

Private Portfolio Retrenchment and Foreign Exchange Intervention in Emerging Markets

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Abstract

This paper studies how domestic private investors absorb global financial shocks in emerging markets and how private absorption shapes foreign exchange intervention policy (FXI). Using a panel of 19 emerging markets, we estimate the semi-elasticity of residents' gross portfolio outflows to expected excess currency returns. The estimates show that FXI is more intensive where private retrenchment is less return-elastic. We find the strength of retrenchment varies with institutional-investor development: a 10-percentage-point increase in pension-fund and insurance-company assets relative to GDP is associated with a roughly 10 percent larger semi-elasticity. Security-level data from Colombian pension funds provide complementary micro evidence. Net foreign asset purchases by Colombian pension funds decline when expected excess currency returns rise, while the micro-estimates of elasticities indicate that retrenchment per peso varies across mandates, illustrating how the allocation of savings across investors shapes aggregate absorption. Accounting for institutional-investor size widens the estimated difference between floaters and interveners in responses of expected excess currency returns to VIX changes. A parsimonious demand-system model interprets these patterns as FXI substituting for private retrenchment and explains why unconditional comparisons across policy regimes understate intervention's stabilizing effect.

JEL Classification: F31, F32, G23.

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Introduction

This paper explores variation in private domestic investors response to global financial shocks across EMEs and what explains this variation. We find evidence that suggests domestic institutional investors with international portfolios, such as pension funds and insurance companies, offset foreign demand shocks to domestic assets in EMEs. In addition, we show that the responsiveness of these investors helps explain why some economies rely more heavily on foreign exchange intervention (FXI) than others. Finally, we present how this link matters for evaluating FXI effectiveness.

While existing works on external financial shock spillovers to EMEs have emphasized either official intervention in response to the shock or the origin of the shock itself, private retrenchment–stop interaction in EMEs remains underexplored relative to studies of advanced economies. This paper puts EMEs’ private savers and their retrenchment at the center of the external adjustment of these economies. Specifically, the paper provides empirical evidence revealing that responsiveness of private retrenchment to excess currency return is a key determinant of how foreign demand shocks spill over to excess currency return and how responsive FXI policy should be to stabilize against such shocks.

To discipline the empirical analysis, we develop a two-period model of a bond market in which investors with inelastic demands jointly determine how foreign demand shocks move excess currency return. The model yields three predictions that guide the empirical analysis. First, private absorption is stronger when domestic investors with internationally diversified portfolios and flexible mandates hold more of national savings. Second, stronger private absorption dampens the response of excess currency returns to foreign demand shocks and thus FXI policy can be less aggressive. Third, because central banks’s intervention function is characterized by private absorption, any comparison across countries with FXI regimes that omit this margin understate the stabilizing effect of intervention. Using a panel of EMEs and Colombian pension funds’ portfolio data, we find empirical evidence supporting each prediction.

Motivating Fact — Table 1 compares how gross portfolio outflows, net portfolio inflow, and FXI (reserve) flow comove with the VIX, a common proxy of global financial condition, across economies with different FXI policies. The first two columns compare non-reserve-currency ad-

vanced economies (AEs) and EMEs. In both groups, gross portfolio outflow negatively correlates with the VIX, but the correlation is smaller in absolute value in EMEs. Net portfolio inflow, defined as gross inflow minus gross outflow, negatively correlates with the VIX in EMEs while it does not show a significant correlation in AEs. This suggests retrenchment is weaker in EMEs than in AEs and insufficient to absorb fluctuating portfolio inflow driven by global financial conditions. FXI flow is defined as the net sales of foreign reserves by the central bank, in a way that positive values indicate decumulation of foreign reserves. Central banks decumulate foreign reserves as the VIX rises in both AEs and EMEs, yet the correlation is more significant in EMEs than in AEs. These are in line with Avdjiev et al. (2022) that finds comovement of the VIX index with gross outflow from non-bank, non-government sectors is small while comovement with outflow from reserves is large.

The last two columns in Table 1 breaks EMEs in our sample into floaters and interveners by their intervention behaviors.¹ Floaters resemble advanced economies: gross outflows retrench when the VIX rises whereas net portfolio inflow and FXI flow are not significantly correlated with the VIX. In interveners, by contrast, gross outflow does not significantly move as the VIX rises and net inflow falls strongly when the VIX rises, accompanied by larger FXI decumulation (intervention).

Table 1. Correlation of Gross Flows with change of VIX index

Variable	G10 x Reserve	EM All	EM Floaters	EM Intervenors
Gross PF Outflow	-0.190*	-0.097**	<u>-0.132**</u>	<u>-0.066</u>
Net PF Inflow	-0.045	-0.158***	<u>-0.092</u>	<u>-0.217***</u>
FXI Flow	0.141	0.124***	<u>0.091</u>	<u>0.154**</u>

Note: This table shows correlations of gross portfolio outflows, net portfolio inflows (gross inflows minus gross outflows), and FXI flows with the log change in the VIX index for a panel of 19 EMEs and 5 advanced economies that are not reserve currency issuers. The table presents the mean of individual country's correlation coefficients. All flow variables are defined as a share of GDP, and positive FXI denotes net sales of foreign reserves. Emerging market economies are classified as floaters and interveners following Blanchard et al. (2015). Table 5 lists countries by group. *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively.

These patterns are robust to alternative proxies for global financial cycle. Yet, they can be interpreted in two different ways. For one, the retrenchment can be weak in the intervener economies

¹ Following Blanchard et al. (2015), we estimate country-level VARs and measure the cumulative response of foreign exchange intervention (FXI) at two-quarter horizon to an identified global capital-flow shock. We classify EMEs whose responses are at or stronger than the median across the full classification sample as interveners and the remainder as floaters. Section 2.2.1 elaborates on the classification methodology.

because their private sector is unable to absorb foreign shocks, and FXI is used as a substitute for weak private absorption. Alternatively, the weaker retrenchment can be due to the FXI policy reducing the change in return differentials in response to foreign demand shocks while private sector has the same capacity to absorb shocks across two groups. This reveals that the key object to study is not the comovement of gross outflow with the global financial cycle itself, but the elasticity of home savers' retrenchment to return differential changes. If home savers' retrenchment is more elastic to return differentials in floaters than in interveners, the first interpretation holds. On the contrary, if floaters and interveners have the same retrenchment elasticity, the second interpretation holds.

To formalize this argument and guide our empirical analysis, we model a market of home bonds where home savers and foreign investors with inelastic demand for home bonds participate. In the model, the return differential between home and foreign bonds determine home savers' international portfolio allocation and foreign investment in home bonds. Without official intervention, the response of equilibrium excess currency return to a shift in foreign demand depends on the excess currency return-elasticity of private retrenchment. FXI is introduced as the central bank's participation in home bond market to reduce the excess currency return differential.

The model delivers three predictions that guide our empirical analysis. First, the FXI policy is less responsive to excess currency return when private retrenchment is more elastic to the return differential. When excess currency return rises after a foreign demand shock, home savers with more elastic portfolios retrench more strongly from foreign assets, so the shock is absorbed with less impact on the price. Hence, since FXI is costly, the FXI policy remains less responsive to excess currency return when private retrenchment is more elastic. Our empirical supports this prediction by comparing the semi-elasticity of gross portfolio outflow to excess currency return across countries with different FXI policies.

Second, the model hints where to look for home savers that contribute to private absorption. In the model, the retrenchment elasticity is higher when internationally diversified home savers are larger. This points to pension funds and insurance companies, which are large institutional investors that exist in most EMEs and allocate across domestic and foreign assets. We provide two pieces of evidence. Using a novel fund-security level dataset on Colombian pension

funds' portfolios, we show that pension funds reduce their net purchases of foreign securities when excess currency return rises, consistent with home savers' behavior in the model. Further, we estimate the retrenchment elasticity of Colombian pension funds with different risk profiles and show their per-peso contribution to aggregate elasticity varies. Second, using cross-country variation, we find that economies with larger pension fund and insurance company assets exhibit larger retrenchment elasticity. These results indicate that domestic institutional investors with international portfolios are important source of private absorption capacity in EMEs.

Finally, the model shows how observed-effectiveness of FXI policy can be biased when private absorption capacity is not accounted for. The first prediction shows that FXI is endogenous to private retrenchment elasticity. The endogeneity makes unconditional comparisons across countries with different FXI policies understate the stabilizing effect of FXI. Consistent with this prediction, we show that the difference in excess currency return's sensitivity to the VIX between floaters and interveners is larger once we account for retrenchment elasticity, proxied by pension fund and insurance company assets. These results imply that FXI effectiveness should be evaluated in conjunction with the domestic private investors' ability to absorb the same shocks. More broadly, they suggest that the development of institutional investors with international portfolios can strengthen private shock absorption and reduce reliance on official intervention.

Related Literature — This paper speaks to four strands of literature in international finance. It is closest to the recent inelastic-demand and portfolio-balance view of asset prices. In this literature, shifts in desired holdings move equilibrium prices because investor demand curves have finite slopes (Gabaix and Koijen, 2024; Koijen and Yogo, 2019). This mechanism has been applied to international portfolios and exchange rates by Koijen and Yogo (2026) and Jiang et al. (2024), and is closely related to preferred-habitat models of bond and currency markets (Greenwood et al., 2023; Gourinchas et al., 2025). Under this view, price change in response to shifts in demand of a group of investors is pinned down by the elasticity of the other investors' demand curves.

Recent studies have found that composition of external investors influence how asset prices move in response to global financial tightening. Using security-level data from the US and Europe, Zhou (2025) show that sovereign bonds prices experience further declines when foreign investment funds holds larger fraction of the outstanding bonds. Bertaut et al. (2025) uses ad-

ministrative fund portfolio data to document that demand elasticity for EME bonds depend on investor type and currency denomination of the bonds. This paper studies the aggregate demand elasticity of the opposite hand, namely domestic investors with international portfolios. We find that their demand for foreign assets is inelastic and the demand inelasticity associates with the FXI policy function across countries

We study capital retrenchment by domestic savers in response to external shocks through the lens of the inelastic demand hypothesis. When foreign investors reduce demand for domestic assets, home savers can absorb the shock by retrenching from foreign assets and reallocating toward domestic assets to exploit higher expected returns on domestic assets. Their return elasticity governs the strength of retrenchment, which in turn determines the extent to which excess currency returns and exchange rates respond to foreign demand shocks. This paper therefore relates to the literature on capital retrenchment and private absorption of external shocks.

The literature documents that domestic investors retrench from foreign assets as the global financial condition tightens. Forbes and Warnock (2012) identify retrenchment as a sharp decline in residents' gross capital outflows and show that such episodes become more likely when global risk rises. Using quarterly flows disaggregated by domestic sector, Avdjiev et al. (2022) show that responses to global risk vary across EMEs and Advanced Economies (AEs) as well as across flow types. A few papers model gross capital outflow and its retrenchment in response to global financial shocks. Caballero and Simsek (2020) models retrenchment of domestic investment overseas in response to foreign exits and shows that free capital flow's implication for stability depends on symmetry of expected return and financial development across countries. Jeanne and Sandri (2023) models the stabilization role of private retrenchment in a small open economy and shows that the usefulness of FXI and capital controls depends on financial development. Davis and van Wincoop (2024) develop a model of symmetric economies in which a rise in global risk aversion lowers risky-asset prices and shifts relative wealth from internationally diversified investors toward more home-biased investors, generating a simultaneous retrenchment in gross capital inflows and outflows. This paper contributes to this literature by providing systematic empirical evidence that EM private retrenchment varies with the development of internationally diversified domestic institutional investors. We complement our aggregate evidence with an analysis of micro-level data from Colombian pension funds to examine how individual fund characteristics

can influence aggregate retrenchment behavior.

Third, this paper contributes to the literature on foreign exchange intervention and its effectiveness. Theoretical literature studies what FXI can achieve when financial frictions introduce incomplete risk sharing and limit private arbitrage (Cavallino, 2019; Fanelli and Straub, 2021; Itskhoki and Mukhin, 2026). They show that FXI can improve welfare by mitigating financial-market driven distortions in capital flows and exchange rates. Basu et al. (2025) show that FXI can stabilize shocks to investor demand for local-currency assets but only if FX markets are shallow, in other words, when local-currency debt carries a positive premium. Jeanne and Sandri (2023) connects FXI policy with domestic financial development. They show that FXI is relatively more attractive in less financially developed economies. This paper contributes to the literature by emphasizing flexibility and international diversification of domestic investors' portfolio as a source of private absorption that shapes FXI policy, in addition to financial development by size.

An empirical work that studies FXI effectiveness faces an identification challenge because intervention responds endogenously to exchange-rate and macroeconomic conditions. The empirical literature uses higher-frequency time series data or exploits cross-country variation to identify the effect of FXI. Kuersteiner et al. (2018) exploit a discontinuous intervention rule, while Fratzscher et al. (2019) use daily intervention data from 33 countries. Blanchard et al. (2015) compare policy and exchange rate responses to exogenous global capital inflow shocks across countries. They suggest that FXI succeeds in mitigating the shock's impact on nominal and real exchange rates by presenting that exchange rate response to a global capital inflow shock is smaller in countries where FXI responds more to the shock. Beltran and He (2024) examine how the exchange rate response to an exogenous currency-demand shock identified by mechanical rebalancing of a local-currency government-bond index varies with the degree of FX management. These studies find that FXI moves exchange rates or stabilize exchange rate against external shocks, although its magnitude and persistence vary. This paper takes the cross-country approach, and introduces another layer of endogeneity: FXI policy is used more intensively where private retrenchment is more inelastic to excess currency returns. The additional endogeneity implies that FXI policy effectiveness should be evaluated while accounting for the private absorption margin for external shocks.

Lastly, this paper relates to the literature studying exchange-rate dynamics driven by inter-

national portfolio flows. The seminal work of Gabaix and Maggiori (2015) shows that exchange rate can be moved by the portfolio choices of international investors due to incomplete risk sharing across countries. Empirical results in Hau and Rey (2005) and Camanho et al. (2022) show that portfolio rebalancing under incomplete FX-risk trading links asset returns, capital flows, and exchange rates. Recent studies on emerging market securities further reveal that transmission of global financial shocks depends on who holds domestic assets and what risks those investors bear. Zhou (2025) shows that foreign investor composition matters: investment funds amplify global-risk spillovers, while banks, insurers, and pension funds remain relatively stable. Relative to these papers, this paper shifts attention from foreign investors' portfolio demand and risk exposure to home savers in EMEs, showing that their retrenchment elasticity characterizes a domestic absorption margin that shapes exchange-rate dynamics and FXI policy.

The rest of the paper is organized as follows. Section 1 describes the model and its predictions. Section 2 presents empirical evidence on private absorption and FXI policy. Section 3 studies pension funds and insurance companies as the source of private absorption. Section 4 revisits FXI effectiveness conditional on private absorption capacity. Section 5 concludes.

1 Demand System Model of Excess Currency Returns

In this section, we develop a partial equilibrium model of a bond market that guides our empirical analysis in the later sections. The bond market is cleared by the return differential between home and foreign bonds. The model clarifies how foreign demand shocks are absorbed by private retrenchment and official intervention. Home savers and a representative foreign investor demand home bonds, and their demand functions are not fully elastic to the return differential, in the spirit of Jiang et al. (2024) and Kojen and Yogo (2026). Foreign demand for home bonds is subject to a shock that represents global financial conditions. Since demand functions are inelastic, this shock moves the equilibrium excess currency return.

