it} + \beta_2^h (D_t^{flows} * exposure_{it}) + e_{ji,t+h}, \tag{5}$$

where $Loan_{ji}$ represents the monthly amount of new corporate loans issued by bank i to firm j, and D_t^{flows} and $exposure_{it}$ are the same as in equation 4. We include firm-bank fixed effects (α_{ji}) to control for observed and unobserved time-invariant differences in bank-firm pairs, firm-time fixed effects (α_{jt}) to control for time-varying credit demand, and employ robust standard errors. Here, the coefficient of interest is β_2^h, which captures the impact of an increased trading activity with foreigners on banks' lending behavior, during either periods

of sizable portfolio inflows or outflows. For the case of inflows, a positive and statistically significant β_2^h would imply that banks actively redirect the increased liquidity (from selling bonds to foreigners) into corporate sector loans.

Our findings, presented in Figure 10, confirm that banks that sell (purchase) significant amounts of bonds to foreign investors extend more (less) credit. For instance, in Panel 10a, an average bank that sells COP 300 billion worth of bonds to foreign investors (as shown in Figure 9a) increases its average loan issuance by COP 0.9 billion over a 10-month period. A back-of-the-envelope calculation scaling this effect by the 400 new bank-firm loans issued monthly during the sample period suggests a total increase of COP 360 billion in new corporate loans. This closely matches the initial shock in the bank's exposure, indicating that credit conditions are highly sensitive to bond inflows. This is similarly reflected in Panel 10b, which shows that an average bank that purchases COP 100 billion worth of bonds from foreign investors (as seen in Figure 9b, month 9) reduces its average loan issuance by approximately COP 3 billion over a 10-month period.

Figure 10: Effects of portfolio flows on new corporate loans



(a) Portfolio inflows

(b) Portfolio outflows

Note: Authors' calculations. The figure shows coefficients from the regression presented in equation (5), with robust confidence intervals significant at a 5 percent level.

In Appendix E, we investigate whether these results are amplified by differences in banks' balance sheet characteristics. We find that banks with higher profitability and stronger solvency metrics increase their lending activity more significantly during portfolio inflows. Conversely, banks with higher solvency experience smaller reductions in lending during outflows, emphasizing the importance of bank-specific factors in shaping credit supply responses to foreign capital movements.

4.2.1 Investor-based heterogeneous effects

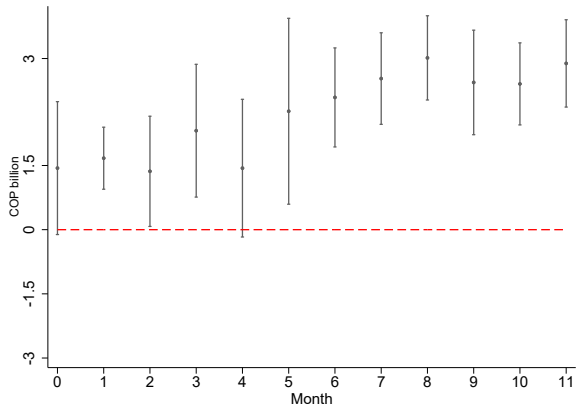
Building on the classification in Section 3.2, we now assess whether benchmark-driven and unconstrained agents have differing impacts on the credit market. To test this, we estimate the following specification:

$$Loan_{ji,t+h} = \alpha^h_{ji} + \alpha^h_{jt} + \beta^h_1 Expo^U_{it} + \beta^h_2 Expo^{BD}_{it} + \beta^h_3 (D^{flows}_t * Expo^{BD}_{it}) + \beta^h_4 (D^{flows}_t * Expo^U_{it}) + e_{ji,t+h} \quad (6)$$

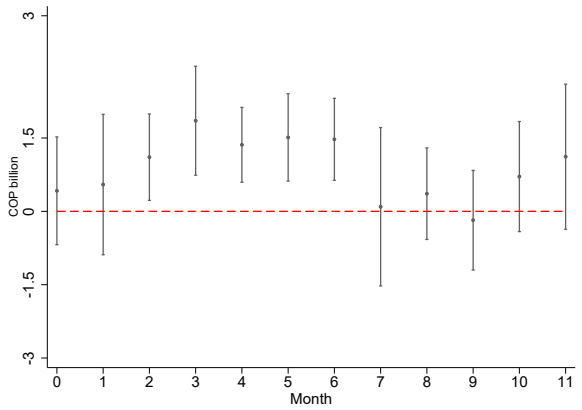
where $Expo^{BD}_{it}$ and $Expo^U_{it}$ represent the exposure of bank i to sovereign bond transactions with benchmark-driven and unconstrained investors, respectively. These variables refine $exposure_{it}$ (as in equation 4) by breaking it down by investor type. They are calculated by weighting the total volume of gross transactions between bank i and all foreign investors by the monthly share of each investor type (benchmark-driven and unconstrained) in the overall pool. To ease interpretation, we standardize both variables so that an impulse shock corresponds to a one-standard-deviation increase. We again control for firm-bank fixed effects (α_{ji}), firm-time fixed effects (α_{jt}), and employ robust standard errors. The coefficients of interest for this specification are β^h_3 and β^h_4, which measure how increased trading with benchmark-driven and unconstrained investors affects banks' lending behavior.

The results confirm that the effects differ by investor type. Figures 11a and 11c show that inflows and outflows, respectively, from unconstrained investors amplify the crowding-out channel (as previously depicted in Figure 10a). In contrast, Figures 11b and 11d show that flows from benchmark-driven investors have a smaller impact, which subsides after the first six months. These findings indicate that banks' credit supply is less responsive when trading bonds with benchmark-driven than unconstrained investors, confirming a differential crowding-out effect in the credit market. This can be attributed to the nature of unconstrained investors, who are more reactive to local variables and changes in risk aversion in response to local shocks. Our results are robust to the inclusion of bank and bank-firm fixed effects, indicating that the differential impact on the credit market is driven by the type of investor banks trade bonds with (Appendix F).

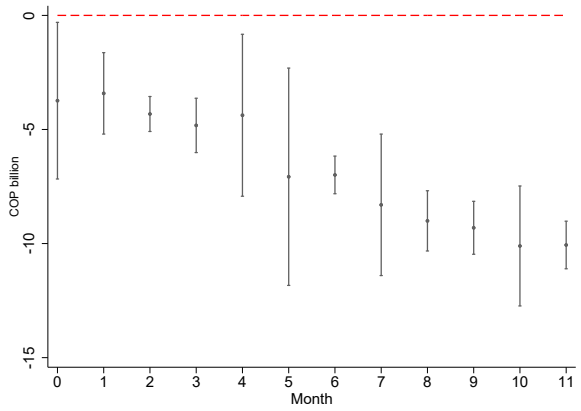
Figure 11: Investor-type effects of portfolio flows on new corporate loans



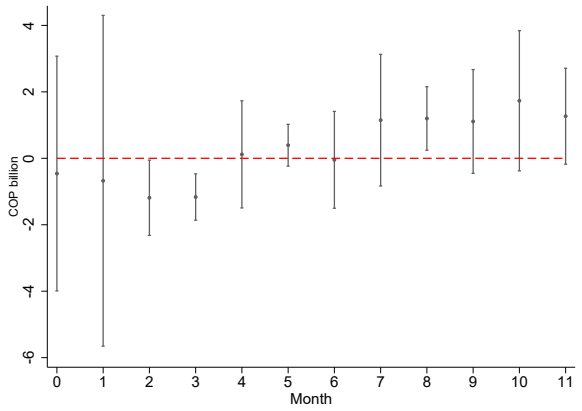
(a) Inflows of unconstrained investors



(b) Inflows of Benchmark-driven investors



(c) Outflows of unconstrained investors



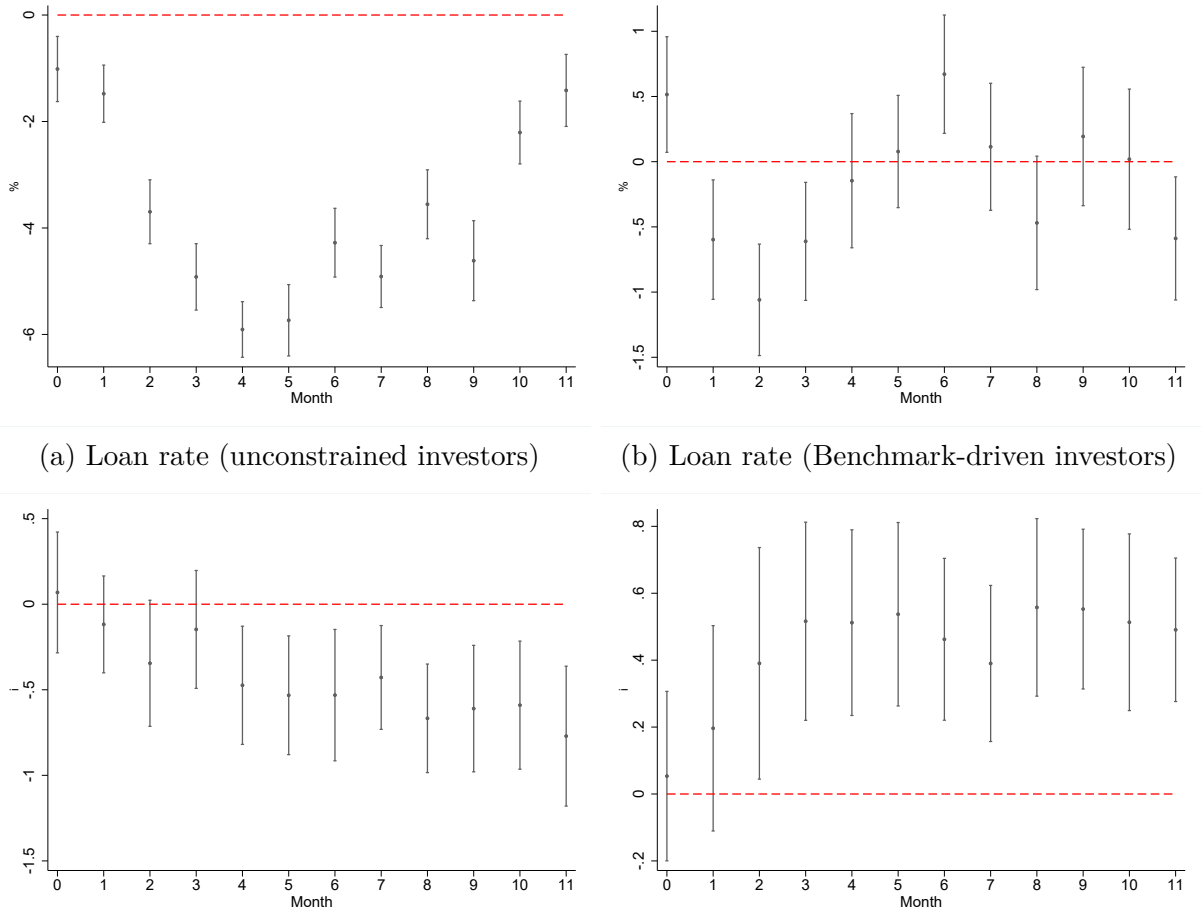
(d) Outflows of Benchmark-driven investors

Note: Authors' calculations. The Figure shows coefficients from the regression as presented in equation (6), with robust confidence intervals significant at a 5 percent level.

Beyond the loan amount, understanding other loan characteristics is also valuable. For portfolio inflows, we estimate equation (6) using the loan interest rate or default probability as dependent variables. Our findings show that banks selling more bonds to unconstrained investors issue loans with lower interest rates following high portfolio inflows (Figure 12a) and experience lower subsequent default probabilities (Figure 12c). Alternatively banks selling more bonds to benchmark-driven investors see weaker effects, with smaller interest rate reductions and higher default probabilities on new loans (Figures 12b and 12d). At face value, these findings suggest that banks' risk-taking behavior varies by their exposure to different foreign investors. Banks more exposed to benchmark-driven investors tend to take on higher risks during capital inflow episodes, potentially weakening their debtor assessment

and raising default probabilities.

Figure 12: Investor-type effects of portfolio inflows on loan conditions



(a) Loan rate (unconstrained investors)

(b) Loan rate (Benchmark-driven investors)

(c) Default prob (unconstrained investors)

(d) Default prob (Benchmark-driven investors)

Note: Authors' calculations. The Figure shows coefficients from the regression as presented in equation (6), with robust confidence intervals significant at a 5 percent level.

4.2.2 Bank-based response to the global financial cycle

As a complement to the previous analysis on local credit conditions, this section examines whether local banks respond differently to Global Financial Conditions (GFC) based on their exposure to different types of foreign investors in sovereign bond market. We draw on the literature exploring the impact of GFC –proxied by VIX changes– on capital flows and credit growth.[7] These studies highlight a transmission channel where, during GFC boom phases (marked by easing U.S. monetary policy) lower interest rates increase dollar liquidity (Bruno

[7]See Forbes and Warnock (2012); Cerutti et al. (2015); di Giovanni et al. (2017); Jordà et al. (2018).

and Shin, 2015a). For instance, di Giovanni et al. (2017) show that easing GFC conditions lower borrowing costs and boost local lending. As the VIX declines, firms demand more credit, and banks gain easier access to foreign capital, driving credit expansion.