The model delivers three main predictions that we test empirically in section 2. First, the elasticity of home savers' retrenchment to excess currency return is larger when home investors with more flexible mandates and larger target foreign-bond shares hold more wealth. Second, when FXI is costly, the central bank intervenes more aggressively when private retrenchment is less

elastic. Third, the observed effectiveness of FXI policy is underestimated when private absorption capacity is not accounted for.

1.1 Model Environment

The model is a two-period discrete-time model of a small open economy. Home and foreign bonds are traded in the first period and pay off in the second period. Home savers, foreign investors, and the central bank trade home bonds, while home savers also hold foreign bonds. Bonds are denominated in their respective currencies, so the equilibrium in the home bond market determines the expected return differential between home and foreign bonds in home currency units, i.e., the excess currency return.

1.1.1 Bonds and Excess Currency Return

Bonds — Home and foreign bonds are zero-coupon bonds that pay one unit of their respective currency in the second period. A unit of home (foreign) bond costs $P_H = 1/(1+r)$ ($P_* = 1/(1+r^*)$) units of home (foreign) currency in the first period and pays one unit of home (foreign) currency in the second period. The interest rates r and r^* are exogenous and constant throughout the model. The nominal exchange rate S is defined as units of home currency per unit of foreign currency, and S' denotes the second-period exchange rate. Hence, the home-currency gross return on the foreign bond is $(1 + r^*)S'/S$.

Exchange Rate and Returns — The return differential between home and foreign bond should include change in exchange rates as bonds are denominated in different currencies. Let $s = \log S$ and $s' = \log S'$. The second-period exchange rate is stochastic, and we normalize the long-run expected future exchange rate to one. The excess currency return on the home bond relative to the foreign bond is

$$rx = r - r^* - (s' - s)$$

With assumption of exogenous interest rates and $\mathbb{E}S' = 1$, the expected excess currency return

pins down the current exchange rate as follows, up to second-order approximation:²

$$s \approx r^* - r + \mathbb{E}[rx] + \frac{1}{2} \text{Var}(S') \quad (1)$$

1.1.2 Agents and Demand Functions

We model our demand functions in the spirit of global demand system for financial assets with inelastic demands. Hence, the functions are characterized by exogenous parameters that define target share of foreign assets in an investor's portfolio and flexibility in portfolio adjustment. The global demand system approach, in contrast to traditional international macro models with optimal portfolios, provides a novel approach to explain exchange rate disconnect (Meese and Rogoff, 1983) and 'anomalies' such as the gravity effect (Portes and Rey (2005)) in international capital flows (see Kojen and Yogo (2026) and Jiang et al. (2024) for more discussion). The exogenous parameters in the demand function reflects industry structure of the financial market, which is determined in a longer horizon by factors such as regulations and tax policies.

The economy is populated with a unit measure of home savers, a representative foreign investor, and a central bank. Home savers allocate wealth between home and foreign bonds. The foreign investor demands home bonds for their excess return, and her demand is subject to a shock in the first period. The equilibrium expected excess currency return clears the home bond market.

Home Savers — Following Gabaix and Kojen (2024), we model domestic savers as investors with portfolio mandates. In this framework, an investor or fund is characterized by a target equity share, which determines both her baseline asset allocation and marginal propensity to allocate new wealth to that asset. We adapt this logic to home savers in a small open economy by imposing a target share of foreign bonds in their portfolio, which are risky asset, since their home-currency value fluctuates with the exchange rate.

We denote the target share of foreign bonds in home saver i 's portfolio as θ_i . We assume she enters the first period with wealth $\bar{W}_{i0}$, $\theta_i \in [0, 1]$ of which being allocated to foreign bonds and $1 - \theta_i$ to home bonds. $\bar{B}_{Hi}^*$ and $\bar{B}_{Hi}$ are the quantities of each bond she holds that achieve this

²Notice that variance of future exchange rate $\text{Var}(S')$ is solved as a solution of a fixed-point problem if we extend our model to infinite horizon. Yet, in our two-period model, we consider the variance as exogenously given.

target share:

$$\theta_i = \frac{\bar{S}P_*\bar{B}_{Hi}^*}{\bar{W}_{i0}}, \quad 1 - \theta_i = \frac{P_H\bar{B}_{Hi}}{\bar{W}_{i0}}$$

$\bar{S}$ and $\bar{W}_{i0}$ denote nominal exchange rate and initial wealth of investor i prior to the shock, and therefore $\bar{B}_{Hi}^*$ and $\bar{B}_{Hi}$ are investor i 's initial bond holdings of foreign and home bonds. Thus, θ_i is the foreign-bond analogue of the equity share in Gabaix and Koijen (2024): absent return-induced rebalancing, a marginal dollar assigned to saver i is allocated with share θ_i to foreign bonds and share $1 - \theta_i$ to home bonds.

We assume that saver i is allowed to adjust her foreign-bond share in response to changes in the expected excess return on home bonds à la Gabaix and Koijen (2024):

$$\frac{SP_*\bar{B}_{Hi}^*}{\bar{W}_{i0}} = \theta_i \exp\{-\kappa_i(E[rx] - \bar{rx}^e)\}, \quad \kappa_i \geq 0 \quad (2)$$

The parameter κ_i captures the flexibility of saver i 's mandate. $\bar{rx}^e$ denotes the steady-state expected excess return on home bonds, which is the equilibrium level of expected excess return in the absence of foreign demand shocks. At this equilibrium, home savers maintain their initial bond holdings, $\bar{B}_{Hi}^*$ and $\bar{B}_{Hi}$. When $\kappa_i = 0$, the saver behaves like a fixed-share investor: exchange-rate movements change wealth, but the saver keeps the foreign-bond share fixed at θ_i . When $\kappa_i > 0$, savers shrink the share of foreign bonds in their portfolio as expected excess return on home bonds grows over the steady-state level.

Foreign Investors — The representative foreign investor demands home bonds for their expected excess return. We specify foreign demand as

$$B_F = \bar{B}_F (1 + \gamma^F(\mathbb{E}[rx] - \bar{rx}^e) + \varepsilon) \quad (3)$$

where $\gamma^F > 0$ is the elasticity of foreign demand to excess currency return. The shock ε captures exogenous shifts in foreign investors' demand for home bonds. A negative shock, $\varepsilon < 0$, represents a foreign retreat from home bonds, as in a tightening of global financial conditions. The finite value of γ^F captures inelastic foreign demand, in the spirit of Gabaix and Koijen (2024), Koijen and Yogo (2026), and Jiang et al. (2024).

1.2 No-FXI Equilibrium

We first study the equilibrium without foreign exchange intervention. We normalize the total supply of home bonds to one, so market clearing is

$$B_H + B_F = 1. \quad (4)$$

Thus, all bond holdings are measured as shares of total home-bond supply. The market clearing condition clarifies that a shift in foreign demand for home bonds is offset by home savers' increased demand for home bonds, which is funded by retrenchment from foreign bonds. The expected excess currency return adjusts to clear the market. Since the bond demands are not fully elastic, the magnitude of change in expected excess return is determined by the elasticity of retrenchment with respect to expected excess return. We first characterize this elasticity and then derive how it determines the equilibrium expected excess return.

The equilibrium is solved as a deviation from the steady state where foreign demand shock is zero, $\varepsilon = 0$, and is approximated to first order in ε . We denote the steady-state value of a variable X by $\bar{X}$, its deviation from the steady state by $\hat{X} = X - \bar{X}$, and its log deviations by $x = \log X - \log \bar{X}$.

1.2.1 Home Saver's Retrenchment

We log-linearize home saver i 's demand for foreign bonds in equation (2) around the steady state to obtain linear demand functions for home and foreign bonds in log deviations.

$$b_{Hi} = \frac{\theta_i}{1 - \theta_i} \gamma_{Hi} \cdot \widehat{rx} \quad (5)$$

$$b_{Hi}^* = -\gamma_{Hi} \cdot \widehat{rx} \quad (6)$$

where $\gamma_{Hi} \equiv 1 - \theta_i + \kappa_i$ denotes the elasticity of home saver i 's foreign-bond demand with respect to expected excess currency return. The elasticity can be broken down into two components. First, the term $1 - \theta_i$ captures the wealth effect of exchange-rate changes on home-currency wealth. When expected excess return rises, the home currency depreciation increases the home-currency value of foreign bonds and the saver's wealth. The home saver should move $1 - \theta_i$ of the increased

wealth from foreign bonds to home bonds to match the target share of foreign bonds, θ_i . Second, the term κ_i captures the rebalancing for higher return on home bonds. When expected excess return rises, a home saver rebalances toward home bonds as much as its mandate allows, which is κ_i . Notice that the first effect generates retrenchment even when $\kappa_i = 0$. Appendix A.1.1 shows the derivation of these demand functions and the expression for γ_{Hi} .

Integrating individual demands across home savers gives aggregate domestic demands for home and foreign bonds as a deviation from the steady state level:

$$b_H = \frac{\Gamma_H}{P_H \bar{B}_H} \cdot \widehat{rx} \quad (7)$$

$$b_H^* = -\frac{\Gamma_H}{\bar{S} P^* \bar{B}_H^*} \cdot \widehat{rx} \quad (8)$$

where Γ_H denotes the aggregate semi-elasticity of home savers' demand for bonds with respect to expected excess currency return. The same parameter in equation (8) captures semi-elasticity of retrenchment with respect to expected excess currency return. We call Γ_H the *aggregate semi-elasticity of private retrenchment* hereafter, and characterize it as follows.

$$\Gamma_H \equiv \int \bar{W}_{i0} \theta_i \gamma_{Hi} di \quad (9)$$

Characterization of Γ_H shows what makes aggregate home savers' retrenchment more return-elastic, and therefore capture private absorption capacity of foreign demand shocks. Notice that Γ_H consists of exogenous parameters θ_i s and κ_i s, which are given exogenously to represent different fund mandates. Distribution of savings across funds with different combinations of θ_i and κ_i determines the aggregate semi-elasticity Γ_H . Concentration of wealth managed by funds with more flexible mandates increases the aggregate semi-elasticity while foreign-bond share's (θ_i) effect on the elasticity is more subtle. Larger target foreign-bond share makes individual investors' retrenchment more elastic until $\theta_i = (1 + \kappa_i)/2$. In other words, retrenchment by an individual investor for a unit change in return increases with larger target foreign-bond share as long as the share is 'too large' relative to their flexibility. This non-monotonicity arises because the wealth effect and size effect work in opposite directions. On one hand, the wealth effect, captured by $1 - \theta_i$ in γ_{Hi} , decreases with larger foreign-bond share because a smaller fraction of increased wealth due

to appreciated foreign currency is reallocated to home bonds. On the other hand, the size effect, captured by θ_i in equation (9), increases the amount of retrenchment for a given change in returns.

Following prediction summarizes this observation.

Prediction 1. *The aggregate semi-elasticity of private retrenchment with respect to expected excess currency return is larger when home investors with more flexible mandates and larger target foreign-bond shares manages more wealth.*

Notice slow-moving institutional factors determine the distribution of wealth across these parameters. Regulations and tax policies that favor or disfavor certain types of funds, such as pension funds or mutual funds, shape the distribution of wealth across funds with different mandates and eventually influence the elasticity of capital flow from residents across borders. Section 3.1.2 provides an empirical evidence from a micro-data of Colombian pension funds portfolio showing that funds with different mandates exhibit varying elasticity of retrenchment with respect to expected excess currency return. The variation in retrenchment elasticity across funds supports the notion in prediction 1 that for a given volume of savings in the country, the aggregate retrenchment elasticity can vary depending on how wealth is distributed among funds with different micro-elasticities.

1.2.2 Equilibrium Expected Excess Currency Return

We now solve for the equilibrium response of expected excess currency return to a foreign demand shock as deviation from the steady state. In the absence of FXI, home savers absorb the foreign demand shock through their retrenchment from foreign bonds. Put differently, deviation of domestic and foreign demand for home bonds from their respective steady state should offset each other. Formally,

$$\widehat{B}_H + \widehat{B}_F = 0 \quad (10)$$

Combining equation (3), (7), and (10) yields the equilibrium expected excess currency return:

$$\widehat{rx} = -\frac{\overline{B}_F}{A^{LF}}\varepsilon, \quad A^{LF} \equiv \frac{\Gamma_H}{P_H} + \gamma^F \overline{B}_F \quad (11)$$

Because $A^{LF} > 0$, a negative foreign demand shock, $\varepsilon < 0$, raises the expected excess return

on home bonds. By equation (1), this corresponds to a depreciation of the home currency. The response is smaller when home savers' retrenchment is more elastic, i.e., when Γ_H is larger for a given level of foreign investors' demand elasticity and foreign holdings of home bonds.

1.3 Equilibrium with Endogenous FXI

In this section, we introduce foreign exchange intervention (FXI) into the model. FXI is implemented by the central bank's simultaneous purchase (sale) of home bonds and sale (purchase) of foreign reserves. We assume that the central bank desires to close the excess return gap while minimizing the cost of intervention. Using a stylized objective function, we capture this trade-off and derive the FXI policy function. The FXI policy is linear in expected excess return, and the policy function is steeper when home savers' retrenchment is less elastic.

1.3.1 FXI Policy Function

We introduce the central bank's linear FXI policy rule by assuming the central bank wants to close the excess return gap while minimizing the intervention cost. A full-fledged open economy models such as Cavallino (2019) and Itskhoki and Mukhin (2026) describe how the two motives coexist. The excess return induces incomplete international risk sharing, which diverts consumption from its optimal path. Hence, the central bank uses foreign reserves to close the excess return. Yet, maintaining reserves is costly because reserves (i.e., foreign bond holdings by the central bank) yield lower return than the interest rate at which the central bank borrows to finance reserve accumulation. In addition, although our model abstracts from the full infinite-horizon setting, intervention today depletes the capacity for future interventions. Therefore, the central bank desires to minimize the size of intervention simultaneously with closing the excess return gap.

This objective can be represented by a quadratic objective function of the central bank in equation (12). We assume the central bank chooses its FXI policy function ex-ante and follows the policy in the first period in response to change in expected excess return due to foreign demand shock.³

$$\mathcal{J} \equiv \widehat{B}_{CB}^2 + \zeta (\widehat{rx})^2 \quad (12)$$

³As the 'FXI' in our model is an adjustment of net supply of home bonds to private agents, domestic and foreign, any purchase or supply of home bonds with an intention to influence the excess currency return by the central bank or the government can be interpreted as FXI.

The first term captures the cost of intervention and the second term captures the welfare loss due to incomplete risk sharing.

$\widehat{B}_{CB}$ is the dollar-deviation demand for home bonds generated by the central bank's intervention. The FXI policy is the choice of $\widehat{B}_{CB}$ as a function of expected excess return, $\widehat{r\bar{x}}$. We focus on the response of intervention to deviations in expected excess return, not the level of the central bank's steady-state balance sheet. The policy boils down to choosing how the central bank reacts to changes in expected excess return. The optimal policy function is as follows:

$$\widehat{B}_{CB} = \gamma_{CB}^{opt} \widehat{r\bar{x}} \quad (13)$$

where $\gamma_{CB}^{opt} = \frac{\zeta}{\frac{1}{P_H} \Gamma_H + \gamma^F \bar{B}_F}$. See appendix A.2 for derivation of the optimal policy.

The optimal policy function in equation (13) shows that the FXI policy is characterized by Γ_H that consists of a set of exogenous parameters. In particular, the central bank's intervention substitutes for private retrenchment when the private retrenchment is inelastic to return changes. Prediction 2 summarizes this result, for which we provide empirical evidence in section 2.2.

Prediction 2. *FX intervention policy is more responsive to changes in expected excess return when the aggregate retrenchment is less elastic to the return.*

1.3.2 Policy Function Endogeneity and Observed FXI Effectiveness

Empirical studies of FXI effectiveness suffer from endogeneity due to simultaneous changes in FXI actions, exchange rates, and other macroeconomic variables. The relation between retrenchment elasticity and FXI policy function summarized by prediction 2 introduces an additional endogeneity to cross-country studies of FXI policy effectiveness. When FXI policy is used to substitute for private retrenchment that is weak due to exogenous primitives, the observed cross-country difference such studies capture is attenuated. We formalize this bias using the response function of excess currency return to foreign shocks, $R(\gamma, \Gamma_H)$, defined in equation (14).

$$R(\gamma_{CB}, \Gamma_H) \equiv \frac{\partial \widehat{r\bar{x}}}{\partial(-\varepsilon)} = \frac{\bar{B}_F}{\Gamma_H/P_H + \gamma^F \bar{B}_F + \gamma_{CB}} \quad (14)$$

Consider two countries (Inelastic and Elastic) with different private retrenchment elasticities

Γ_H^I and Γ_H^E , respectively, and everything else equal. Private retrenchment is more elastic in country E , hence $\Gamma_H^I < \Gamma_H^E$. From the optimal policy rule in equation (13), FXI in country I is more responsive to excess currency returns than in country E .

$$\gamma_{CB}^I \equiv \frac{\zeta}{\Gamma_H^I/P_H + \gamma^F \bar{B}_F} > \frac{\zeta}{\Gamma_H^E/P_H + \gamma^F \bar{B}_F} \equiv \gamma_{CB}^E \quad (15)$$

The observed difference of response function $R(\gamma_{CB}, \Gamma_H)$ between the two country can be decomposed as the sum of the policy effect at fixed private elasticity and the difference due to private capacity.

$$\underbrace{R(\gamma_{CB}^I, \Gamma_H^I) - R(\gamma_{CB}^E, \Gamma_H^E)}_{\text{Observed cross-country difference}} = \underbrace{R(\gamma_{CB}^I, \Gamma_H^I) - R(\gamma_{CB}^E, \Gamma_H^I)}_{\text{Policy effect at low private elasticity} < 0} + \underbrace{R(\gamma_{CB}^E, \Gamma_H^I) - R(\gamma_{CB}^E, \Gamma_H^E)}_{\text{Private elasticity effect} > 0} \quad (16)$$

Decomposition in equation (16) shows that the observed cross-country difference captures the policy effect offset by the private elasticity effect. Hence the observed differential is smaller in magnitude than the policy effect, or even reversed in sign if the private elasticity effect dominates the policy effect. Prediction 3 summarizes the discussion on the endogeneity bias in observed FXI effectiveness.

Prediction 3. *The endogeneity of FXI policy to private retrenchment elasticity attenuates observed difference in expected excess currency return's response to global financial shocks across countries with different FXI policy functions.*

2 Private Semi-Elasticity and FXI: Empirical Evidence

In this section, we present empirical evidence for the relation between private absorption of foreign shocks and FXI policy using a panel of emerging market economies. The panel covers 19 EMEs whose currencies are not pegged to another currency according to the classification by Ilzet-zki et al. (2019), and sample period from 2001Q1 to 2024Q2.

2.1 Empirical Model: Aggregate Semi-Elasticity of Retrenchment

In this section, we estimate aggregate private semi-elasticity of retrenchment, Γ_H in equation (8) of the model. Specifically, we estimate the semi-elasticity of gross portfolio outflow with respect to expected excess currency return, as gross portfolio outflow captures the retrenchment from and acquisition of foreign securities. Because retrenchment (expansion) decisions depend on the excess currency return, the elasticity is a more rigorous statistics than a reduced-form correlation of gross portfolio outflow and a proxy of foreign shocks to study how private cross-country capital flow responds to foreign shocks.

By definition of balance of payment (BPM6) statistics, gross portfolio outflow excludes capital flow due to change in reserve assets, and measures flows originating from private savers.⁴ We define expected excess currency return as the difference between returns on domestic and foreign bonds with one year maturity. We directly measure the ex-ante excess return on home bond with a survey-based measure of expected exchange rate. Specifically, the expected return on foreign bond is converted to domestic currency terms using the Consensus Forecast of exchange rate one year ahead. This measure of expected excess return is often used in the empirical literature on uncovered interest rate parity (UIP) deviation. Kalemli-Özcan and Varela (2025) examine its properties and show that it is closely related with global financial conditions.

The empirical model used to estimate the private retrenchment semi-elasticity is a regression of gross portfolio outflow, normalized by lagged GDP, on the first-difference of expected excess currency return ($rx_{i,t}^e$). The coefficient on expected excess currency return, λ , is the empirical counterpart of the negative of aggregate semi-elasticity of retrenchment, $-\Gamma_H$, in the model. We refer to λ as the private retrenchment elasticity henceforth. Formally, we estimate a pooled regression with country fixed effects in equation (17):

$$\text{Gross Portfolio Outflow}_{i,t} = \delta_i + \lambda \Delta rx_{i,t}^e + \eta \text{Gross Portfolio Outflow}_{i,t-1} + \nu_{i,t} \quad (17)$$

⁴This measure may include flows from government or quasi-government entities such as sovereign wealth funds that are not classified as reserve assets. Though they are technically not changes in reserve assets, they may be driven by motives to affect the exchange rate. We find our results to be robust to using an alternative measure of gross portfolio outflow that explicitly excludes government and central bank flows constructed by Avdjiev et al. (2022). Their breakdown of international capital flows by sector provides portfolio debt outflow from banks and other private sectors ('corporate' in the paper). We use the sum of flows from both private sectors as an alternative measure of gross private portfolio outflow. See table C.2 for the results using this alternative measure.

A lag of gross portfolio outflow is controlled for to capture the persistence in gross portfolio outflow.⁵

The estimation is subject to endogeneity because change in gross portfolio outflow (retrenchment) moves the excess currency return in equilibrium. We address the endogeneity of expected excess return using an instrumental variable. In particular, we use a proxy of foreign demand shock, which is assumed to be exogenous to $\nu_{i,t}$. The foreign shock should be relevant for expected excess return, as they shift foreign demand for home bonds and thus move the excess return in equilibrium, as shown in section 1. We use a common proxy of global financial condition, the VIX index, as the instrumental variable. As the index captures implied volatility in US equity options and therefore mainly reflects the risk-aversion of US-based investors, it serves as a exogenous instrument for expected excess currency return. Also, the literature, such as Kalemli-Özcan and Varela (2025), as well as our first-stage statistics, find high correlation between the VIX index and the excess currency return, which supports the relevance of the VIX index as an instrument.

Table 2 reports the estimation results of equation (17) for the full sample of 19 EMEs and for five non-reserve currency advanced economies (AEs): Australia, Canada, New Zealand, Norway, and Sweden. The estimated private retrenchment elasticity is negative and statistically significant for both samples of EMEs and AEs. This implies that private savers decrease purchases of, or retrench from, foreign financial assets when the expected excess currency return on domestic securities increases. Yet, the elasticity is smaller in absolute value for the sample of EMEs than for the sample of AEs. In EMEs, a one standard deviation increase in expected excess return, 2.5%p, is associated with a retrenchment of -0.2% p of GDP, equivalent in magnitude to 0.3 standard deviations of gross portfolio outflow. In AEs, a one standard deviation increase in expected excess return, 2.4%p, is associated with a retrenchment of -0.6% p of GDP, equivalent in magnitude to 0.4 standard deviations of gross portfolio outflow. Such difference in private retrenchment elasticity between EMEs and AEs is consistent with our motivating evidence in table 1 as well as stronger retrenchment by advanced economies documented in the literature (Avdjiev et al. (2022) and Forbes and Warnock (2012)). The model predicts that the error term ν_{it} is positively correlated with the expected excess return, so the OLS estimate is biased towards zero. As expected, the IV estimate

⁵The empirical model is a dynamic panel regression model with an autoregressive term. Yet, the long time dimension (~ 80) relative to the cross-sectional dimension (19) relieves us from the Nickell bias (Nickell, 1981).

of λ is larger in absolute value than the OLS estimate.

Table 2. Retrenchment Elasticity Estimates

	EME		AE	
	IV	OLS	IV	OLS
$\Delta r x^e$	-0.084*** (0.023)	-0.023*** (0.004)	-0.251* (0.132)	-0.044 (0.046)
Lag Dep. Var.	0.255*** (0.056)	0.243*** (0.049)	0.256** (0.123)	0.233*** (0.078)
No. Observations	1335	1335	440	440
Country FE	Yes	Yes	Yes	Yes
First-stage F-statistic	49.68		196.97	

Note: The table reports estimates of regression (17) separately for 19 emerging market economies (EMEs) and five non-reserve-currency advanced economies (AEs): Australia, Canada, New Zealand, Norway, and Sweden. Gross portfolio outflow is measured as a share of GDP. In the IV columns, $\Delta r x^e$ is instrumented with $\Delta \ln VIX$; the OLS columns estimate the same specification without instrumenting $\Delta r x^e$. All regressions include country fixed effects and lagged gross portfolio outflow. Standard errors are clustered by country. First-stage F statistics are reported for the IV specifications. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

2.1.1 Robustness: Alternative Instrument Variables

As a robustness check, we replace $\Delta \ln VIX$ with alternative proxies of foreign demand shocks. First we construct a quantity-based proxy that captures a common component in U.S. net purchases of individual destination countries' securities, using Treasury International Capital (TIC) data augmented by (Bertaut and Judson, 2022). We normalize estimated U.S. net purchases of each destination country's bonds and equities by lagged U.S. holdings and extract the common component of the resulting monthly series using a dynamic factor model. Appendix C.2.1 describes the construction of this instrument in detail and Table C.7 reports the corresponding IV estimates. The results are qualitatively consistent with the baseline estimates: the semi-elasticity is negative and statistically significant for the full EME sample and for floaters, but smaller and statistically insignificant for interveners. The first stage remains strong for the full sample and floaters but is weaker for interveners, whose estimate should therefore be interpreted with a grain of salt.

In addition, we show that our results are robust to using alternative proxies of global financial cycles that are commonly used in the literature: the global financial cycle factor from Miranda-Agrippino and Rey (2020) and the dollar index. Table C.5 and Table C.6 in the appendix report estimation results using these two alternative instruments. They also exhibit lower first-stage F

statistics for interveners, but the results remain qualitatively consistent with the baseline estimates. Table 3 summarizes the first-stage F statistics for all alternative instruments, which shows that $\Delta \ln VIX$ is the most relevant instrument for our sample of EMEs. Therefore, we retain $\Delta \ln VIX$ as the baseline instrument.

Table 3. First-Stage F-Statistics for Various Instruments

	$\Delta \ln(VIX)$	TIC common factor	GFCy factor	Dollar index
All emerging markets	49.68	41.27	4.65	22.75
Floaters	98.14	79.46	7.68	44.12
Interveners	9.20	8.29	0.24	2.85

Note: The table reports first-stage F statistics of the IV regression for various instruments used in the IV regressions for three groups of EMEs: the full sample, floaters, and interveners. The instruments include the baseline $\Delta \ln VIX$, a quantity-based proxy for foreign demand shocks constructed from the Bertaut–Judson-augmented TIC data, the global financial cycle factor from Miranda-Agrippino and Rey (2020), and the dollar index.

2.1.2 Robustness: Fama-Implied Excess Currency Return

We use the survey measure of expected exchange rates as our baseline because it directly captures investors’ expectations regardless of the source of the ‘excess’ return.⁶ The literature on uncovered interest rate parity (UIP) deviation often use a regression-based approach to estimate expected exchange rate changes, as in Fama (1984). In this section, we show the robustness of our results by replacing survey expectations with a Fama-implied measure of expected excess currency return.

Following Fama (1984), we estimate the following monthly regression separately for EMEs and AEs:

$$100 (\ln S_{i,m+12} - \ln S_{i,m}) = \mu_i + \beta_g (i_{i,m} - i_{US,m}) + \varepsilon_{i,m+12}, \quad g \in \{\text{EME}, \text{AE}\}.$$

Here, $S_{i,t}$ is the nominal exchange rate expressed as units of local currency per U.S. dollar, so an increase denotes local-currency depreciation. The term $i_{i,t} - i_{US,t}$ is the local–U.S. one-year interest-rate differential, μ_i is a country fixed effect, and β_g is a common slope within country group g . Table C.4 in the appendix reports the Fama regression estimates, which show that investing in high-interest-rate currencies gives positive excess currency returns on average, consistent with

⁶The literature on excess currency return, or uncovered interest rate parity (UIP) deviation, attributes the excess return to either risk premia or prices for intermediaries’ constraints. (Itskhoki and Mukhin (2021), Gabaix and Maggiori (2015))

the literature on UIP deviation. We use the fitted value from this regression as expected 12-month depreciation, and construct the Fama-implied expected excess currency return as:

$$rx_{i,m}^F = (i_{i,m} - i_{US,m}) - E\widehat{\Delta s_{i,m+12}}$$

We average monthly $rx_{i,m}^F$ within each quarter and take its first difference to obtain $\Delta rx_{i,t}^F$, which replaces the survey-based $\Delta rx_{i,t}^e$ in our baseline specification.

To assess robustness of our results to model-implied excess currency rate, we replace the baseline survey-based measure $\Delta rx_{i,t}^e$ with the Fama-implied measure $\Delta rx_{i,t}^F$ while preserving empirical strategy and sample. We re-estimate regression (17) on the baseline samples, instrument $\Delta rx_{i,t}^F$ with $\Delta \ln VIX_t$, and retain country fixed effects and lagged gross portfolio outflow. Table 4 reports the resulting estimates.

Table 4. Retrenchment Elasticity Estimates: Fama-Implied Excess Currency Return

	EME		AE	
	IV	OLS	IV	OLS
Δrx^F	-0.302*** (0.100)	-0.016 (0.013)	59.616 (549.922)	0.385*** (0.093)
Lag Dep. Var.	0.251*** (0.051)	0.239*** (0.048)	-3.561 (33.838)	0.203*** (0.060)
No. Observations	1335	1335	440	440
Country FE	Yes	Yes	Yes	Yes
First-stage F-statistic	55.58		0.01	

Note: The table reports estimates of regression (17) separately for 19 emerging market economies (EMEs) and five non-reserve-currency advanced economies (AEs): Australia, Canada, New Zealand, Norway, and Sweden. Gross portfolio outflow is measured as a share of GDP. Instead of survey forecasts, Δrx^F is constructed using a Fama-style regression. Monthly realized 12-month depreciation is regressed on the local–U.S. interest-rate differential, with country fixed effects and a common slope estimated separately for EMEs and AEs. Fama-implied expected excess returns equal the interest-rate differential minus fitted depreciation; they are averaged within quarter and first-differenced. The estimation sample matches that of the survey-based baseline in Table 2. In the IV columns, Δrx^F is instrumented with $\Delta \ln VIX$; the OLS columns estimate the same specification without instrumenting Δrx^F . All regressions include country fixed effects and lagged gross portfolio outflow. Standard errors are clustered by country. First-stage F statistics are reported for the IV specifications. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

For EMEs, the IV estimate remains negative and statistically significant, qualitatively consistent with the baseline result based on survey expectations. For AEs, however, the IV point estimate is uninformative with the first-stage F-statistic being virtually zero. This lack of instrument relevance arises because changes in the Fama-implied return are proportional to changes in the

interest-rate differential, whose response to $\Delta \ln VIX$ is pronounced among EMEs but small and not statistically significantly different from zero among AEs.⁷ The failure to obtain an informative AE estimate therefore reflects the absence of a first-stage relationship rather than evidence against return-elastic retrenchment among AEs.