Building on di Giovanni et al. (2017), we assess how global conditions differentially affect banks with greater exposure to benchmark-driven flows. We estimate the following panel regression, using either new corporate loan amounts or loan interest rates as the dependent variable:

$$\begin{aligned} Loan_{jit} =& \alpha_{ji} + \beta_1 ln(VIX_t) + \beta_2 Expo_{it}^{BD} + \beta_3 Expo_{it}^{U} + \beta_4 ln(VIX_t) * Expo_{it}^{BD} + \beta_5 ln(VIX_t) * Expo_{it}^{U} + \\ & \beta_6 ln(CDS_t) + \beta_7 ln(CDS_t) * Expo_{it}^{BD} + \beta_8 ln(CDS_t) * Expo_{it}^{U} + \beta_9 ln(VIX_t) * ln(CDS_t) * Expo_{it}^{BD} \\ & + \beta_{10} ln(VIX_t) * ln(CDS_t) * Expo_{it}^{U} + \beta_{11} Z_t + e_{jit}. \end{aligned} \tag{7}$$

We use the VIX index in logs as the proxy for GFC, the log of Colombia's 5-year Credit Default Swaps (CDS) to control for country-specific risk aversion, and the following macro control variables in Z_t: (i) domestic policy rate, (ii) GDP growth, (iii) exchange rate changes, and (iv) inflation. Additionally, to control for bank heterogeneity, the following bank characteristics are included: (i) log of assets, (ii) capital ratio, (iii) liquidity ratio, (iv) return on total assets (ROA), (v) return on equity (ROE), (vi) total equity and (vii) solvency.

Table 3 reports estimates of the coefficients for the amount of new loans in the first column, and the nominal interest rate in the second column. In the first row, we report estimates for the marginal effect of log(VIX), which is negative and statistically significant when employing the amount of new loans as the dependent variable. The estimated value suggests that a 1% decrease in VIX is associated with a 0.03% increase in the amount of new loans. In that sense, a reduction in log(VIX) equal to its interquartile range during the sample period (0.52), implies a 0.02% increase in the average amount of new loans.

Based on di Giovanni et al. (2017), this suggests that external risk aversion has an amplifying effect on local credit, explained both from a demand and supply channel. Under the demand channel, when VIX falls as global conditions improve, firms react by demanding more credit. On the other hand, the enhanced access of banks to foreign capital, with lower rates, under better global conditions, can also increase local credit from the supply side. Moreover, the positive marginal effect of log(VIX) on the nominal interest rate suggests that movements in VIX affect supply factors. That is, when banks offer less credit under worse

global conditions, they create an upward pressure on lending rates, holding firm demand constant. The estimated value suggests that a 1% decrease in VIX is associated with a 0.0007% increase in the amount of new loans. A fall in log(VIX) equal to its interquartile range during the sample period, implies an increase equivalent to 0.0004% in the average interest rate of new loans.

Moving on to the differential response of those banks that tend to buy more bonds from benchmark-driven foreign investors during high portfolio inflows, in the first column of Table 3 we observe that the interaction term between log(VIX) and $Expo_{it}^{BD}$ is negative and statistically significant, while it has the opposite sign for those that tend to negotiate more with unconstrained foreigners. This indicates that banks that are tightly related to benchmark-driven investors tend to be more procyclical to global factors, amplifying the effects of global shocks on local credit conditions. The opposite holds for banks that are more exposed to unconstrained investors, as the coefficient for $log(VIX)_t * Expo_{it}^{U}$ is negative and statistically significant. This confirms that a higher presence of benchmark-driven investors makes credit conditions more sensitive to external financial conditions.

Table 3: Global financial cycle analysis

	(1) Log loan amount		(2) Loan interest rate	
log(VIX)	-0.033***		0.00069***	
	(0.0078)		(0.00022)	
log(VIX)*Exp^{U}	0.32***	-0.048	0.0022	-0.084***
	(0.096)	(0.59)	(0.0027)	(0.018)
log(VIX)*Exp^{BD}	-0.35***	0.061	0.00031	0.087***
	(0.098)	(0.60)	(0.0028)	(0.018)
log(CDS)	-0.055***		-0.0013***	
	(0.016)		(0.00046)	
log(CDS)*Exp^{U}	0.25**	-0.26	0.079***	0.11***
	(0.10)	(0.69)	(0.0029)	(0.021)
log(CDS)*Exp^{BD}	-0.25**	0.26	-0.086***	-0.12***
	(0.11)	(0.70)	(0.0030)	(0.022)
Col policy rate	-0.0026		0.011***	
	(0.0042)		(0.00012)	
Real GDP growth	0.027***		0.00051***	
	(0.0055)		(0.00016)	
FX change	0.014***		-0.00049***	
	(0.0011)		(0.000032)	
Inflation	0.13***		-0.00054	
	(0.013)		(0.00038)	
Observations	228,212	228,212	228,212	228,212
Macro controls and trend	✓		✓	
Bank controls	✓		✓	
BankxFirm F.E.	✓	✓	✓	✓
FirmxTime F.E.	✓	✓	✓	✓

Authors' calculations. Data from JP Morgan and Bloomberg for the sample period is 2014-2023. The table shows panel regressions for equation (7) using monthly data. The VIX is the lagged quarterly average, FX change is the monthly COP/US dollar exchange rate change (%), and inflation is the annual CPI change in every month. A linear time trend is also included as a regressor. Further, the lagged values of the following bank-level characteristics are also controlled for (not reported): leverage, return on total assets (ROA), solvency and liquidity ratio. Robust standard errors in parenthesis. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4.3 The role of macroprudential policies

4.3.1 Bank-based foreign exchange exposures

Delving deeper into the macro-financial implications of the different investment strategies by foreign agents, we now examine their interaction with macroprudential policies, particularly foreign exposure limits for local banks. In Colombia, banks face restrictions on significant

long or short FX positions relative to their capital[8]. This central bank policy serves as a macroprudential tool to mitigate currency mismatches in the banking system.

To evaluate if the effect of these limits on the exchange rate risk is different for banks that have a higher exposure to benchmark-driven foreign investors, we build upon the literature that shows the inner workings of the portfolio balance channel, pioneered by Henderson and Rogoff (1981), Kouri (1981), and Branson and W. (1985). In essence, the portfolio channel states that changes in the mix of different currency denominated assets are only optimally admissible with an accompanying exchange rate change. The main underlying assumption is for assets not to be perfect substitutes i.e., banks and investors should not be indifferent to changes in portfolio compositions.