2.2 Retrenchment Semi-Elasticity and FXI Intensity

In this subsection, we show that the private retrenchment semi-elasticity is negatively correlated with the intensity of FXI policy. First, we contrast semi-elasticities across groups of countries with different FXI regime, floaters and interveners. The estimated private retrenchment semi-elasticity is smaller for the sample of interveners than for the sample of floaters, which is consistent with the model’s prediction that FXI policy is stronger where private retrenchment is less return-elastic. Then we extend our analysis to cross-country variation in the semi-elasticity and its relation with a continuous measure of FXI intensity.

2.2.1 FXI Regime Classification

We compare private retrenchment elasticity across two groups of EMEs that differ in the extent of their foreign exchange market intervention. We classify the 19 EMEs in the sample into floaters and interveners using the methodology by Blanchard et al. (2015). The classification method categorizes economies based on how FXI policy responds to global financial shocks. This approach is more suitable for our study than alternative methods such as relying on official statements by monetary authorities or unconditional moments of exchange rate. Classification based on monetary authorities’ claims can be misleading, as many economies are known to manage their exchange rates in effect despite their claims of being a floater. Relying on unconditional correlation between two currencies for classification as in Ilzetzki et al. (2019) is also insufficient for this study

⁷We examine this mechanism by regressing $\Delta(i_{i,t} - i_{US,t})$ on $\Delta \ln VIX_t$ separately for EMEs and AEs, including country fixed effects and clustering standard errors by country. In the quarterly sample used for the Fama-IV exercise, the estimated coefficient is 0.013 with a standard error of 0.079 for AEs, compared with 1.038 with a standard error of 0.191 for EMEs. The monthly specification produces the same pattern: the AE coefficient is 0.049 with a standard error of 0.032, whereas the EME coefficient is 0.779 with a standard error of 0.287. This contrast echoes findings of De Leo et al. (2025), who show that short-term market rates in EMEs can rise following a U.S. monetary tightening even as domestic policy rates fall. They link the resulting wedge between local market and policy rates to dollar-funding premia, proxied by the EMBI spread, which comove with global risk conditions including the VIX. Although their interest-rate differential differs from ours, their evidence provides a mechanism through which global financial conditions exert a stronger influence on EME market rates than on AE market rates.

because the unconditional correlation is a composite outcome of private and official actions, rather than an isolated effect of FXI policy.

The classification method by Blanchard et al. (2015) uses a vector autoregression (VAR) to investigate how foreign exchange intervention responds to global financial shocks. The VAR is estimated for each individual country, and cumulative impulse response of FXI to a global financial shock is compared across countries. Countries whose FXI exhibits more than median cumulative response are classified as interveners, and the rest are classified as floaters. In the vector, we include sum of gross capital inflow across all countries in the sample excluding the country of VAR estimation as the most exogenous variable. Formally,

$$GKF_{i,t} = \frac{\sum_{j \neq i} \text{Gross Inflow}_{j,t}}{\sum_{j \neq i} \text{GDP}_{j,t}} \quad (18)$$

The full set of vector includes the GKF, policy interest rate differential, gross private capital outflow, inflow, net sales of foreign reserve, and log nominal exchange rate, from the most to the least exogenous variable. Policy rate differential between country i and the US controls for stabilization policy by moving interest rates, in other words, unsterilized interventions. Gross capital flows and foreign reserve are scaled by lagged GDP. Net sales of foreign reserve captures the FXI policy and are measured as the sum of change in foreign reserve and off balance sheet FX position. As jump in GKF implies an increase in gross inflow, an FXI policy that ‘leans against the wind’ should exhibit a negative response in net sales of foreign reserve. Appendix B describes further details of the classification process.

Table 5. List of Countries in the Sample

Regime		Countries									
Floaters		CHL	COL	CZE	HUN	IDN	ISR	KOR	MEX	ZAF	
Interveners		BRA	IND	LKA	MYS	PER	PHL	POL	RUS	THA	TUR

Note: The table shows the list of countries in the sample and their FXI regime classification. The classification is based on the cumulative response of net sales of foreign reserve to a global financial shock, as estimated from a VAR à la Blanchard et al. (2015). See appendix A.2 for details.

We include all sample economies from the original Blanchard et al. (2015) paper in this classification exercise, including advanced economies that are not issuers of reserve currency (Australia, Canada, New Zealand, Norway, Sweden). We extend the sample period of the original paper,

which allows us to capture the recent trend of FXI policy in EMEs. Among the 19 EMEs in our sample, 9 are classified as floaters and 10 are classified as interveners. Table 5 reports the list of countries in each group.

2.2.2 Retrenchment Semi-Elasticity: Floaters vs. Intervenors

Table 6. Private Retrenchment Elasticity Estimates

	IV		OLS	
	Floater	Intervener	Floater	Intervener
Δrx^e	-0.095*** (0.013)	-0.061 (0.060)	-0.031*** (0.005)	-0.012*** (0.004)
Lag Dep. Var.	0.261*** (0.068)	0.237** (0.112)	0.250*** (0.057)	0.223** (0.103)
No. Observations	738	597	738	597
Country FE	Yes	Yes	Yes	Yes
First-stage F-statistic	98.14	9.20		

Note: The table reports estimates of regression (17) separately for nine floaters and ten interveners, classified using the updated procedure based on Blanchard et al. (2015). Gross portfolio outflow is measured as a share of GDP. In the IV columns, Δrx^e is instrumented with $\Delta \ln VIX$; the OLS columns estimate the same specification without instrumenting Δrx^e . All regressions include country fixed effects and lagged gross portfolio outflow. Standard errors are clustered by country. First-stage F statistics are reported for the IV specifications. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

The left two columns in Table 6 compare the private retrenchment semi-elasticity of floaters against interveners'. The point estimates indicate that gross portfolio outflow is more elastic among floaters than interveners. These results are consistent with the prediction 2 that FXI policy is more responsive to excess returns where private retrenchment is less return-elastic. IV estimation results for interveners come with a caveat as the first-stage F statistic is a bit lower than the rule-of-thumb threshold of 10. The lower relevance of the instrument for interveners can be interpreted as a result of stronger FXI policy, which reduces the response of expected excess return to foreign shocks by intention.⁸ The third and fourth columns in the table present the estimation results from the OLS regression, which are biased towards zero due to the endogeneity.

⁸ Appendix figure E.2 shows negative correlation between the first stage F-statistics from the semi-elasticity estimation for individual countries and the intensity of FXI policy.

2.2.3 Retrenchment Semi-Elasticity: Cross-Country Comparison

We strengthen the link between FXI practices and the semi-elasticity of retrenchment using cross-country variation in the semi-elasticity. To this end, we estimate country-specific semi-elasticities of gross capital outflows and compare them with a continuous measure of FXI intensity. We measure FXI intensity as the cumulative impulse response of FXI to an exogenous capital inflow shock, estimated from the VAR employed for the FXI regime classification. The country-wise semi-elasticities are estimated from the following regression equation (19) for each i :

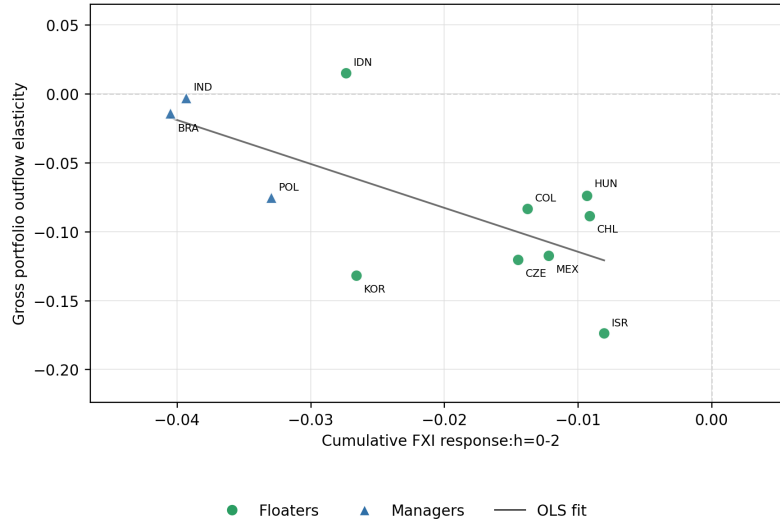
$$\text{Gross Portfolio Outflow}_{i,t} = \delta_i + \lambda_i \Delta r x_{i,t}^e + \eta_i \text{Gross Portfolio Outflow}_{i,t-1} + \nu_{i,t} \quad (19)$$

Figure 1 plots estimates of individual country's semi-elasticities, λ_i , against the cumulative response of FXI to a global financial shock for each country. As the first-stage regression of country-wise semi-elasticity estimation is not as strong as the pooled regression, we exclude countries with low first-stage F statistics from the scatter plot in Figure 1. Table C.2 in the appendix shows the estimation results for individual countries. The comparison shows that lower semi-elasticity (smaller in absolute value) is associated with stronger FXI policy (larger cumulative FXI response to GKF shock in absolute value). This observation is consistent with the model's prediction that FXI policy is stronger where private retrenchment is less return-elastic.

3 Pension Funds as Private Stabilizer

The model emphasizes that home savers with international portfolio absorb foreign demand shocks and thereby characterize optimal FXI policy. Empirical evidence in section 2.2 supports the negative relation between private retrenchment elasticity and FXI policy shown in the model. A natural question that follows is who the empirical counterpart of the home savers in the model is. Prediction 1 suggests that the size of wealth managed by home savers with flexible mandates and larger foreign exposure determines the aggregate retrenchment elasticity. Given larger role institutional investors have in international capital allocation, we investigate if development of pension funds and insurance companies explains the variation in home demand elasticity across economies. We focus on pension funds and insurance companies because they are large institutional investors that

Figure 1. Semi-Elasticity and FXI Policy



Note: This figure shows country-wise gross portfolio outflow semi-elasticity plotted against a measure of FXI intensity. The measure of FXI intensity is the cumulative impulse response of FXI to a global financial shock up to $h = 2$ from the VAR à la Blanchard et al. (2015). The scatter plot excludes LKA, MYS, PER, PHL, THA, and ZAF for low first-stage F statistics (under 5) in the country-wise semi-elasticity estimation, and RUS and TUR for short sample period.

exist across most EMEs, as opposed to more sophisticated institutional investors such as hedge funds and mutual funds that are not as developed in EMEs.

We demonstrate the relevance of pension fund and insurance company development to the elasticity through two sets of evidence. First, using a novel microdata on Colombian pension funds' portfolio, we show that pension funds behave just like home savers in the model. To the best of our knowledge, this dataset is yet to be explored in the literature, and we are the first to use it to study pension funds' behavior in response to foreign shocks. We further show that the retrenchment behavior varies across funds with different risk profiles, highlighting that an additional peso invested in more elastic funds makes aggregate retrenchment larger given a fixed amount of national savings. In addition to the micro-evidence, we examine how retrenchment elasticity varies with the size of pension funds-insurance company across countries. The cross country study supports our claim that aggregate semi-elasticity is larger where institutional investors with foreign exposure and flexible mandates are more developed.

These findings suggest that allowing pension funds and other institutional investors to hold internationally diversified portfolios can generate a macro-financial benefit beyond the private gains from diversification. Foreign asset holdings enable these investors to retrench when global

financial conditions tighten, reducing currency depreciation and the reliance on FXI. Regulations that restrict overseas investment may therefore weaken this private stabilization margin. Yet, we leave this implication as positive rather than normative, since the paper does not quantify the welfare trade-off between exchange-rate stabilization and other objectives of pension regulation.

3.1 Micro Evidence: Colombian Pension Funds

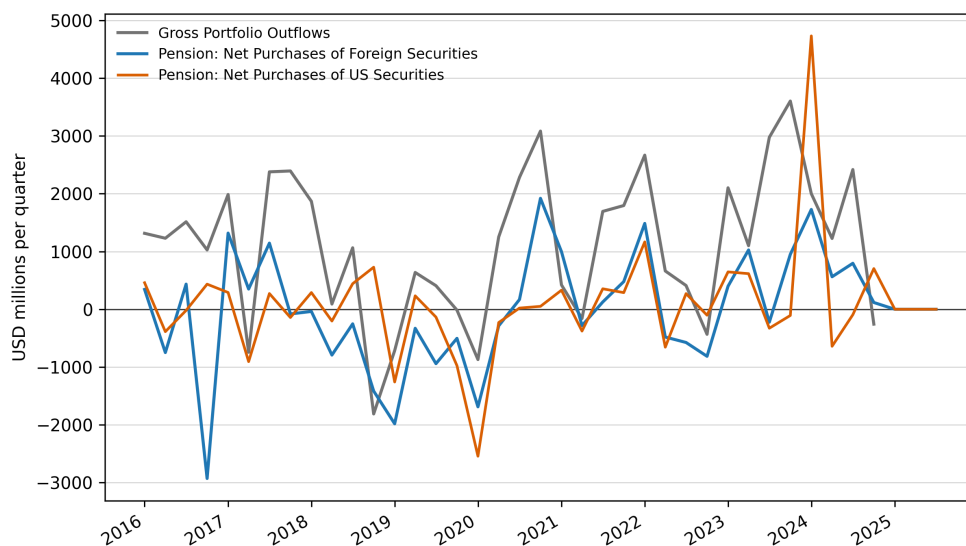
We use security-level portfolio data on Colombian pension funds from the Financial Superintendence of Colombia (Superintendencia Financiera de Colombia), the country’s financial regulator. Pension funds are required to report composition of their investment portfolio, including the quantity and value of each security they hold, on a monthly basis. Using these data, we compute each pension fund’s net purchases of foreign securities, a measure that is unaffected by valuation effects. We find pension funds’ net purchases of foreign securities comove with the expected excess currency return and the VIX index in a way similar to home savers in our model.

Colombian pension fund system consists of three major types: mandatory pension funds, programmed withdrawal funds, and the severance funds. We focus on mandatory pension funds (Fondos de Pensiones Obligatorias), which are the largest and most representative segment of the system. The regulatory dataset records the purchase date of each security, and each holding is tracked separately by purchase date. This data structure allows us to track purchases and sales of foreign securities over time as fund-security-purchase date pairs. A security exits a fund’s portfolio when it is sold or matures. Because maturity dates are recorded in the dataset, we identify matured securities by their disappearance from a fund’s portfolio after their maturity dates. Sales are identified either by a decline in the quantity of a fund-security-purchase-date combination or by its disappearance before maturity. Some fund-security-purchase date pairs disappear and reappear immediately. We consider this as re-labeling and not actual sales and purchases. We compute the net purchases of foreign securities as purchases minus sales and securities that mature, and then aggregate these flows across funds and securities to obtain the total net purchase flow into foreign securities.

3.1.1 Foreign-Security Purchases and Global Financial Conditions

To assess the magnitude of pension fund flows, we compare pension funds' net purchases of foreign securities with gross portfolio outflows reported in the Balance of Payments (BoP) statistics. Figure 2 plots the BoP portfolio outflow along with net purchase flow to all foreign and US securities, measured in millions of U.S. dollars. Pension fund flows are comparable in magnitude to gross portfolio outflows in the BoP statistics, and they closely co-move over time. Table C.3 in the appendix reports the summary statistics of pension funds' net purchases relative to gross portfolio outflows.