Gabaix and Maggiori (2015) and Perez-Reyna and Villamizar-Villegas (2019) are recent contributions examining this channel, both of which resort to some financial friction that guarantees an imperfect asset substitutability. In Gabaix and Maggiori (2015) for instance, there is imperfect intermediation by financiers due to limited commitment, while in Perez-Reyna and Villamizar-Villegas (2019) the financial friction is created by regulations on the amount of foreign currency held by banks.

In the following exercise, we extend the empirical framework found in Perez-Reyna and Villamizar-Villegas (2019) to include the differential impact of banks being more exposed to benchmark-driven investors during high portfolio inflows. In other words, we examine whether binding constraints have a greater effect on banks if they have a tighter relationship with benchmark-driven investors. Hence, given the higher volatility of this type of foreign investor, we expect banks that buy more bonds from them to react more when in close proximity to regulatory constraints.[9] The sample period for this exercise is from January 2010 to October 2015, since the regulatory limit was in effect during this period.

As in Perez-Reyna and Villamizar-Villegas (2019), we contrast exchange rate episodes

[8]This refers to banks' daily foreign exchange exposure, measured as the difference between USD-denominated assets and liabilities relative to total equity (converted to USD using the daily average exchange rate), excluding FX derivatives. From 2004 to 2015, regulations capped exposure at 50% of capital and prohibited negative values. While the formal lower limit was 0%, banks effectively adhered to a 1% threshold due to penalty risks. The lower limit changed to -20% on October 16, 2015, and all limits were lifted in September 2018.

[9]In the model found in Perez-Reyna and Villamizar-Villegas, this would entail categorizing foreign assets into benchmark-driven and unconstrained. To generate a higher exchange-rate response by highly exposed banks, one could impose a smoothing function to unconstrained funds reflecting more stability (less likelihood of sudden movements that would breach the regulatory cutoff).

when banks barely reached a binding limit, to episodes in which they barely missed it. Using a Regression Discontinuity Design, we estimate the following specification, based on a local non-parametric approach in which the outcome variable (y_t) represents the daily variation of the exchange rate, X_t denotes the distance of the financial sector from the regulatory cutoff, D_t is a dummy switched on if the financial sector exceeded that cutoff, and $Expo_t^U$ and $Expo_t^{BD}$ are the exposure of the financial sector to unconstrained and benchmark-driven investors (calculated as in equation 6).

$$\arg\min_{\delta,\eta} \sum_{j=1}^{J} \sum_{t=2}^{T-J} \Big(y_{t+j} - a_j - b_j(X_t) - \theta_j D_t - \gamma_j(X_t) D_t - \psi_j \text{Expo}_t^U - \varphi_j \text{Expo}_t^{BD} - \delta_j D_t \text{Expo}_t^U - \eta_j D_t \text{Expo}_t^{BD} \Big)^2 K(\cdot) \tag{8}$$

where $\delta = (\delta_1, ..., \delta_j)'$ denotes the incremental impact of the exposure to unconstrained investors when banking limits hold, and $\eta = (\eta_1, ..., \eta_j)'$ is the incremental impact of the exposure to benchmark-driven investors, j periods after treatment[10]. The term $K(\cdot)$ represents a kernel function which assigns weights to each observation based on X_t.

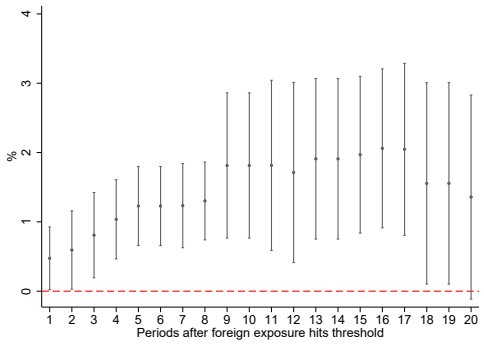
Figure 13 depicts the IRF of exchange rate changes in response to financial constraints imposed on the entire financial sector, as characterized by equation (8). Results show that the effects, measured as the marginal effect of banking limits (D_t) on exchange rate changes, are significant. Moreover, Table 4 reports: estimates for the marginal effect of banking limits (1^{st} column), estimates for the interaction term between banking regulations and the exposure of the financial sector to benchmark-driven investors (2^{nd} column), and estimates for the interaction term between banking regulations and the exposure of the financial sector to unconstrained investors (3^{rd} column).

As shown, the second column indicates that banking constraints are amplified when banks purchase more bonds from benchmark-driven investors. In contrast, these constraints are less pronounced if banks have a higher exposure to unconstrained foreign investors. This finding is further supported by the third column of Table 4, which shows that banks buying more bonds from unconstrained investors are less responsive to regulatory constraints.

[10]For comparability purposes, the marginal effect of banking limits in equation (8) is given by $\theta_j + \delta_j \overline{\text{Expo}_t}^U + \eta_j \overline{\text{Expo}_t}^{BD}$, where $\overline{\text{Expo}_t}^U$ and $\overline{\text{Expo}_t}^{BD}$ are the mean exposure of the financial sector to unconstrained and benchmark-driven investors during the sample period.

On average, a one-unit increase in the final sector's exposure to unconstrained foreign investors reduces the exchange rate effect by 0.3 percentage points, whereas a one-unit increase in its exposure to benchmark-driven investors amplifies the effect by 1.6 percentage points. These results confirm that financial conditions and the impact of banking constraints vary depending on the exposure to different types of investors.

Figure 13: Effects of banking limits on the exchange rate



Note: Authors' calculations. The Figure shows coefficients from the monthly regression as presented in equation (8), with robust confidence intervals significant at a 5 percent level.

Table 4: Differential Effects of banking limits on the exchange rate

Periods	Marginal effect of D_t	Incremental effect of Expo_t^{BD}	Incremental effect of Expo_t^{U}
1	0.53**	0.65**	-0.12**
	(0.30)	(0.30)	(0.06)
2	0.83***	1.02***	-0.19***
	(0.31)	(0.30)	(0.06)
3	1.07***	1.31***	-0.25***
	(0.33)	(0.33)	(0.06)
4	1.21***	1.49***	-0.28***
	(0.24)	(0.23)	(0.04)
5	1.46***	1.80***	-0.34**
	(0.35)	(0.34)	(0.06)
6	1.01***	1.24***	-0.23***
	(0.35)	(0.34)	(0.06)
7	1.23***	1.52***	-0.28***
	(0.23)	(0.23)	(0.04)
8	1.66***	2.05***	-0.38***
	(0.28)	(0.27)	(0.05)
9	2.39***	2.94***	-0.55***
	(0.52)	(0.51)	(0.10)
10	1.84***	2.26***	-0.42***
	(0.73)	(0.72)	(0.13)
15	1.94***	2.39***	-0.45***
	(0.43)	(0.42)	(0.08)
20	1.09**	1.34**	-0.25**
	(0.78)	(0.76)	(0.14)

Note: Authors' calculations. Each coefficient results from a separate regression discontinuity model implemented using local linear regression on daily data with optimal bandwidth from Calonico et al. (2014) Robust standard errors in parentheses. ***, **, * denote statistical significance at the 1, 5, and 10 percent level respectively.