Figure 2. Colombian Pension Fund Net Purchases and BoP Gross Portfolio Outflow



Note: This figure plots the net purchase flow of foreign securities by Colombian pension funds and the gross portfolio outflow from Balance of Payment statistics in millions USD. The monthly net purchase flow is computed from the regulatory dataset on Colombian pension funds' portfolio and summed within a quarter.

Pension fund-driven outflows are not only significant in magnitude but also comove with the expected excess currency return and the VIX index. To make the flows comparable over time, we scale net purchases of foreign securities by pension funds' assets under management (AUM) at the end of the previous period. Table 7 shows that Colombian pension funds' net purchases of both foreign and U.S. securities co-move with expected excess currency returns and the VIX index. The negative correlation between net purchases and expected excess currency returns implies that pension funds reduce their purchases of foreign and U.S. securities when expected excess returns increase, consistent with the behavior of home savers in the model. The outflows also exhibit the

relationship with the VIX implied by the model: pension funds reduce their purchases of foreign and U.S. securities when global financial conditions deteriorate and local currency assets give larger excess currency returns.

Table 7. Correlation of Colombian Pension Fund Net Foreign Security Purchase with VIX and Δrx^e

Net Purchases	$\Delta \log \text{VIX}$	Δrx^e
Net Purchases of US Securities / AUM	-0.085	-0.114
Net Purchases of Foreign Securities / AUM	-0.166	-0.307

Note: The table shows the correlation of Colombian pension funds' net purchase of US/foreign securities with the excess currency return and the VIX index.

3.1.2 Retrenchment Elasticities Across Different Risk Profiles

Section 3.1.1 presents the diagnostic evidence from Colombian pension fund portfolios, showing negative correlations between net purchase flows to foreign and U.S. securities and both expected excess currency returns and the VIX index. In this section, we exploit the rich micro-level data to reveal heterogeneity in return elasticities of net purchase flows across pension funds with different investment mandates and assess how they contribute to the aggregate portfolio-outflow response. In particular, we estimate the portfolio share θ_i and adjustment parameter κ_i that govern individual retrenchment in the model. The microdata allows us to identify these primitives from investor-level transactions and then aggregate the resulting semi-elasticities into a micro counterpart of the macro semi-elasticity Γ_H for comparison.

Colombian pension system lets households choose the risk profiles of pension funds they save in: High, Moderate, and Low risk, with each of four fund managers (AFPs, Administrators of Pension Funds) operating one portfolio in every profile.⁹ The investment regime imposes tighter limits on foreign-security exposure as mandates become safer, generating substantial cross-profile variation in actual foreign shares. Prediction 1 implies that aggregate retrenchment depends on how national savings are distributed across investors with different foreign exposures and mandate flexibility. With the micro data, we reveal the variation of elasticity across funds with different risk profiles.

The monthly portfolios report each fund's security-level market values, so both total assets

⁹The original labels are *Mayor Riesgo*, *Moderado*, and *Conservador*; see the definitions and investment regime in Decree 2955 of 2010 and the Superintendencia Financiera's description of the multifund system.

and the fraction invested abroad are observed. Using reported acquisition dates and values, quantity reductions, and the disappearance of securities from a portfolio, we impute net purchases of foreign securities. This imputed net purchase measure captures actual trading activity and is not influenced by changes in market values.

We construct net purchase flows of three asset scopes: U.S. Treasuries, all U.S. securities, and all foreign securities. The net purchase flows are scaled by the size of each fund, using AUM of each fund in the previous month. *U.S. Treasuries* retains only securities issued by the U.S. Treasury, which is the closest counterpart for foreign bond in our model. *All foreign* provide the closest micro counterpart to the aggregate portfolio-asset outflow used in the macro regression as they cover the broadest set of Colombian investments overseas.

Estimation of micro-elasticity— We regress net purchase flows over expected excess currency return to estimate micro elasticity. For risk profile g and asset scope s , we estimate the following panel regression model with AFP j fixed effect:

$$y_{j,g,s,t} = \delta_{j,g,s} + \eta_{g,s}y_{j,g,s,t-1} + \lambda_{g,s}\Delta rx_t^e + \varepsilon_{j,g,s,t}, \quad (20)$$

We instrument Δrx_t^e by $\Delta \ln VIX_t$ to address potential endogeneity between $\varepsilon_{j,g,s,t}$ and Δrx_t^e , as in the baseline macro regression. The model is estimated by 2SLS with fund and month two-way-clustered standard errors. The first stage regressions show high relevance of the instrument, with the F statistics between 19.4 and 21.4. Appendix Table D.9 reports the first stage regression results.

To map the estimate $\hat{\lambda}$ into primitive parameters of the model, recall that individual foreign-bond demand and the aggregate semi-elasticity satisfy

$$b_{Hi}^* = -\gamma_{Hi}\widehat{rx}, \quad \gamma_{Hi} = 1 - \theta_i + \kappa_i \quad (21)$$

Because the net purchase flows ($y_{j,g,s,t}$) are divided by total AUM rather than by the position in scope s , $\hat{\lambda}_{g,s}$ identifies $-\theta_{g,s}\gamma_{g,s}$, not $-\gamma_{g,s}$. We measure $\theta_{g,s}$ as the mean market-value share of scope s in total AUM, and recover

$$\hat{\gamma}_{g,s} = -\frac{\hat{\lambda}_{g,s}}{\theta_{g,s}}, \quad \hat{\kappa}_{g,s} = -\frac{\hat{\lambda}_{g,s}}{\theta_{g,s}} - (1 - \theta_{g,s}) \quad (22)$$

Notice that $\hat{\lambda}_{g,s}$ captures the amount of retrenchment from foreign asset s for a percentage point increase in excess currency return per peso saving in a fund with risk profile g . Therefore, pension funds of risk profile g will retrench from foreign asset s by

$$-\Gamma_{g,s} = -\hat{\lambda}_{g,s} \overline{W}_g \quad (23)$$

where $\overline{W}_g$ is the average AUM of funds with risk profile g . Summing across all risk profiles gives the total retrenchment from foreign asset s . To place this micro-estimate in the same unit as our macro-estimate presented in section 2, we compute $\hat{\Gamma}_{g,s}$ using the mean AUM in terms of GDP.

Estimation results—Table 8 presents the estimated micro retrenchment elasticity, λ , for different risk profiles and asset scopes. The elasticity varies across risk profiles within each asset scope. The micro-elasticity estimates highlight the heterogeneity in retrenchment behavior across funds with different mandates under which they operate. Despite our prior that pension funds allowed to take on larger risk would exhibit higher retrenchment elasticities, the estimates are the reverse of our prior: net purchase flows are more elastic for funds with lower risk allowances. We leave this puzzle for future research.¹⁰

For US Treasuries, estimated λ is the largest in low-risk funds at 0.085 and smallest in high-risk funds at 0.026 while moderate-risk funds fall in between at 0.074. The low statistical significance of this parameter for high-risk funds suggests that these funds' response to excess currency returns is limited. Using the share of US Treasuries in each fund's portfolio, θ , we recover the demand elasticity, γ , from $\lambda = -\theta\gamma$. The recovered γ is highest for Moderate-risk funds, which is attributed to their larger adjustment flexibility, κ . Estimated λ s for net purchases of all foreign securities follow a similar pattern, being largest for low-risk funds and smallest for high-risk funds, with moderate-risk funds in between. The estimate for high risk fund exhibits additional purchase of foreign securities when excess currency returns increase, if anything. Yet, the estimate for high-risk funds show no statistical significance, suggesting these funds do not significantly adjust their foreign asset investment in response to excess currency returns.

¹⁰To suggest possible candidates to explain this puzzle, we suspect the maturity structure of their liability and the comovement of foreign equity prices with excess currency return. Because population approaching retirement age tends to choose safer funds, low-risk funds can be incentivized to realize their peso gain more readily. Or, if equity risk premium on foreign equities increases when excess currency return increases, the high-risk funds may choose to continue holding foreign bonds in order to 'buy the dip' in foreign equity markets.

Table 8. Micro Estimates of Retrenchment Parameters

Risk	$\hat{\lambda}$ (SE)	θ (%)	κ	γ	Position	AUM	Γ	Γ/GDP
<i>U.S. Treasuries</i>								
High risk	-0.026 (0.026) [†]	1.298	1.00	1.99	0.39	30.00	0.77	0.0006
Moderate risk	-0.074 (0.025) [†]	1.074	5.89	6.88	2.19	203.57	15.03	0.0137
Low risk	-0.085 (0.016)	1.648	4.17	5.15	0.43	26.11	2.22	0.0019
Risk-profile sum	–	1.157	–	–	3.01	259.68	18.02	0.0162
<i>All foreign</i>								
High risk	0.049 (0.082)	58.082	-0.50	-0.08	17.42	30.00	-1.47	-0.0011
Moderate risk	-0.079 (0.071)	42.050	-0.39	0.19	85.60	203.57	16.12	0.0147
Low risk	-0.115 (0.022) [†]	15.622	-0.11	0.74	4.08	26.11	3.01	0.0026
Risk-profile sum	–	41.245	–	–	107.11	259.68	17.66	0.0162

Note: This table shows estimates of primitive parameters that characterize the retrenchment elasticities estimated using micro-level Colombian pension fund data. The dependent variable is monthly net purchases divided by previous-month total AUM, in percentage points. Standard errors are in parentheses. θ is the ratio of mean market-value positions to mean total AUM. Γ and Γ/GDP presents retrenchments per one-percentage-point excess-return change in trillions of COP and as a percentage of GDP, respectively. "Position" denotes the time-averaged value of holdings within the specified asset scope for funds of each risk profile, expressed in trillions of COP. "AUM" is average asset under management over the sample period in trillions of COP, summed across funds within a risk profile. The risk-profile sum adds the three separately estimated contributions. A dagger denotes a two-way-cluster covariance matrix that required the positive-semidefinite correction.

The magnitude of retrenchment from asset s by pension funds with risk profile g is given as

$$\Gamma_{g,s} = \gamma_{g,s} \theta_{g,s} \overline{W}_{g,s} = -\lambda_{g,s} \overline{W}_{g,s} \quad (24)$$

where the second equality follows from equation (22). The total retrenchment from asset s by the pension sector is the sum of retrenchments across all risk profiles, which is the weighted sum of funds' AUM with weights given by their respective $\lambda_{g,s}$:

$$\Gamma_s = - \sum_g \lambda_{g,s} \overline{W}_{g,s} \quad (25)$$

The estimates of $\lambda_{g,s}$ in table 8 suggest that aggregate retrenchment in response to a one-percentage-point change in excess returns would be larger if more pension savings were allocated to low-risk funds.

To compare the micro-level estimates with the aggregate retrenchment elasticity from section 2, we compute Γ_s using average GDP-scaled AUM. The GDP-scaled retrenchment from US treasuries and foreign assets are reported in the last column of table 8. The micro-estimate of re-

trenchment by pension funds is about 1/5 of the aggregate retrenchment (0.083 versus 0.0162). The smaller magnitude of the micro-estimate reflects the fact that pension funds only represent a subset of the total Colombian residents investing overseas, and the lower frequency of the data used in the macro-estimation. Appendix figure D.1 shows the contribution of different risk profiles to retrenchment estimated at the quarterly frequency.

3.2 Cross-Country Evidence

In the previous subsection, we show that pension funds retrench from foreign securities when expected excess currency return increases. To reinforce our argument that development of institutional investors with international exposure contributes to private absorption of external shocks, we show its relevance to the aggregate semi-elasticity of gross portfolio outflow. In particular, we show that the semi-elasticity is larger in economies with larger pension fund and insurance company assets. We connect the size of pension fund and insurance company assets to the semi-elasticity using a regression model with an interaction term between expected excess currency return and pension fund and insurance company assets. Specifically, we estimate the following regression model that includes an interaction of first-differenced excess currency return (Δrx^e) with pension fund and insurance company assets (X_i^c).

$$\text{Gross Portfolio Outflow}_{i,t} = \delta_i + \zeta_0 \Delta rx_{i,t}^e + \zeta_1 \Delta rx_{i,t}^e \cdot X_i^c + \eta \text{Gross Portfolio Outflow}_{i,t-1} + \nu_{i,t} \quad (26)$$

We instrument $\Delta rx_{i,t}^e$ and its interaction with X_i^c using first-differenced VIX index and its interaction with X_i^c to address the endogeneity of expected excess return. The coefficient ζ_1 captures how the semi-elasticity of gross portfolio outflow changes with pension fund and insurance company asset size. We measure pension fund and insurance company assets in terms of GDP, using World Bank data on financial sector development. In order to focus on cross-country variation of these assets, we use the country-average size of pension fund and insurance company assets over the sample period, X_i . We center the variable by cross-country mean, $X_i^c = X_i - \bar{X}$, to make the coefficient on excess currency return (ζ_0) show semi-elasticity for a country with average pension fund and insurance company asset size.

Table 9 shows the estimation results of regression (26). The IV column shows the estimation

Table 9. Semi-Elasticity and Pension Fund · Insurance Assets

	IV	OLS
Δrx_{it}^e	-0.084*** (0.022)	-0.023*** (0.004)
$X_i^c \times \Delta rx_{it}^e$	-0.001** (0.000)	-0.000 (0.000)
Lag gross portfolio outflow	0.271*** (0.061)	0.248*** (0.051)
Observations	1335	1335
Countries	19	19
L-M Statistics	32.40	
Relative CV ($\alpha = 0.1, \tau = 0.1$)	29.28	

Note: The table reports estimates of regression (26) for the full sample of 19 EMEs. The dependent variable is gross portfolio outflow as a share of GDP. Column IV instruments Δrx_{it}^e and $X_i^c \times \Delta rx_{it}^e$ using the first difference of log VIX and its interaction with X_i^c . Column OLS estimates the same specification without instrumenting. X_i^c is each country's average pension fund plus insurance company assets as a share of GDP, measured in percentage points and centered at the cross-country mean. Both specifications include country fixed effects and lagged gross portfolio outflow; standard errors are clustered by country. L-M Statistics reports the generalized weak-IV statistic from Lewis and Mertens (2025), and Relative CV reports its 10% critical value under a 10% relative-bias tolerance. A statistic above the critical value rejects the weak-instrument null. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

results from the instrumental variable regression, while the OLS column shows the estimation results without instrumenting for expected excess return as a reference. We find ζ_1 to be negative for the full EME sample, which implies gross portfolio outflow is more elastic to excess currency return when pension fund and insurance company assets are larger, consistent with our prediction. When a country's pension fund and insurance company assets are larger than cross country average by 10%p of GDP, the semi-elasticity is about 10% larger (0.084/0.01). The table reports the generalized weak-IV statistic from Lewis and Mertens (2025) and its 10% critical value under a 10% relative-bias tolerance. The L-M statistic implies that the instruments are not weak for the IV regression and less biased than the OLS estimates. The OLS results show that estimation without using the IV is biased towards zero, as expected from the endogeneity of expected excess return to gross portfolio outflow.

The baseline measure of pension fund and insurance company assets may confound the effect introduced by the development of the internationally-exposed portfolio investors with the depth of financial market, as they are often correlated. To address this concern, we show that the development of financial market in magnitude does not associate with the elasticity. We use the amount of outstanding domestic public and private debt securities in terms of GDP as a mea-

sure of financial market development. Replacing the pension fund–insurance company size with these measures, Table C.8 in the appendix presents that retrenchment elasticity does not increase with the size of financial market. This confirms that development of pension funds and insurance companies, not just the sheer size of financial market, contributes to private stabilization capacity.

4 FXI Effectiveness: Conditional on Private Absorption Capacity

Prediction 3 reveals that since FXI policy intensity is characterized by private retrenchment elasticity, evaluating FXI policy effectiveness requires conditioning on private absorption capacity. In this section, we contrast the effect of the VIX on excess currency return across FXI regimes, conditional on private retrenchment elasticity. We rely on our findings from section 3 to proxy the private absorption capacity with pension fund and insurance company assets size. We find that larger pension fund and insurance company assets reduce the response of excess currency return to changes in VIX, and that the difference in responses across FXI regimes is larger when we control for pension-insurance asset size.

Kalemlı-Özcan and Varela (2025) show that the VIX index is highly associated with expected and realized excess currency return, especially in EM currencies. They reveal that global financial conditions go a long way in explaining the variation in excess currency return. We expand their analysis to compare interveners against floaters in terms of the sensitivity of excess currency return to global financial shocks. Specifically, we regress changes in the excess currency return (Δr_{xit}) over a proxy of global financial shock, first-differenced VIX index, and its interaction with an indicator for interveners. We add an interaction term of the first-differenced VIX index with the pension and insurance company asset size to condition on private absorption capacity. We use average pension fund and insurance company assets over the sample period for each country, centered by cross-country mean, to focus on cross-country variation. In addition, we control for previous quarter’s gross capital inflow, following Kalemlı-Özcan and Varela (2025), to account for the direct effect of capital inflow on excess currency return. Formally, we estimate the following

regression:

$$\begin{aligned} \Delta r x_{i,t}^e = & \alpha_i + \beta_0 Z_t + \beta_M Z_t \times Intervener_i + \beta_X Z_t \times X_i^c \\ & + \delta GrossInflow_{it-1} + \varepsilon_{it} \end{aligned} \quad (27)$$

where Z_t is change in VIX index, and X_i^c is pension funds and insurance assets centered by cross-country mean, scaled in terms of GDP. β_0 captures the effect of the VIX index on excess currency return for floaters with average pension fund and insurance company asset size. Coefficient β_M captures difference in the effect between interveners and floaters, while β_X captures how the effect changes with pension fund and insurance company asset size.

Table 10. Correlation of Excess Currency Return with VIX changes: Across FXI Regimes

	VIX only	+ Intervener	+ Wealth
$\Delta \ln VIX$	3.751*** (0.504)	4.467*** (0.420)	4.610*** (0.465)
$\Delta \ln VIX \times Intervener$		-1.590* (0.948)	-1.918** (0.971)
$\Delta \ln VIX \times X_i^c$			-0.015* (0.009)
Lag Gross inflow	0.018*** (0.006)	0.016*** (0.006)	0.016** (0.006)
R-squared	0.111	0.116	0.118
No. observations	1342	1342	1342
Countries	19	19	19
Country FE	Yes	Yes	Yes

Note: The table shows the estimation results of regression (27). The dependent variable is the change in excess currency return, $\Delta r x_{it}^e$. *Intervener* is a dummy variable for countries with stronger FXI policy, classified following the methodology in section 2.2.1. X_i^c denotes pension funds and insurance company assets centered by cross-country mean, scaled in terms of GDP. Country fixed-effects are included. The standard errors are country-clustered.

Table 10 reports the estimation results for equation (27). The first column presents the baseline specification without interaction terms. Expected excess currency returns increase with the VIX index, consistent with the model's prediction in equation (11) and findings by Kalemli-Özcan and Varela (2025). Quantitatively, a one-standard-deviation increase in the VIX raises expected excess currency returns by 0.83%p, approximately one-third of a standard deviation of excess currency returns.

Second column adds the interaction between the VIX and the intervener indicator. The co-

efficient is negative though marginally significant, providing evidence that expected excess currency returns are less sensitive to global financial conditions in interveners than in floaters. Being an intervener reduces the estimated response of expected excess currency returns to the VIX by one third of the average response. The last column adds the interaction of the VIX and pension fund–insurance company asset size. After accounting for the size of institutional investors, the estimated difference between interveners and floaters becomes larger and more statistically significant. Excess currency return responds less to the VIX in interveners by 41.6% relative to the average response. The interaction with pension-insurance asset size is also negative, although only marginally significant. Quantitatively, a 10-percentage-point increase in pension fund and insurance company assets relative to GDP reduces the estimated sensitivity of expected excess currency returns to the VIX by 3.34% relative to the sample average.

These results are consistent with the paper’s central mechanism: stronger private absorption directly dampens the response of expected excess currency returns to global financial shocks, while central banks intervene more intensively where private absorption is weaker. Consequently, the observed response of expected excess currency returns reflects the combined roles of private absorption and official intervention. Thus, the difference across FXI regimes unconditional on private absorption capacity is smaller than the policy’s effect, as discussed in section 1.3.2. This suggests that FXI policy’s effect in stabilizing exchange rates and excess currency returns estimated in the literature (i.e. Blanchard et al. (2015), Beltran and He (2024)) understates policy effectiveness.

Breaking Down Excess Currency Return

It is useful to examine through which component of expected excess currency returns—the interest rate differential or expected depreciation—the VIX index moves with excess currency returns, and how FXI policy and private retrenchment mitigate these effects. To this end, we decompose expected excess currency returns into these two components, and estimate the following pooled regression with country fixed effects:

$$y_{i,t} = \alpha_i + \beta_0 Z_t + \beta_M Z_t \times Intervener_i + \beta_X Z_t \times X_i^c + \delta GrossInflow_{it-1} + \varepsilon_{it} \quad (28)$$

where $y_{i,t}$ is either the change in the interest rate differential or the change in expected depreciation.

Table 11. Breakdown of Excess Currency Return: Interest Rate Differential and Expected Depreciation

	$\Delta(i - i^*)$			$\Delta(s^e - s)$		
	VIX only	+ Intervener	+ Wealth	VIX only	+ Intervener	+ Wealth
$\Delta \ln VIX$	1.044*** (0.185)	0.838*** (0.148)	0.947*** (0.124)	-3.371*** (0.580)	-4.232*** (0.444)	-4.337*** (0.476)
$\Delta \ln VIX \times Intervener$		0.456 (0.394)	0.208 (0.321)		1.909* (1.108)	2.150* (1.129)
$\Delta \ln VIX \times X_i^c$			-0.012*** (0.004)			0.011 (0.010)
Gross inflow	0.020*** (0.006)	0.021*** (0.006)	0.020*** (0.006)	0.004 (0.012)	0.006 (0.012)	0.006 (0.013)
R-squared	0.051	0.053	0.058	0.088	0.095	0.096
No. observations	1342	1342	1342	1342	1342	1342
Countries	19	19	19	19	19	19
Country FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: The table shows the estimation results of regression (28). The dependent variable in the first panel is the change in interest rate differential, $\Delta(r_{it} - r_t^*)$, and the dependent variable in the second panel is the change in expected depreciation, $\Delta\mathbb{E}(s_{i,t+1} - s_t)$. The standard errors are country-clustered.

Table 11 reports the estimation results. The left panel presents the regression for the change in the interest rate differential, while the right panel presents the regression for the change in expected depreciation. The VIX index has a significant effect on both components of expected excess currency returns. However, deteriorating global financial conditions are associated with a larger increase in expected appreciation than in the interest rate differential. Being an intervener reduces the effect of the VIX on expected depreciation, but does not mitigate the effect on the interest rate differential. This is consistent with the objective of FXI policy in practice, which is primarily to stabilize exchange rates. Finally, larger pension fund and insurance company sectors mitigate the effect of the VIX on interest rate differential, but not on expected depreciation. Quantitatively, a ten percentage-point larger pension fund and insurance company assets in terms of GDP reduces the effect of the VIX on interest rate differential change by about 10%.

Comparison with Blanchard et al. (2015)

Blanchard et al. (2015) identify global capital flow shocks using country-specific structural VARs and find that nominal and real exchange rates respond less in economies whose central banks intervene more strongly. While their outcomes are the exchange rates themselves, our pri-

mary outcome is the expected excess currency return, which directly measures the time-varying risk premium on home-currency assets through which global financial shocks are transmitted. The decomposition in Table 11 nevertheless connects our results to theirs. The estimates suggest that the expected-depreciation component of excess currency returns responds less to the VIX among interveners than among floaters, albeit the statistical significance is weak. Their cross-country evidence relates estimated country-level exchange rate responses to estimated intervention responses, while our panel framework directly compares FXI regimes and allows private absorption capacity to enter the analysis. Once we account for pension fund and insurance company asset size, the estimated difference between interveners and floaters becomes more significant. This evidence indicates that unconditional cross-country comparisons in Blanchard et al. (2015) may understate the stabilizing role of FXI because intervention tends to be stronger where private absorption is weaker.

5 Conclusion

This paper shows that domestic private absorption is a central margin through which emerging market economies offset the global financial cycle. In the model, the return elasticity of private retrenchment determines both how strongly foreign demand shocks affect excess currency returns and how intensively the central bank intervenes. The cross-country estimates are consistent with more intensive FXI where private absorption is weaker. Security-level evidence from Colombia shows that pension funds retrench from foreign securities when domestic excess currency returns rise, and an additional peso makes different contributions to aggregate retrenchment depending on the fund's elasticity. In addition, the cross-country analysis associates larger pension fund and insurance company sectors with more elastic gross portfolio outflows. The estimates further suggest that accounting for this private absorption capacity reveals a stronger stabilizing role for FXI than unconditional comparisons across policy regimes imply. Taken together, the results indicate that private portfolio adjustment and official intervention jointly determine how economies absorb global financial shocks.

These findings have implications for financial-sector policy as well as for the direction of future research. Restrictions on investment overseas often originate from micro-prudential inten-

tions. Yet our finding that institutional investors investing overseas contribute to private absorption of foreign shocks implies that their external savings have macro-prudential contribution. Policy on overseas investment should account for this stabilization role.

This points us to a further research with a focus on the welfare implications of the externality created by overseas investment of domestic institutional investors. Decentralized funds choose their foreign exposure based on private risk-return considerations, but their capacity to retrench during downturns in the global financial cycle stabilizes the exchange rate, a benefit they may not internalize. Future research can embed this externality in a welfare framework and assess whether the resulting stabilization gains justify costs and additional portfolio risks associated with such policies.

Finally, the puzzling pattern of micro-elasticity observed in the Colombian portfolio data warrants further investigation to understand the primitive of this behavior. Understanding the drivers of larger micro-elasticities is critical to narrow down the sources of private absorption capacity and to design policies that effectively foster private stabilization, and eventually 'graduate' from relying on official intervention for stabilization.

References

- Avdjiev, Stefan, Bryan Hardy, Şebnem Kalemli-Özcan, and Luis Servén**, “Gross Capital Flows by Banks, Corporates, and Sovereigns,” *Journal of the European Economic Association*, October 2022, 20 (5), 2098–2135.
- Basu, Suman S., Emine Boz, Gita Gopinath, Francisco Roch, and D. Filiz Unsal**, “Integrated Monetary and Financial Policies for Small Open Economies,” *Econometrica*, 2025, 93 (6), 2201–2234.
- Beltran, Paula and Chang He**, “Inelastic financial markets and foreign exchange interventions,” June 2024. Working paper; revise and resubmit at American Economic Journal: Macroeconomics.
- Bertaut, Carol and Ruth Judson**, “Estimating U.S. Cross-Border Securities Flows: Ten Years of the TIC SLT,” FEDS Notes, Board of Governors of the Federal Reserve System February 2022. Data updated September 2025; page last updated October 2025.
- , **Ester Faia, Şebnem Kalemli-Özcan, Camilo Marchesini, Simon Paetzold, and Martin Schmitz**, “Asset Elasticities and Currency Risk Transfer,” NBER Working Paper 34275, National Bureau of Economic Research September 2025.
- Blanchard, Olivier, Gustavo Adler, and Irineu Carvalho Filho**, “Can Foreign Exchange Intervention Stem Exchange Rate Pressures from Global Capital Flow Shocks?,” IMF Working Paper 2015/159, International Monetary Fund July 2015.
- Caballero, Ricardo J and Alp Simsek**, “A Model of Fickle Capital Flows and Retrenchment,” *Journal of Political Economy*, June 2020, 128 (6), 2288–2328.
- Camanho, Nelson, Harald Hau, and Hélène Rey**, “Global Portfolio Rebalancing and Exchange Rates,” *The Review of Financial Studies*, October 2022, 35 (11), 5228–5274.
- Cavallino, Paolo**, “Capital flows and foreign exchange intervention,” *American Economic Journal: Macroeconomics*, April 2019, 11 (2), 127–170.

- Davis, J Scott and Eric van Wincoop**, “A theory of capital flow retrenchment,” *Journal of International Economics*, July 2024, 150, 103952.
- De Leo, Pierre, Gita Gopinath, and Şebnem Kalemli-Özcan**, “Monetary policy and the short-rate disconnect in emerging economies,” NBER Working Paper 30458, National Bureau of Economic Research March 2025. Revised March 2025.
- Fama, Eugene F**, “Forward and spot exchange rates,” *Journal of Monetary Economics*, 1984, 14 (3), 319–338.
- Fanelli, Sebastián and Ludwig Straub**, “A Theory of Foreign Exchange Interventions,” *The Review of Economic Studies*, March 2021, 88 (6), 2857–2885.
- Forbes, Kristin J and Francis E Warnock**, “Capital flow waves: Surges, stops, flight, and retrenchment,” *Journal of International Economics*, November 2012, 88 (2), 235–251.
- Fratzscher, Marcel, Oliver Gloede, Lukas Menkhoff, Lucio Sarno, and Tobias Stöhr**, “When Is Foreign Exchange Intervention Effective? Evidence from 33 Countries,” *American Economic Journal: Macroeconomics*, January 2019, 11 (1), 132–156.
- Gabaix, Xavier and Matteo Maggiori**, “International Liquidity and Exchange Rate Dynamics,” *The Quarterly Journal of Economics*, March 2015, 130 (3), 1369–1420.
- **and Ralph S J Kojen**, “In search of the origins of financial fluctuations: The inelastic markets hypothesis,” NBER Working Paper 28967, National Bureau of Economic Research August 2024. Revised August 2024.
- Gourinchas, Pierre-Olivier, Walker Ray, and Dimitri Vayanos**, “A Preferred-Habitat Model of Term Premia, Exchange Rates, and Monetary Policy Spillovers,” *American Economic Review*, November 2025, 115 (11), 3788–3824.
- Greenwood, Robin, Samuel Hanson, Jeremy C Stein, and Adi Sunderam**, “A Quantity-Driven Theory of Term Premia and Exchange Rates,” *The Quarterly Journal of Economics*, November 2023, 138 (4), 2327–2389.