5 Concluding remarks

Our study introduces a novel strategy to distinguish between benchmark-driven and unconstrained foreign investors. This approach enhances our understanding of how different investor types impact financial stability and credit conditions in emerging markets, specifically in Colombia. By distinguishing between these investor types, we uncover significant differences in their influence on the financial landscape. Benchmark-driven investors, who follow passive strategies, make investment decisions primarily influenced by changes in index weights and global factors. In contrast, unconstrained investors are more responsive to idiosyncratic factors and aim to consistently outperform benchmarks, typically reacting first to local

shocks.

We find that local banks adjust their bond holdings in response to foreign investor demand, which in turn affects their lending capacity, reflecting a crowding-out effect. This dynamic is particularly pronounced for banks with higher exposure to foreign investors. Increased foreign participation in the sovereign bond market can lead to amplified lending by local banks. Moreover, banks more exposed to unconstrained investors tend to lend more during periods of high inflows, while those exposed to benchmark-driven investors show a more muted response.

We also find that banks closely linked to benchmark-driven investors tend to be more reactive to global factors, amplifying the effects of global shocks on local credit conditions. Conversely, banks with greater exposure to unconstrained investors exhibit less sensitivity to these external influences. This confirms that a stronger presence of benchmark-driven investors makes local credit conditions more vulnerable to global financial fluctuations.

Overall, these findings highlight the importance of understanding the heterogeneity of foreign investors and their trading strategies. Policymakers can benefit from considering these differences when designing macroprudential policies to mitigate risks and enhance financial stability. Specifically, policies should account for the distinct impacts of benchmark-driven and unconstrained investors to better manage the risks associated with foreign portfolio inflows. Future research could extend this analysis to other emerging markets to assess the external validity of our findings. Additionally, examining the long-term effects of different types of foreign investment on economic growth and financial stability would provide deeper insights into the broader implications of foreign portfolio flows.

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Appendix A Baseline panel regression results

The results for the baseline panel regression in equation 2 are summarized in Table A1. Rows show the average coefficients for GBI_exog_t and the control variables. In column 1, we show the coefficient for GBI_exog_t with no controls. The positive and statistically significant coefficient indicates a high degree of indexation among the sampled investors.

The second column incorporates control variables, whose coefficients generally align with financial intuition, reflecting their expected impact on investment decisions. Most coefficients are statistically significant, except for the VIX. Specifically, the positive coefficient for the returns of the dollar-denominated portfolio of Colombian sovereign bonds referenced in the GBI-EM index (Ret_TES_USD) indicates that investor demand for sovereign bonds increases as these bonds appreciate, making them a more attractive investment.

The positive coefficient for the spread between the returns of 10-year Colombian sovereign bonds and U.S. Treasuries ($Spread_TES_Tsy$) suggests that foreign demand for sovereign bonds is influenced by rate differentials, as this spread reflects the attractiveness of Colombian bonds over U.S. risk-free Treasuries.

In contrast, the negative coefficient for the monthly returns of the nominal COP/USD exchange rate (Ret_FX) implies that foreign investors tend to stabilize their allocation of Colombian sovereign bonds within their overall portfolios. As the COP appreciates, sovereign bonds represent a larger share of their total portfolios, prompting investors to sell bonds to rebalance their holdings.

Finally, the negative coefficient for the monthly spread between Colombia's 5-year CDS and the average CDS of a group of Latin American countries ($Spread_CDS$) is consistent with expectations. A higher perceived risk of Colombia relative to its peers reduces foreign investors' appetite for Colombian assets.

Table A1: Baseline panel regression results

	(1)	(2)
GBI_exog	0.0552***	0.0542***
	(0.0241)	(0.0242)
Ret_TES_USD		0.0248***
		(0.00495)
Spread_TES_Tsy		0.000969***
		(0.000121)
Ret_FX		-0.0227***
		(0.00637)
Spread_CDS		-0.00330***
		(0.000462)
VIX		-0.00151
		(0.00152)
Constant	0.611**	-0.344
	(0.193)	(0.304)
Observations	13144	13144
Controls		✓
InvestorF.E.	✓	✓
TimeF.E.	✓	✓

Authors' calculations. Standard errors in parenthesis.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Appendix B Investor-based counterparts

Bearing in mind the classification of foreign agents presented in Section 3.2, we now assess if there is a differential impact on bank's bond portfolios, depending on the type of offshore agent (benchmark-driven or unconstrained) that they negotiate with.

To formally corroborate this, we estimate the following extension of equation (4):

$$Bonds^{banks}_{i,t+h} = \alpha^h_i + \alpha^h_t + \beta^h_1 expo^U_{it} + \beta^h_2 expo^{BD}_{it} + \beta^h_3 (D^{flows}_t * expo^U_{it}) + \beta^h_4 (D^{flows}_t * expo^{BD}_{it}) + e_{i,t+h} \tag{B1}$$