- Hau, Harald and Hélène Rey**, “Exchange Rates, Equity Prices, and Capital Flows,” *The Review of Financial Studies*, October 2005, 19 (1), 273–317.
- Ilzetzi, Ethan, Carmen M Reinhart, and Kenneth S Rogoff**, “Exchange Arrangements Entering the Twenty-First Century: Which Anchor Will Hold?,” *The Quarterly Journal of Economics*, January 2019, 134 (2), 599–646.
- Itskhoki, Oleg and Dmitry Mukhin**, “Exchange Rate Disconnect in General Equilibrium,” *Journal of Political Economy*, August 2021, 129 (8), 2183–2232.
- and —, “Optimal Exchange Rate Policy,” NBER Working Paper 31933, National Bureau of Economic Research April 2026. Revised April 2026.
- Jeanne, Olivier and Damiano Sandri**, “Global Financial Cycle and Liquidity Management,” *Journal of International Economics*, December 2023, 146, 103736.
- Jiang, Zhengyang, Robert J Richmond, and Tony Zhang**, “A portfolio approach to global imbalances,” *The Journal of Finance*, 2024, 79 (3), 2025–2076.
- Kalemli-Özcan, Şebnem and Liliana Varela**, “Five Facts about the UIP Premium,” NBER Working Paper 28923, National Bureau of Economic Research January 2025. Revised January 2025.
- Koijen, Ralph SJ and Motohiro Yogo**, “A demand system approach to asset pricing,” *Journal of Political Economy*, 2019, 127 (4), 1475–1515.
- and —, “Exchange rates and asset prices in a global demand system,” *Journal of Political Economy*, August 2026, 134 (8). Forthcoming.
- Kuersteiner, Guido M., David C. Phillips, and Mauricio Villamizar-Villegas**, “Effective sterilized foreign exchange intervention? Evidence from a rule-based policy,” *Journal of International Economics*, July 2018, 113, 118–138.
- Lane, Philip R and Gian Maria Milesi-Ferretti**, “The external wealth of nations revisited: international financial integration in the aftermath of the global financial crisis,” *IMF Economic Review*, 2018, 66, 189–222.

- Lewis, Daniel J. and Karel Mertens**, “A Robust Test for Weak Instruments for 2SLS with Multiple Endogenous Regressors,” *The Review of Economic Studies*, 2025. Advance online publication.
- Meese, Richard A and Kenneth Rogoff**, “Empirical exchange rate models of the seventies: Do they fit out of sample?,” *Journal of International Economics*, 1983, 14 (1-2), 3–24.
- Miranda-Agrippino, Silvia and H  lene Rey**, “US monetary policy and the global financial cycle,” *The Review of Economic Studies*, 2020, 87 (6), 2754–2776.
- Nickell, Stephen**, “Biases in dynamic models with fixed effects,” *Econometrica*, 1981, 49 (6), 1417–1426.
- Portes, Richard and Helene Rey**, “The determinants of cross-border equity flows,” *Journal of International Economics*, 2005, (65), 269–296.
- Zhou, Haonan**, “The fickle and the stable: Global Financial Cycle transmission via heterogeneous investors,” *SSRN Electronic Journal*, September 2025.

A Proofs

A.1 Derivation of Equilibrium Excess Return

A.1.1 Home-Saver Demand Equations

We derive equations (5) and (6). Let $\widehat{rx} \equiv \mathbb{E}[rx] - \overline{rx}^e$. Since P_H , P_* , and $\mathbb{E}s'$ are fixed, equation (1) implies $s - \bar{s} = \widehat{rx}$. The home-currency value of home saver i 's initial wealth changes with the exchange rate through her steady-state foreign-bond exposure:

$$w_{i0} = \theta_i \widehat{rx}. \quad (\text{A.1})$$

Log-linearizing the portfolio mandate in equation (2) gives

$$\widehat{rx} + b_{Hi}^* - w_{i0} = -\kappa_i \widehat{rx}. \quad (\text{A.2})$$

Combining equations (A.1) and (A.2) yields the foreign-bond demand equation:

$$b_{Hi}^* = -(1 - \theta_i + \kappa_i) \widehat{rx} = -\gamma_{Hi} \widehat{rx}. \quad (\text{A.3})$$

The budget constraint implies that the home-currency value of the home-bond purchase is the mirror image of the foreign-bond sale. In log deviations,

$$(1 - \theta_i) b_{Hi} + \theta_i b_{Hi}^* = 0. \quad (\text{A.4})$$

Using the foreign-bond demand equation above, the home-bond demand equation is

$$b_{Hi} = \frac{\theta_i}{1 - \theta_i} \gamma_{Hi} \widehat{rx}. \quad (\text{A.5})$$

A.1.2 Stochastic Equilibrium

We derive equation (11). Absent FXI, the home-bond market clearing in deviations is

$$\hat{B}_H + \hat{B}_F = 0. \quad (\text{A.6})$$

Equation (7) implies

$$\hat{B}_H = \frac{\Gamma_H}{P_H} \hat{rx}. \quad (\text{A.7})$$

The foreign investor's demand in equation (3) implies

$$\hat{B}_F = \overline{B}_F (\gamma^F \hat{rx} + \varepsilon). \quad (\text{A.8})$$

Substituting these two demand equations into market clearing gives

$$\left(\frac{\Gamma_H}{P_H} + \gamma^F \overline{B}_F \right) \hat{rx} + \overline{B}_F \varepsilon = 0. \quad (\text{A.9})$$

Therefore,

$$\hat{rx} = -\frac{\overline{B}_F}{A^{LF}} \varepsilon, \quad A^{LF} \equiv \frac{\Gamma_H}{P_H} + \gamma^F \overline{B}_F, \quad (\text{A.10})$$

which is equation (11).

A.1.3 Gross Flow in Response to a Foreign Demand Shock

We can express home savers' gross flow response by plugging equation (11) into equations (7) and (8):

$$P_H \hat{B}_H = -\frac{\Gamma_H \overline{B}_F}{A^{LF}} \varepsilon, \quad (\text{A.11})$$

$$\overline{S} P_* \hat{B}_H^* = \frac{\Gamma_H \overline{B}_F}{A^{LF}} \varepsilon. \quad (\text{A.12})$$

When $\varepsilon < 0$, home savers increase home-bond holdings and reduce foreign-bond holdings.

A.2 Central Bank Intervention Rule

We derive equation (13). Because the home-bond market-clearing condition is written in dollar deviations, let b_{CB} denote the central bank's dollar-deviation demand for home bonds. Consider a linear intervention rule:

$$b_{CB} = \gamma_{CB} \widehat{r}x. \quad (\text{A.13})$$

With FXI, the market-clearing condition includes the central bank's intervention:

$$\widehat{B}_H + \widehat{B}_F + b_{CB} = 0. \quad (\text{A.14})$$

Substituting the home-saver demand, foreign-investor demand, and intervention rule into equation (A.14) gives

$$(A^{LF} + \gamma_{CB}) \widehat{r}x + \overline{B}_F \varepsilon = 0, \quad A^{LF} \equiv \frac{\Gamma_H}{P_H} + \gamma^F \overline{B}_F. \quad (\text{A.15})$$

Thus, for a given policy slope γ_{CB} , the equilibrium expected excess return is

$$\widehat{r}x = -\frac{\overline{B}_F}{A^{LF} + \gamma_{CB}} \varepsilon. \quad (\text{A.16})$$

Using $b_{CB} = \gamma_{CB} \widehat{r}x$, the central bank's expected loss in equation (12) becomes a function of γ_{CB} :

$$\mathbb{E}\mathcal{J}(\gamma_{CB}) = (\gamma_{CB}^2 + \zeta) \left(\frac{\overline{B}_F}{A^{LF} + \gamma_{CB}} \right)^2 \text{Var}(\varepsilon). \quad (\text{A.17})$$

Since $A^{LF} > 0$, the first-order condition is

$$\frac{\gamma_{CB}}{\gamma_{CB}^2 + \zeta} = \frac{1}{A^{LF} + \gamma_{CB}}. \quad (\text{A.18})$$

Solving this condition yields

$$\gamma_{CB}^{opt} = \frac{\zeta}{A^{LF}} = \frac{\zeta}{\frac{\Gamma_H}{P_H} + \gamma^F \overline{B}_F}. \quad (\text{A.19})$$

The optimal intervention rule is therefore less aggressive when home savers' retrenchment is more elastic, as summarized by a larger Γ_H .

B VAR-Based Classification of Foreign Exchange Intervention Regimes

In this appendix, we elaborate on the VAR-based classification of foreign exchange intervention regimes from Blanchard et al. (2015). For each economy j , we classify the exchange rate regime using the response of foreign exchange intervention to an identified global capital flow shock. The classification is based on country-level vector autoregressions (VARs) estimated separately for each economy. The endogenous vector is ordered as

$$Y_{j,t} = (GKF_{j,t}, INT_{j,t}, GPKO_{j,t}, GPKI_{j,t}, FXI_{j,t}, ER_{j,t})'. \quad (\text{B.20})$$

The variables are ordered from most exogenous to least exogenous and the VAR is identified using a Cholesky decomposition. The country-level VAR is

$$Y_{j,t} = a_j + \sum_{\ell=1}^{p_j} A_{j,\ell} Y_{j,t-\ell} + u_{j,t}, \quad E(u_{j,t} u'_{j,t}) = \Sigma_j. \quad (\text{B.21})$$

The lag length p_j is chosen country by country by AIC over the admissible lag range. The impulse responses are computed to a one-standard-deviation innovation in the first structural shock, corresponding to $GKF_{j,t}$.

The variables entering the VAR are constructed as

$$GKF_{j,t} = \frac{4 \cdot \sum_{k \neq j} \text{Gross private inflows}_{k,t}}{\sum_{k \neq j} GDP_{k,t-1}} \quad (\text{B.22})$$

$$GPKI_{j,t} = \frac{4 \cdot \text{Gross private inflows}_{j,t}}{GDP_{j,t-1}}, \quad GPKO_{j,t} = \frac{4 \cdot \text{Gross private outflows}_{j,t}}{GDP_{j,t-1}} \quad (\text{B.23})$$

$$FXI_{j,t} = \frac{4 \cdot (-\Delta \text{Reserves}_{j,t} + \Delta \text{Off BS}_{j,t})}{GDP_{j,t-1}} \quad (\text{B.24})$$

$$INT_{j,t} = i_{j,t} - i_{US,t}, \quad ER_{j,t} = -\log \left(\text{local currency per U.S. dollar}_{j,t} \right) \quad (\text{B.25})$$

With this convention, a positive value of $ER_{j,t}$ denotes an appreciation. A positive value of $FXI_{j,t}$ denotes reserve sales, while a negative value denotes reserve accumulation. As a positive GKF shock implies a surge in global capital inflows, a stabilizing response of FXI to the shock should be a negative response.

Let $\hat{\Theta}_{j,FXI}(h)$ denote the cumulative impulse response of FXI in country j at horizon h to the global capital flow shock. The classification uses responses at horizon $h = 2$. The estimated regime group is then denoted as

$$j \in \text{Intervener} \quad \text{if} \quad \hat{\Theta}_{j,FXI}(2) \leq c, \quad (\text{B.26})$$

$$j \in \text{Floater} \quad \text{if} \quad \hat{\Theta}_{j,FXI}(2) > c \quad (\text{B.27})$$

with c being the cross-country median response, formally:

$$c = \text{median}_{j \in \mathcal{S}} \hat{\Theta}_{j,FXI}(2) \quad (\text{B.28})$$

C Additional Results and Robustness Check

Table C.1. Gross outflow originating from non-bank private entities: from Avdjiev et al. (2022)

	EM	Floater	Intervener
UIP Deviation	-0.067*** (0.020)	-0.071*** (0.022)	-0.057 (0.044)
Lag private PD outflow	0.046 (0.083)	0.070 (0.124)	-0.020 (0.104)
No. Observations	1007	623	384
Country FE	Yes	Yes	Yes
First-stage F-statistic	67.57	127.86	9.54

Note: This table shows the gross retrenchment elasticity of non-bank private entities using the reclassified capital flow measures from Avdjiev et al. (2022). The flow variable is the sum of 'bank' and 'corporate' outflows in the original dataset. $\Delta_{i,t}$ is instrumented by the change in the VIX. Standard errors are clustered by country.

Table C.2. Countrywise Semi-Elasticity

Country	FXI group	λ_i	s.e.	1SFS
CHL	Floater	-0.089	0.147	28.318
COL	Floater	-0.083	0.036	10.485
CZE	Floater	-0.120	0.067	7.174
HUN	Floater	-0.074	0.047	12.555
IDN	Floater	0.015	0.011	7.151
ISR	Floater	-0.174	0.114	10.376
KOR	Floater	-0.132	0.048	13.929
MEX	Floater	-0.118	0.046	48.417
ZAF	Floater	-0.199	0.162	1.557
BRA	Intervener	-0.014	0.009	14.387
IND	Intervener	-0.003	0.003	6.511
LKA	Intervener	0.395	0.377	1.160
MYS	Intervener	-0.069	0.274	0.514
PER	Intervener	0.755	1.230	0.569
PHL	Intervener	0.123	0.170	2.029
POL	Intervener	-0.075	0.039	8.251
THA	Intervener	-1.709	3.228	0.367

Note: The table shows countrywise estimates of the semi-elasticity of the gross capital outflow to GDP ratio with respect to expected excess return, $\mathbb{E}rx$ using two-stage least squares (2SLS). Column λ_i shows the estimate, and column 's.e.' shows the standard error of the estimate. Column 1SFS shows the first stage F-statistic for the 2SLS regressions.

Table C.3. Magnitude of Colombian Pension Fund Net Foreign Security Purchases relative to BoP flow

	Mean	Median	P25	P75	N
Net Purchases of US Securities / BOP	206.09	15.77	-7.21	46.79	36
Net Purchases of Foreign Securities / BOP	92.62	26.25	-29.18	69.30	36

Note: The table shows the ratio of Colombian pension funds' net purchase of US and overall foreign securities to the gross portfolio outflow from Balance of Payments statistics. All numbers except the last column are in percent. Monthly net purchases are summed by quarter to be comparable with quarterly BoP flow.

C.1 Fama-Implied Excess Currency Return

Table C.4. Fama Regression Result

Group	$\hat{\beta}_g$	SE	$p(H_0 : \beta = 1)$	N
EM	-0.220	(0.149)	< 0.001	4256
AE	-0.541	(0.394)	< 0.001	1381

Note: The table reports estimates of the group-specific slope β_g from the monthly Fama regression described in the text. The dependent variable is the realized 12-month log depreciation of the local currency against the U.S. dollar, expressed in percentage points, and the independent variable is the contemporaneous local–U.S. one-year interest-rate differential. The regressions are estimated separately for 19 emerging market economies (EMs) and five non-reserve-currency advanced economies (AEs) and include country fixed effects. The estimation period is January 2001 through December 2024. Standard errors are two-way clustered by country and origin month. The fourth column reports the p -value for the null hypothesis that $\beta_g = 1$, and N denotes the number of monthly observations.

C.2 Alternative Instrument for Excess Currency Return

Table C.5. GFCy Factor as an Instrument for Elasticity Estimation

	Panel A: IV				Panel B: OLS			
	EM	AE	Floater	Intervener	EM	AE	Floater	Intervener
Δrx^e	-0.489*	-1.023**	-0.588*	0.020	-0.023***	-0.044	-0.031***	-0.012***
	(0.259)	(0.435)	(0.316)	(0.392)	(0.004)	(0.046)	(0.005)	(0.004)
Lag Dep. Var.	0.335***	0.344*	0.345**	0.214	0.243***	0.233***	0.250***	0.223**
	(0.106)	(0.187)	(0.137)	(0.144)	(0.049)	(0.078)	(0.057)	(0.103)
No. Observations	1335	440	738	597	1335	440	738	597
Countries	19	5	9	10	19	5	9	10
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F-statistic	4.65	10.51	7.68	0.24				

Note: The table reports IV estimates of regression (17) for the full sample of 19 EMEs and separately for nine floaters and ten interveners. Gross portfolio outflow is measured as a share of lagged GDP, and Δrx^e is instrumented with the GFCy factor from Miranda-Agrippino and Rey (2020). All specifications include country fixed effects and lagged gross portfolio outflow. Standard errors are clustered by country. First-stage F statistics are reported at the bottom. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table C.6. Dollar Index as an Instrument for Elasticity Estimation

	Panel A: IV				Panel B: OLS			
	EM	AE	Floater	Intervener	EM	AE	Floater	Intervener
Δrx^e	-0.109**	-0.269*	-0.096***	-0.146	-0.026***	-0.039	-0.034***	-0.012**
	(0.043)	(0.142)	(0.035)	(0.151)	(0.004)	(0.059)	(0.005)	(0.005)
Lag Dep. Var.	0.241***	0.319***	0.239***	0.252*	0.223***	0.289***	0.228***	0.209*
	(0.065)	(0.101)	(0.076)	(0.135)	(0.053)	(0.063)	(0.062)	(0.111)
No. Observations	1050	340	599	451	1050	340	599	451
Countries	19	5	9	10	19	5	9	10
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F-statistic	22.75	395.87	44.12	2.85				

Note: The table reports IV estimates of regression (17) for the full sample of 19 EMEs and separately for nine floaters and ten interveners. Gross portfolio outflow is measured as a share of lagged GDP, and Δrx^e is instrumented with the dollar index. All specifications include country fixed effects and lagged gross portfolio outflow. Standard errors are clustered by country. First-stage F statistics are reported at the bottom. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table C.7. TIC-Common Factor as an Instrument for Elasticity Estimation

	EM	Floater	Intervener
$\Delta r x^e$	-0.174** (0.075)	-0.247** (0.117)	-0.068 (0.064)
Lag Dep. Var.	0.273*** (0.063)	0.287*** (0.088)	0.239** (0.116)
No. Observations	1335	738	597
Country FE	Yes	Yes	Yes
First-stage F-statistic	41.27	79.46	8.29

Note: The table reports IV estimates of regression (17) for the full sample of 19 EMEs and separately for nine floaters and ten interveners. Gross portfolio outflow is measured as a share of lagged GDP, and $\Delta r x^e$ is instrumented with the quarterly TIC common factor whose construction is described in Appendix C.2.1. All specifications include country fixed effects and lagged gross portfolio outflow. Standard errors are clustered by country. First-stage F statistics are reported at the bottom. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

C.2.1 Construction of an Alternative IV: Common Factor from TIC Flows

In this appendix, we elaborate on the construction of the TIC common factor, which is used as the secondary proxy for global financial conditions in the empirical analysis. The TIC instrument is constructed from the Bertaut-Judson monthly TIC data, which provides a more accurate description of U.S. portfolio flows to foreign securities than the TIC survey on purchases (see Bertaut and Judson (2022) for details). The factor is constructed from 45 country series and spans 1994M4 through 2025M7 at a monthly frequency. Then the quarterly average of this factor is used in the empirical analysis. For each destination country i and month m , we first construct a normalized U.S. portfolio outflow measure using estimated U.S. purchases of foreign bonds and equities relative to lagged U.S. holdings of the same assets:

$$s_{i,m} = \frac{\text{Purchase of Bonds}_{i,m} + \text{Purchase of Equities}_{i,m}}{\text{Holdings of Bonds}_{i,m-1} + \text{Holdings of Equities}_{i,m-1}}. \quad (\text{C.29})$$

The numerator is the estimated net U.S. transaction flow into country i 's bonds and equities. The denominator is the lagged stock of U.S. holdings of those foreign securities. Thus $s_{i,m}$ measures U.S. net purchases of country i 's securities as a share of the previous month's U.S. portfolio holdings in that country. We exclude tax havens and offshore financial centers, and countries with fewer than 60 monthly observations. Each retained country series is then standardized by its own mean and standard deviation, denoted $z_{i,m}$.

Finally, the common TIC factor is estimated from the country-month panel $\{z_{i,m}\}$ using a one-factor dynamic factor model specified as follows:

$$z_{i,m} = \lambda_i f_m + e_{i,m}, \quad (\text{C.30})$$

$$f_m = \phi f_{m-1} + \eta_m, \quad (\text{C.31})$$

$$e_{i,m} = \rho_i e_{i,m-1} + \nu_{i,m}. \quad (\text{C.32})$$

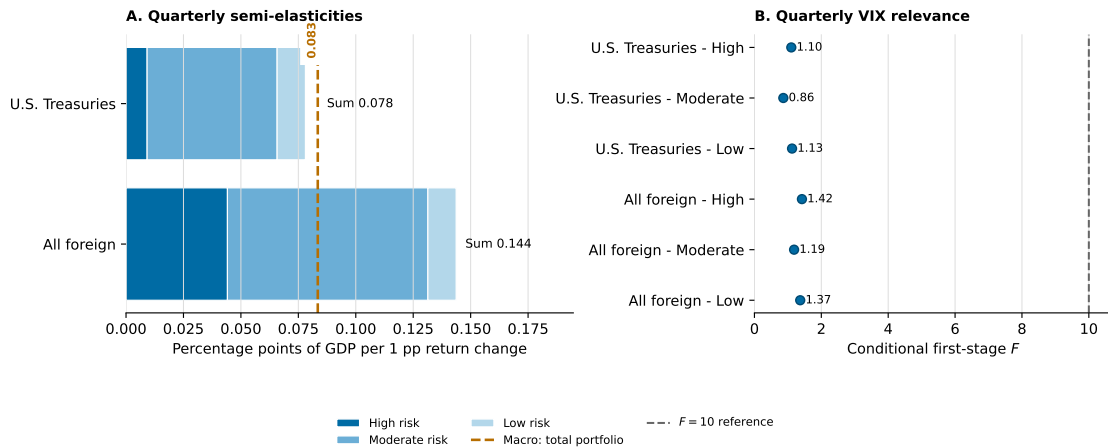
Here f_m is the latent common component in U.S. portfolio outflows to foreign securities, λ_i is the country-specific loading, and $e_{i,m}$ is an idiosyncratic country component. The factor model has a single AR(1) latent factor and AR(1) idiosyncratic errors, and is estimated by maximum likelihood using the Kalman filter.

We orient the factor so that it has a nonnegative correlation with the cross-country average of the standardized TIC series. The quarterly TIC factor used in the empirical analysis is then the average of the oriented monthly smoothed factor within each quarter.

C.3 Semi-Elasticity and Quantitative Financial Market Development

D Parameter Estimation Using Colombian Pension Fund Data

Figure D.1. Contribution to Semi-Elasticity by Risk Profile of Pension Funds—Quarterly Frequency



Note: This figure shows contributions of each risk-profile to the semi-elasticity of the pension fund system as a whole using the micro data at quarterly frequency. The brown line presents the macro-estimated semi-elasticity for comparison.

Table C.8. Debt-Security Normalized Pension Fund and Insurance Company Assets

	Domestic debt securities / GDP		
	Private IV	Public IV	Private + Public IV
Δrx_{it}^e	-0.107*** (0.034)	-0.097*** (0.033)	-0.102*** (0.030)
$X_i^c \times \Delta rx_{it}^e$	-0.00187 (0.00207)	0.00115 (0.00178)	-0.00033 (0.00114)
Lag gross portfolio outflow	0.315*** (0.089)	0.270*** (0.091)	0.301*** (0.091)
Country fixed effects	Yes	Yes	Yes
Observations	933	1037	933
Countries	13	15	13
L-M Statistic	6.80	6.97	7.42
Relative CV ($\alpha = 0.1, \tau = 0.1$)	29.22	28.20	29.72

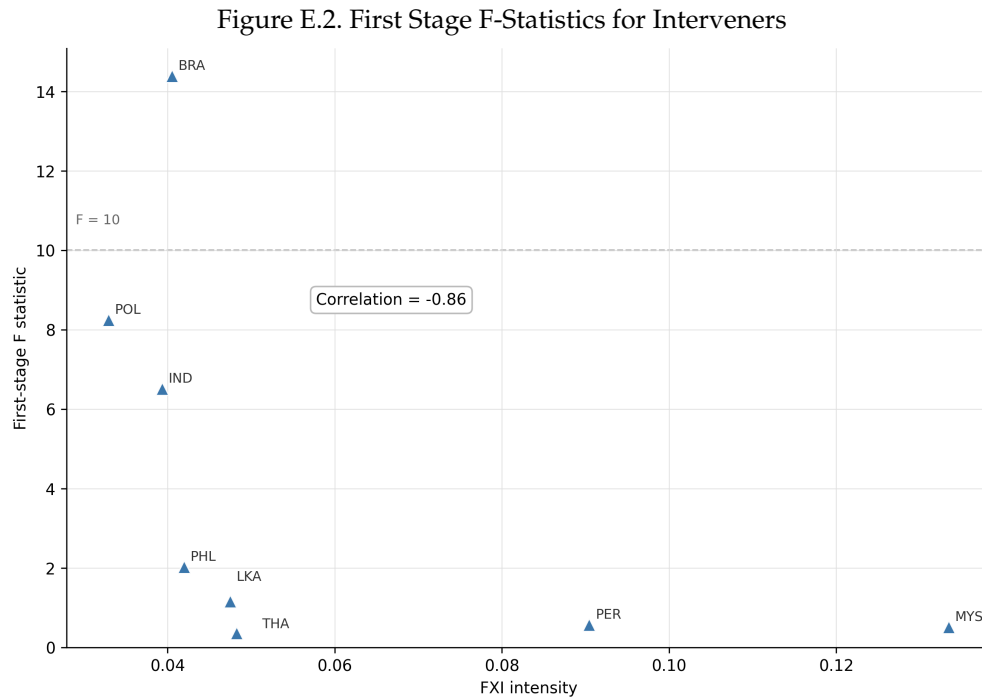
Note: Note: The table shows the estimation results of regression (26) using domestic private debt securities, domestic public debt securities, and their sum as alternative measures of X_i^c , each expressed as a percentage of GDP, averaged within country, and centered at the cross-country mean. The dependent variable is the gross portfolio outflow to GDP ratio, and the key independent variable is the interaction between expected excess currency return and different measures of financial market development in quantity. All specifications include country fixed effects and lagged gross portfolio outflow. Standard errors are clustered by country. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table D.9. First Stage Regression Results

Estimation sample	$\hat{\pi}$ (SE)	F-Stat	N
<i>U.S. Treasuries</i>			
High risk	6.008 (1.363)	19.41	396
Moderate risk	6.066 (1.329)	20.84	396
Low risk	6.031 (1.342)	20.19	396
Pooled 12 funds	6.033 (1.341)	20.23	1188
<i>All US</i>			
High risk	6.087 (1.351)	20.29	396
Moderate risk	6.100 (1.344)	20.60	396
Low risk	5.993 (1.302)	21.17	396
Pooled 12 funds	6.089 (1.344)	20.51	1188
<i>All foreign</i>			
High risk	6.080 (1.314)	21.42	396
Moderate risk	5.924 (1.343)	19.44	396
Low risk	6.065 (1.346)	20.31	396
Pooled 12 funds	6.061 (1.325)	20.91	1188

Note: This table reports the first-stage regression results. $\hat{\pi}$ is the coefficient on $\Delta \ln VIX_t$ and two-way-clustered standard errors are in parentheses. F-Stat is the first-stage F-statistic for the instrument. Risk-profile regressions use four AFPs and 99 months; pooled regressions use all 12 funds.

E Miscellaneous Additional Figures



Note: The figure plots country-level first-stage F statistics against FXI intensity for economies classified as interveners. The first-stage statistic tests the relevance of $\Delta \ln VIX$ for $\Delta r x^e$, while FXI intensity is the negative of the cumulative impulse response of FXI to a global financial shock over horizons $h = 0, 1, 2$, so larger values indicate stronger FXI.

F Data Appendix

The data for empirical exercises cover 19 emerging market economies from 2001Q1 to 2023Q2 at a quarterly frequency.

F.1 Definition of Variables

Expected Excess Currency Return

The expected excess currency return is defined as follows:

$$\mathbb{E}rx = r - r^* - (\mathbb{E}s' - s) \quad (\text{F.33})$$

where r is the home bond return, and r^* is the foreign bond return. The returns r are market yields on one-year zero coupon government bonds. r^* is the return on one-year U.S. Treasury bonds. We use the 12-month-ahead exchange rate forecasts from Consensus Economics to compute the expected exchange rate change, $\mathbb{E}s' - s$. s is defined as 100 times the log of the nominal exchange rate, defined as local currency per U.S. dollar.

Gross capital flows

The gross portfolio flows are from the IMF's balance of payments statistics. Annual nominal GDP data are from the World Bank's World Development Indicators. The gross flows are scaled by each country's GDP in the previous year, to avoid endogeneity between the flow and GDP.

FXI policy measures

We follow Blanchard et al. (2015) in constructing a measure of FXI policy. The measure is the sum of net reserve sales and changes in the central bank off-balance-sheet FX positions. The variable is scaled by GDP in the previous year. We download the level of international reserves excluding gold from the IMF's International Reserves and Foreign Currency Liquidity dataset, and compute the net reserve sales by taking the first difference of the level. The data on central bank off-balance-sheet FX positions are from the same dataset. A positive value of the measure indicates net sales of foreign currency by the central bank, which corresponds to policy actions to appreciate the home currency.

Pension Fund and Insurance Company Asset

We obtain data on pension fund and insurance company assets from the World Bank's Global Financial Development Database. The time series are defined as the total assets of pension funds and insurance companies in terms of GDP. We use these data to explore the source of cross-country variation in private retrenchment elasticity.

Gross Portfolio Asset

The baseline measure of gross portfolio asset is the quarterly gross portfolio investment asset position from the IMF's balance of payments statistics. For quarters where the baseline measure is missing, we complement the data with gross portfolio positions from the External Wealth of Nations dataset by Lane and Milesi-Ferretti (2018). We normalize the gross portfolio asset by GDP in the previous year, to be comparable with the flow measures.

F.2 Data Sources

Table F.10. Data Sources

Variable	Source	API variable name / ticker
Gross PF Outflow	IMF IFS	BFPA_BP6_USD
Gross PF Inflow	IMF IFS	BFPLXF_BP6_USD
Net PF Inflow	IMF IFS	BFPLXF_BP6_USD - BFPA_BP6_USD
FXI	IMF IFS; IMF IRFCL	RAXG_USD; RAPFAFFL_USD; RAPFAFFS_USD with S1X
Net PF and Official In- flow	IMF IFS; IMF IRFCL	
GDP	World Bank WDI	NY.GDP.MKTP.CD
Short interest rate	Bloomberg	ir_1y; fallback ir_3m
U.S. one-year Treasury yield	FRED	DGS1
Spot exchange rate	Bloomberg	
One-year-ahead FX forecast	Consensus Economics	
UIP Deviation / Ex- cess Currency Return	Bloomberg; FRED; Consen- sus Economics	DGS1
VIX	CBOE/FRED	VIXCLS
TIC Common Factor	Bertaut-Judson TIC	BT399_US_FOR_BOND_ESTTRANS; BT399_US_FOR_STK_ESTTRANS; BT99_US_FOR_BOND; BT99_US_FOR_STK
Foreign Portfolio As- sets / GDP	IMF IIP; EWN; World Bank WDI	Assets: Portfolio investment; Portfolio equity assets; Portfolio debt assets; NY.GDP.MKTP.CD
Pension Fund Assets / GDP	World Bank GFD	GFDD.DI.13
Insurance Company Assets / GDP	World Bank GFD	GFDD.DI.11