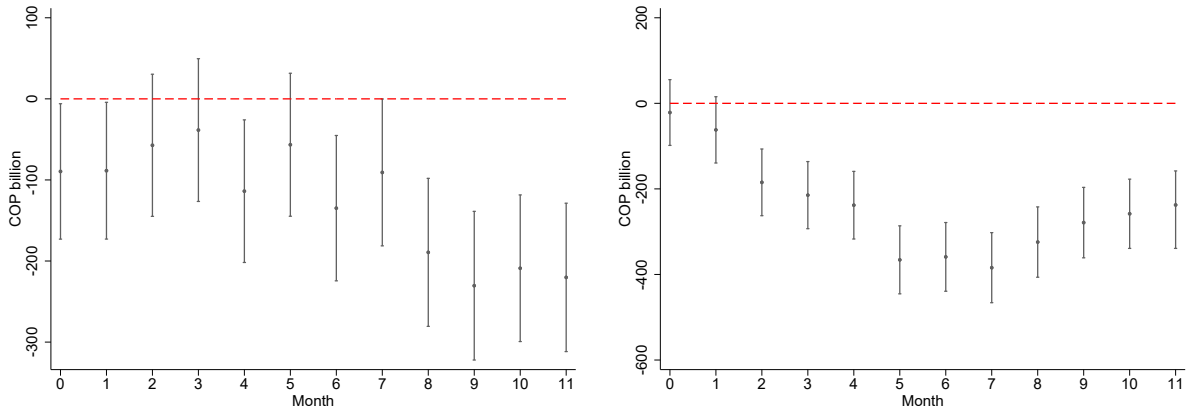
where $Bonds^{banks}_{i,t+h}$ represents the net bond purchases (flows) by local banks, D^{flows}_t is a dummy variable activated during periods of sizable inflows by foreign agents in sovereign bonds (greater than the 75^{th} percentile), and $Expo^{BD}_{it}$ and $Expo^U_{it}$ represent the exposure of bank i to negotiations involving sovereign bonds with benchmark-driven and unconstrained investors, respectively. These variables denote each bank's order book with foreign clients, scaled by the share of benchmark-driven or unconstrained agents in the total pool of foreign investors. We control for bank fixed effects (α_i) and time fixed effects (α_t).

The coefficients of interest for this specification are β^h_3 and β^h_4. Since β^h_4 is the coefficient for the interaction term between D^{flows}_t and $Expo^{BD}_{it}$, it captures the impact of an increased trading activity with benchmark-driven foreigners on banks' bond portfolio, during periods of sizable portfolio inflows. Similarly, β^h_3 captures this effect in the case of unconstrained foreign investors. Given this, both the sign and magnitude of β^h_3 and β^h_4 will reveal how the differing investment strategies of foreign investors influence the overall impact of portfolio inflows on banks' bond portfolio.

The results show that the impact of selling a higher volume of bonds to foreign investors on banks' bond portfolios varies depending on the type of foreigner involved. As illustrated in Figure B1a, transactions with unconstrained investors result in a more substantial and lasting effect on banks' bond portfolios compared to benchmark-driven investors, where the effect appears to reverse and ultimately becomes smaller (Figure B1b). These findings suggest that the effect of portfolio inflows on banks' bond portfolios is more consistent when they trade with unconstrained foreigners, making their impact on banks' liquidity more significant.

Conversely, panel B2a and B2b shows that banks buy bonds by similar magnitudes to unconstrained and benchmark-driven investors after portfolio outflows. In this scenario, the impact of an increase in their transactions with foreigners is positive and significant.

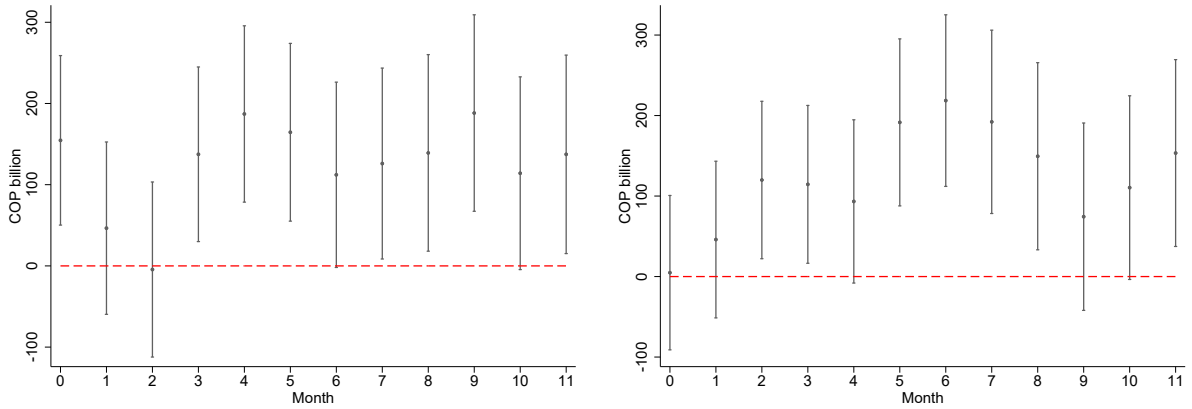
Figure B1: IRFs of sovereign bonds flows by local banks - Portfolio inflows



(a) Incremental effect of $Expo_{it}^{U}$ (b) Incremental effect of $Expo_{it}^{BD}$

Note: Authors' calculations. The Figure shows coefficients from the regression as presented in equation (B1), with robust confidence intervals significant at a 5 percent level.

Figure B2: IRFs of sovereign bonds flows by local banks - Portfolio outflows



(a) Incremental effect of $Expo_{it}^{U}$ (b) Incremental effect of $Expo_{it}^{BD}$

Note: Authors' calculations. The Figure shows coefficients from the regression as presented in equation (B1), with robust confidence intervals significant at a 5 percent level.

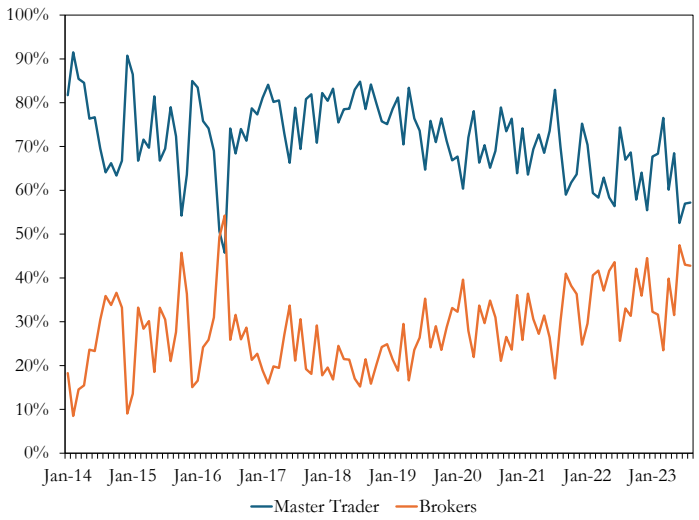
Appendix C Foreigners' sovereign bond negotiation

Colombia's sovereign bond market operates on four main channels:

- **Electronic Trading System (SEN, by its Spanish acronym)**: Managed by the Central Bank of Colombia, SEN is exclusive to market makers. Transactions are blind both in negotiation and settlement.
- **Master Trader**: Run by the Colombian Stock Exchange (BVC, by its Spanish acronym), this platform is open to all market participants, including market makers. Negotiations are blind, but counterparty identities are revealed at settlement.
- **Brokers**: Three active brokers - GFI, SET ICAP, and Tradition - facilitate trades through direct-call systems, where agents often interact with others to assess prices and liquidity before executing trades. While the final trade may be anonymous, participants may know the counterparty.
- **Over-the-Counter (OTC) Market**: Participants can directly contact each other to negotiate trades, then register and settle them through Master Trader. According to the BVC's Fixed Income Monthly Report, about 98% of Master Trader's trading volume comes from OTC-negotiated deals.

As illustrated in Figure C1, 60% to 70% of the monthly trading volume of foreign investors in sovereign bonds takes place in Master Trader. As mentioned earlier, most transactions registered on this platform are executed through the over-the-counter (OTC) market, where counterparties are known directly. For all other transactions, foreign investors must use brokers, although in practice, participants may still gain some insight into the identity of the counterparty. This dynamic may explain why foreign investors often trade bonds with the same group of agents.

Figure C1: Share of foreigners' trading volume by platform



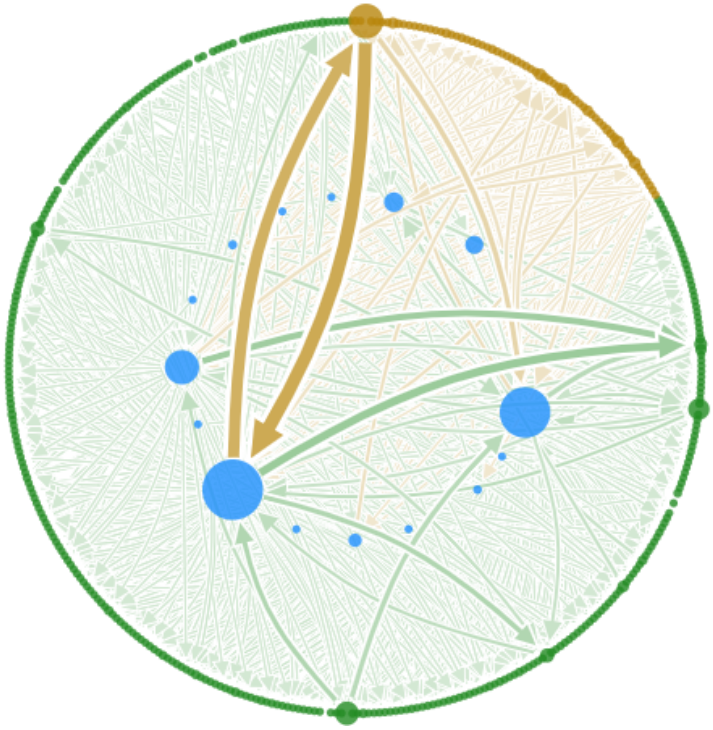
Note: DCV, Authors' calculations. The figure depicts the share of the monthly volume traded by foreign investors in sovereign bonds registered with Master Trader or brokers.

Appendix D Bank-investor relations

One explanation for the crowding-out effect observed in the credit market is the persistence of bank-investor relationships in the sovereign bond market. Foreign investors, on average, negotiate sovereign bonds with only a few banks, which serve as their primary counterparts and remain consistent over time. Consequently, when investors inject (withdraw) liquidity into these banks by purchasing (selling) sovereign bonds, it directly impacts the banks' balance sheets and, subsequently, the volume of new loans they issue.

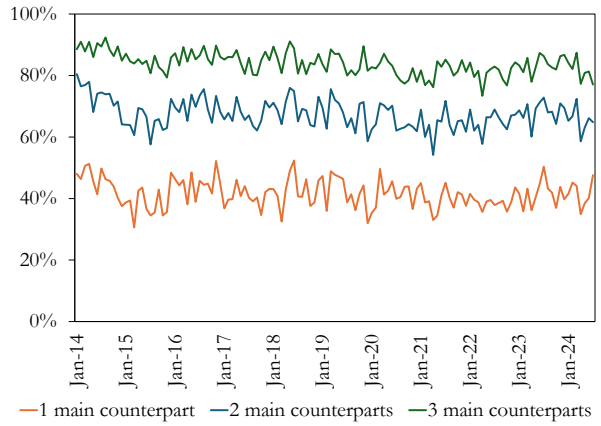
To illustrate this, Figure D1 depicts the network of relationships between banks and foreign investors in the sovereign bond market over a brief period within our sample. While the network shows that multiple transactions occur, most activity is concentrated among a few banks, with flows consistently directed toward the same counterparts over time (indicated by thicker arrows). Figure D2 illustrates the persistence of these relationships. The amount-weighted average probability of foreign investors engaging with their primary bank counterparts remains high over time (D2a), and the majority of investors trade exclusively with a single banking counterpart (D2b).

Figure D1: Network of transactions between foreign investors and their (bank) counterparts in the sovereign bonds market (June to August 2023)



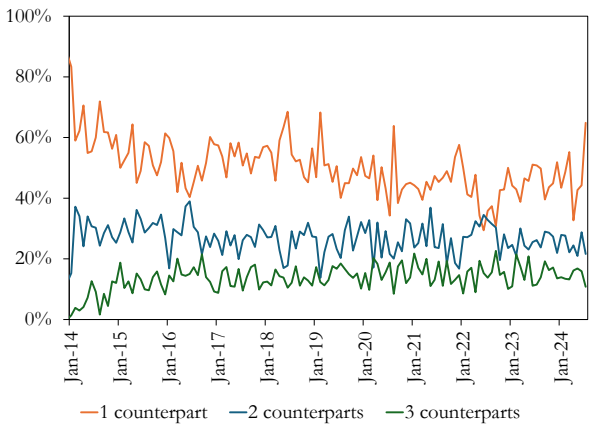
Note: Authors' calculations. The figure depicts all sovereign bond transaction between foreign investors (brown points and arrows for benchmark-driven investors, and green points and arrows for unconstrained foreigners) and local banks (blue points). Thicker arrows represent higher-volume transactions.

Figure D2: Foreigner-bank transactions in sovereign bonds



(a) Average probability of a foreign investor trading with their main bank counterparts.

Note: Authors' calculations. The series is calculated by dividing the monthly traded amount, of each foreign investor with their main counterparts, by the total traded amount of that foreign investor over a given month. Main counterparts are identified as those with which the foreign investor negotiates the highest amount over the whole sample.



(b) Share of foreign agents making transactions with bank counterparts.

Note: Authors' calculations. Referes to the share of foreigners that trade with 1, 2 and 3 bank counterparts over the whole pool of foreign agents.

Appendix E Bank-based heterogeneous effects

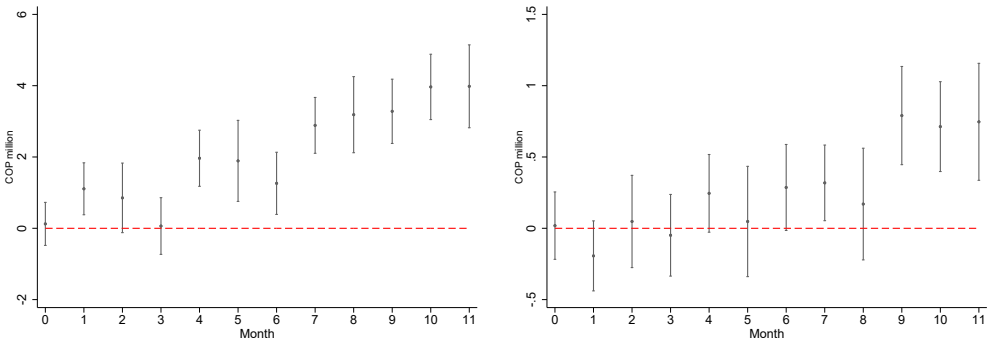
The results presented in equation (5) may be influenced by balance-sheet differences among banks. As it is highlighted in the literature of the bank lending channel, the supply of credit is directly influenced by different bank characteristics (Gambacorta and Marques-Ibanez, 2011). In order to control for some of these factors, in the following specification, some interaction terms between D_t^{flows} and a group of balance sheet variables of commercial banks are included. In particular, we estimate the following specification:

$$\begin{aligned} Loan_{ji,t+h} =& \beta_1^h Expo_{it} + \beta_2^h (D_t^{flows} * Expo_{it}) + \beta^h \mathbf{Banks}_{it} \\ &+ \beta^h (D_t^{flows} * \mathbf{Banks}_{it}) + \beta^h (D_t^{flows} * Expo_{it} * \mathbf{Banks}_{it}) \\ &+ \alpha_{ji}^h + \alpha_{jt}^h + e_{ji,t+h} \end{aligned} \tag{E2}$$

Where $\mathbf{Banks}_{it}$ represents one of the following balance-sheet variables as banks' dimensions that affect credit supply according to the bank lending channel literature: (i) bank's return on total asset (ROA), and (ii) solvency ratio. In Figures E1a and E1b, we evaluate dynamic effects by estimating local projections for the interaction term between $\beta(D_t^{flows} * Expo_{it})$ and $\mathbf{Banks}_{it}$, as exemplified in equation (E2).

The results show that the interaction of bank characteristics, such as ROA and solvency, with D_t^{flows} amplifies the increase in credit supply during periods of significant portfolio inflows (Figures E2a and E2b). The positive and statistically significant coefficients for these interactions, indicate that banks with higher profitability and stronger capital buffers tend to expand their loan issuance to a greater extent after receiving increased liquidity from offshore inflows into sovereign bonds.

Figure E1: IRFs of the amount of new loans



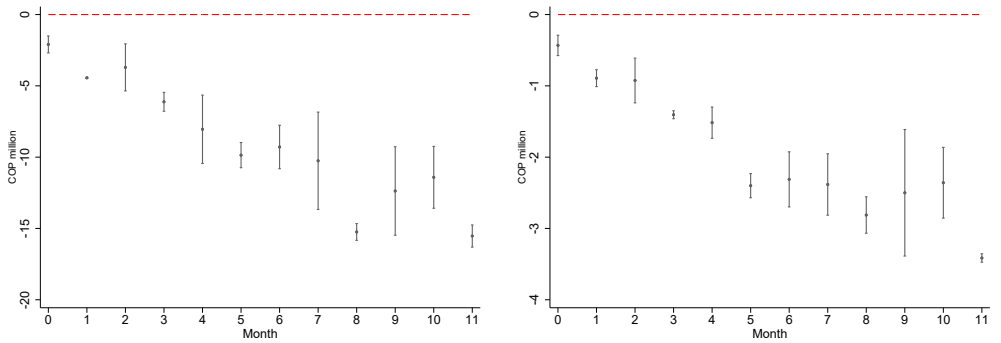
(a) Incremental effect of ROA (b) Incremental effect of Solvency

Note: Authors' calculations. The Figure shows coefficients from the regression as presented in equation (E2), with robust confidence intervals significant at a 5 percent level.

Additionally, we estimate an alternative specification of equation (E2) where D_t^{flows} is activated when a certain month presents negative flows by foreign investors. With this, we investigate how the effects of portfolio outflows on the credit market are influenced by balance-sheet differences among banks.

The analysis underscores how foreign capital outflows influence credit supply, with the extent of the impact depending on banks' balance-sheet characteristics. As shown in Figure E2b, banks with stronger solvency levels experience smaller credit contractions following portfolio outflows compared to those with higher profitability (Figure E2a). This resilience can be attributed to their robust capital buffers, which enable them to sustain lending activity despite the economic pressures of capital withdrawal.

Figure E2: IRFs of the amount of new loans



(a) Incremental effect of ROA (b) Incremental effect of Solvency

Note: Authors' calculations. The Figure shows coefficients from the regression as presented in equation (E2), with robust confidence intervals significant at a 5 percent level.

Appendix F Investor-based heterogenous effects

The results for the panel regression in equation 6, where the dependent variable is shifted forward by $h = 0$ months, are summarized in Table F1. Column 1 presents the coefficients without bank fixed effects, column 2 includes bank fixed effects, and column 3 incorporates bank-firm fixed effects. All especifications include firm-time fixed effects. Overall, the coefficients for the interaction terms $D_t * Expo_{it}^{U}$ and $D_t * Expo_{it}^{BD}$, remain significant and retain the same sign across all specifications, indicating that the results are robust to the inclusion of bank and bank-firm fixed effects.

Table F1: Credit market analysis

	(1)	(2)	(3)
$D_t * Exp_{it}^{U}$	1.080*	1.848***	1.439***
	(0.587)	(0.602)	(0.502)
$D_t * Exp_{it}^{BD}$	1.238***	1.022**	0.420*
	(0.448)	(0.459)	(0.110)
Observations	228,212	228,212	228,212
Bank F.E.		✓	
BankxFirm F.E.			✓
FirmxTime F.E.	✓	✓	✓

Authors' calculations. The table presents panel regressions for equation (6). Each column reports the coefficients for the interaction between D_t, $Expo_{it}^{U}$ and $Expo_{it}^{BD}$, first without bank fixed effects, then with bank fixed effects, and finally with bank-firm fixed effects. All especifications include firm-time fixed effects. Robust standard errors in parenthesis. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.